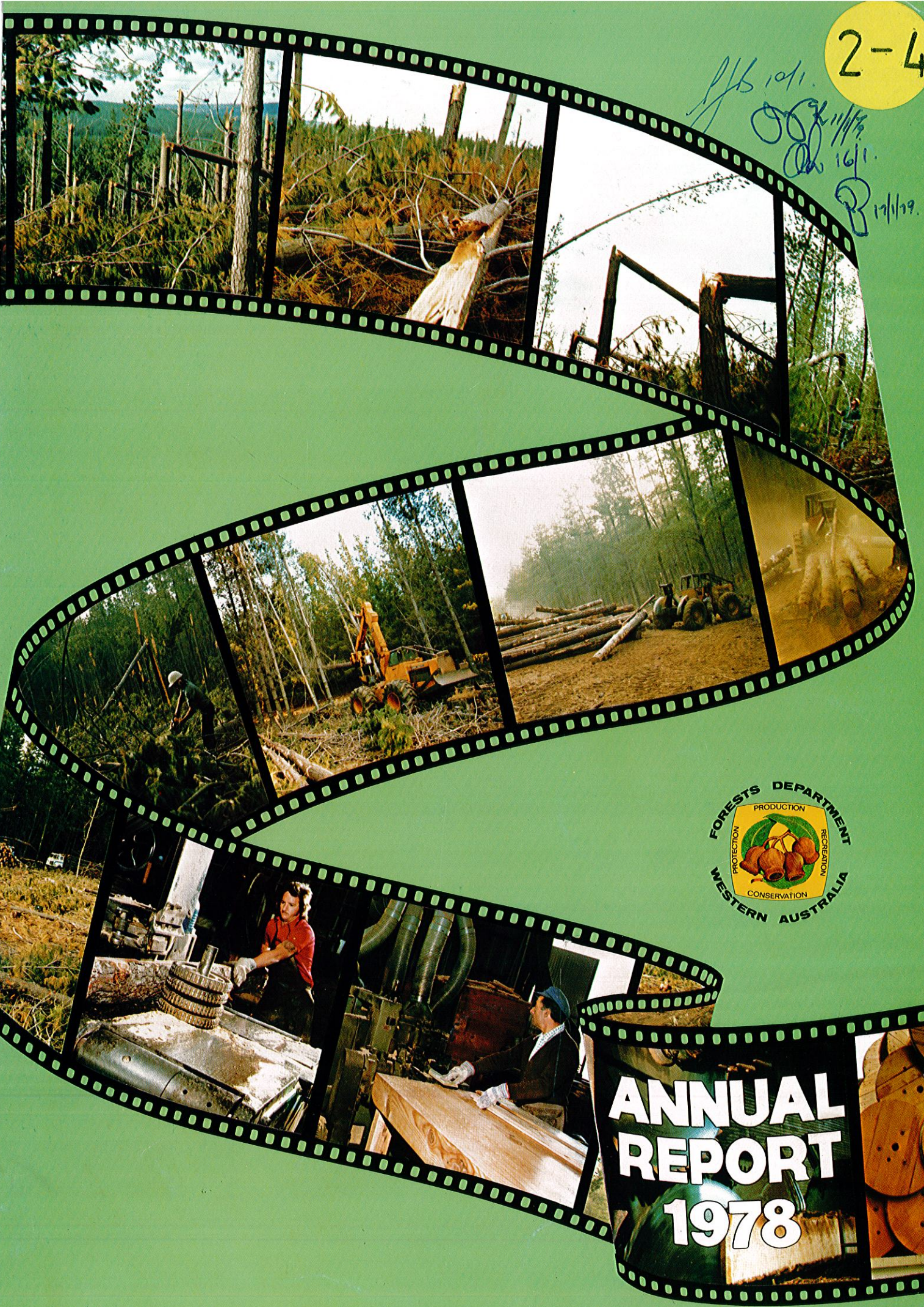


FORESTS DEPARTMENT
PRODUCTION
PROTECTION
RECREATION
CONSERVATION
WESTERN AUSTRALIA

ANNUAL REPORT 1978

Forests Department
PERTH, W.A. 6000

THE HON. THE 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 June* 30, 1978.

B. J. BEGGS,
Conservator of Forests.

Front Cover: The picture strip indicates the damage caused by cyclone Alby and the subsequent salvage operations.

106247—(1)

CONTENTS

PRINCIPAL OFFICERS*

Conservator of Forests	B. J. Beggs, B.Sc. (For.), Dip. For. (Canb.)
Deputy Conservator of Forests	P. J. McNamara, M.A. (Oxon.)
Assistant Conservator of Forests	W. H. Eastman, B.Sc. (For.) Dip. For. (Canb.), Dip. For. (Oxon.)
Assistant Conservator of Forests	F. J. Campbell, B.Sc. (For.), Dip. For. (Canb.)
Chief of Division	J. C. Meachem, D.F.C., 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 (Acting)	J. J. Havel, M.Sc. (For.) (Qld.), Dip. For. (Canb.), Dip. Ed.
Chief of Division	S. J. Quain, B.Sc. (For.) Dip. For. (Canb.)
Superintendent	D. E. Grace, 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 (Acting)	F. H. McKinnell, Ph.D. (A.N.U.), M.Sc. (A.N.U.), B.Sc. (For.), Dip. For. (Canb.)
Superintendent (Extension Services)	P. N. Hewett, B.A. B.Sc. (Adel.), Dip. For. (Canb.)
Superintendent (Plantation)	A. C. van Noort, B.Sc. (For.), Dip. For. (Canb.)
Chief Draftsman	R. M. Davis, E.D., M.A.I.C.
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.

*At 30th June, 1978

THE FOREST AREA

State Forest (Forests Act, 1918–1976)

The area of State forest at 30 June 1978 was 1 853 876 ha, which is an increase of 1 936 ha compared with the area at 30 June 1977.

Timber Reserves (Forests Act, 1918–1976)

The area held under Timber Reserves at 30 June 1978 was 117 517 ha, which is an increase of 519 ha compared with the area at 30 June 1977.

Land Alienations etc.

During the year 54 applications concerning a total of 7 864 ha of forest land were received. The Department agreed to the following:

(a) *Alienations* (area in hectares)		
Timber zone: State forest		912
Crown land		1 346
Outside timber zone		181
(b) *Leases* (area in hectares)		
Timber zone: State forest		—
Crown land		—
Outside timber zone		

Ten alienations and twelve new leases were approved.

Freehold land held at 30 June 1978 in the name of the Conservator of Forests totalled 26 212 ha.

	30 June 1977	30 June 1978	Change
	(ha)	(ha)	
State forest (Forests Act, 1918–1976)	1 851 940	1 853 876	*1 936
Timber Reserves (Forests Act, 1918–1976)	116 998	117 517	*519
Freehold land in the name of the Conservator of Forests	25 693	26 212	*519
	1 994 631	1 997 605	*2 974

* Increase

These areas may be classified into the following broad forest types, rounded to the nearest 1 000 ha.

Type	Area (ha)
Jarrah	1 451 000
Karri	140 000
Wandoo	106 000
Mallet	10 000
Tuart	3 000
Goldfields species	30 000
Pinus radiata	20 000
Pinus pinaster	23 000
Very open areas	215 000
	1 998 000

Jarrah type includes: pure jarrah; mixture of jarrah with marri, blackbutt, wandoo, karri and sheoak as minor species; stands dominated by marri with jarrah as the minor species; stands dominated by 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; mixtures of karri with marri as the major or minor species; mixtures of 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: 8 300 ha of plantation mallet; mixture of mallet with wandoo as the minor species.

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

106247—(2)

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, powerlines and dams.

STATISTICAL SUMMARY OF MAJOR OPERATIONS

Sawn Wood Production

Total Production of Sawn Timber .... 365 780 m³

Trends in Production and Consumption

Year ended 30th June	Production (cubic metres)				Total Export	Local Availability	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	N/A	N/A	139	2 170

Log Production* (m³)

	Crown Land	Private Property
Saw Logs Hardwood	885 540	118 029
Saw Logs Softwood	52 111	1 677
Other Logs Hardwood	434 377	....
Other Logs Softwood	73 437	....

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

Forest Area

Total Area of State forest	1 853 876 ha
Additions to State forest	1 943 ha
Excisions from State forest	7 ha
Land purchased for pine planting	518 ha

Pine Establishment

Areas planted with pines 1977		
Pinus radiata	1 883 ha	2 763 ha
Pinus pinaster and other species	880 ha	
Total area of pine plantation established to date		
Pinus radiata	20 097 ha	43 075 ha
Pinus pinaster and other species	22 978 ha	
Total experimental areas (additional)		465 ha

Management

Area covered by hardwood assessment	61 000 ha
Engineering, new works—	
Roads and tracks	236 km
Houses	Nil

Protection

Prescribed burning area	278 571 ha
Fire outbreaks—	
Number of fires	382
Area burnt	8 575 ha

Nurseries (Hamel and Narrogin)

Produced for private buyers	208 815 trees
Produced for Forests Department	124 047 trees

Sandalwood

Quantity exported	1 266 tonne

Chipwood (hardwood)

Quantity produced	434 377 m^3

LAND MANAGEMENT

System 6 Participation

During the year 1977–78 Departmental officers have compiled the System 6 vegetation map which comprises 3 map sheets at a scale of 1:250 000 covering the entire area (2 600 000 ha) and is based on the interaction of climate, geomorphology and vegetation.

System 6 extends from the wheatbelt to the Indian Ocean between Moore River in the north and Blackwood River in the south. As a major land manager within this region, administering 38 per cent of the total area, the Forests Department has submitted to the Environmental Protection Authority a series of Management Priority Areas, within which the main objective of management is conservation.

These represent 20 per cent of the area controlled by the Forests Department, and 7·5 per cent of the total area of System 6. They cover as wide a range as possible of flora and fauna, and in the main exclude areas infected by *Phytophthora cinnamomi*. Most consist of a central core area in which disturbance is minimal, surrounded by a protective buffer where a greater degree of human activity is considered acceptable. Both their size and their boundaries were determined to provide as much protection as possible from fire and disease. Conservation and recreation are also management objectives in the remainder of the forest estate. However, they are not the primary objectives.

The Department is represented on the committees concerned with preparing the data base, delineating and describing the proposed reserves, evaluating recreational requirements, assessing the economic impact of the proposed reserves and reconciling conflicting land use demands.

Land Use Management Plans

A land use management plan for the forest between Mundaring and Harvey was drafted during the year. The plan allocates management priorities to all land in this portion of the forest, and contains samples of prescriptions and controls designed to provide efficient multiple land use management. It is being circulated to various authorities with direct involvement in the area, for their assessment and comment.

A total of 866 642 ha of State forest and Forests Act timber reserves have now been categorised into the following Management Priority Areas.

Management Priority	Area (ha)
Conservation of flora and fauna	302 927
Conservation of flora and fauna/catchment protection	59 632
Recreation	67 897
Scientific study	22 283
Water production	103 450
Catchment protection	208 036
Hardwood timber production/catchment protection	35 803
Protection	61 206
Water storage	5 408
Total	866 642

Towards the end of the year senior Departmental officers were involved in an enquiry into methods of resolving conflicts between the various forms of land use in the Darling Range. The enquiry was conducted by the Stanford Research Institute for the Government of Western Australia.

Integration of Agriculture and Forestry

In September 1977 a workshop on integrating agriculture and forestry was sponsored by C.S.I.R.O. Division of Land Resources Management, Perth, in association with the Department. The workshop was held at Bunbury and attended by about 50 persons either involved in research in this area or interested in the applications of the technique.

Grazing in Departmental plantations established on former farmland in the Blackwood Valley increased during the year, some 1 700 ha being leased for the purpose. Over the next 20 years, the principles of agro-forestry will be used to develop strategically located fire protection buffers in the Department's pine plantations.

The buffers will be heavily grazed each spring to ensure minimum fuel availability by the start of the fire season. They will not necessarily stop a major fire on their own, but will provide conditions favourable to fire suppression.

Forest Department nursery, West Manjimup.

THE ESTABLISHMENT AND TENDING OF FORESTS

Jarrah Forest

A prescription for stand improvement to meet the land use objectives on jarrah forest adjacent to bauxite pits has been prepared for implementation in the winter of 1978. The prescription includes the poisoning of banksia, thinning of jarrah for water and sawlog production, enrichment planting, and erosion control.

Karri Forest

Satisfactory regeneration of areas of karri forest clear-felled for sawlogs and chiplogs was achieved by a combination of artificial and natural techniques.

During winter 1977 regeneration from seed trees was effective on 1 150 ha, and 720 ha were planted with nursery seedlings. The area prepared for regeneration in winter 1978 amounted to 2 200 ha.

Operational trials by direct or 'spot' seeding were conducted with considerable success.

The West Manjimup nursery was extended and now has the capacity to raise 2·5 million karri seedlings each year. Cultivation and fertiliser regimes have also been improved.

The development of techniques for rehabilitation of soil disturbance resulting from logging is well advanced.

Wandoo Forest

One hundred and four hectares of wandoo forest at Narrogin were treated for regeneration.

Mallet Forest

Thinning was carried out on 206 ha of mallet forest.

Tuart Forest

Twenty hectares of understocked tuart forest were treated for regeneration. Peppermint understorey was bulldozed into gaps and burned when the seed on surrounding tuart crop trees was ready for dispersal. Where natural regeneration was inadequate, nursery stock was planted. Grazing is excluded from regenerated areas.

Softwood Forest

Pine Planting

The Forests Department planted 2 763 ha in 1977, bringing the total area of State pine plantations to 43 075 ha.

Some 884 ha of plantation were destroyed by wind damage during Cyclone Alby in April 1978 and a further 339 ha were burnt in wildfires associated with the cyclone.

During the year 52 ha of mature plantation were clear-felled.

The Department purchased 518 ha of farmland for pine planting. The planting of cleared farmland is a most satisfactory method of achieving softwood reafforestation, but the opportunities for this appear to be decreasing.

Tending Pine Plantations

During the year the following plantation tending was carried out.

Scrub control	2 271 ha
Fertilising with superphosphate	1 361 ha
Fertilising with minor elements	398 ha
High pruning	2 627 ha
Low pruning	5 562 ha
Cleaning	2 340 ha
Non-commercial thinning	329 ha

Departmental Plantation Areas

The areas of plantations (by Divisions) prior to the 1978 planting were as follows.

AREAS OF PLANTATIONS (ha)

Division	*P. radiata*	*P. pinaster* and other species	Total
Wanneroo	738·5	17 269·0	18 007·5
Metropolitan	9·1	207·8	216·9
Mundaring	802·2	611·4	1 413·6
Kelmscott	392·2	1 110·6	1 502·8
Dwellingup	578·3	87·5	665·8
Harvey	3 149·5	2 244·5	5 394·0
Collie	2 182·1	83·5	2 265·6
Kirup	5 475·2	77·3	5 552·5
Nannup	5 304·0	109·4	5 413·4
Busselton	1 050·8	1 132·3	2 183·1
Manjimup	207·9	....	207·9
Pemberton	207·6	44·2	251·8
Total	20 097·4	22 977·5	43 074·9
* Experimental Planting	226·1	238·6	464·7
Grand Total	20 323·5	23 216·1	43 539·6

* Includes Esperance.

Areas planted in 1977, totalling 2 763·5 ha, are detailed below.

1977 PLANTING (ha)

Division	*P. radiata*	*P. pinaster* and other species	Total
Wanneroo	....	840·4	840·4
Mundaring	65·7*	....	65·7
Harvey	242·8	39·9	282·7
Collie	192·0	....	192·0
Kirup	645·9	....	645·9
Nannup	535·5	....	535·5
Busselton	201·3	....	201·3
Total	1 883·2	880·3	2 763·5

*Second Rotation Planting

Tree Nurseries

The Forests Department continues to encourage planting of trees for shelter and amenity purposes in the rural areas of the State. Hamel and Narrogin nurseries last year sold 208 815 trees.

Some 124 047 trees for rehabilitation planting in State forests and catchment areas were supplied by these nurseries.

The following table summarises nursery production for the year.

	Plants Sold to the Public				Departmental Use	Total Plants
Nursery	Pots	Trays	Open rooted	Total	Eucalypts	
Hamel	61 747	35 256	25 560	122 563	114 445	237 008
Narrogin	86 252	....	....	86 252	9 602	95 854
Total	147 999	35 256	25 560	208 815	124 047	332 862

Seed Collection and Use

The value of sales from the seed store was $13 687 for the 1977–78 year. In addition, seed was supplied to Departmental nurseries and research projects.

Seed supplies were collected from departmental seed orchards, high quality plantations, State forests, timber reserves and other Crown land areas.

RESOURCE MANAGEMENT

Water

During the year, the Department continued to manage catchments within State forest in accordance with the Government's stated policy and the requirements of the water supply authorities.

Close co-operation and liaison continued between the Department and the Metropolitan Water Supply, Sewerage and Drainage Board (M.W.S.S. & D.B.) in the use of groundwater in the Gnangara Mound. The aim of this co-operation was to minimise the impact of water withdrawal on the productivity of pine plantations and to maximise the replenishment of shallow aquifers. Both aims were achieved by early, heavy thinning of the young stands. In addition, a jointly financed study of the impact of groundwater fluctuation on the survival of indigenous vegetation continued. A progress report covering the period 1966–1978 was completed.

In the Darling Range (Northern Jarrah Forest) joint investigations were primarily centred on reconciling catchment protection with potentially conflicting forms of land use. A working group appointed by the Water Purity Committee, comprising representatives of the Public Works and Public Health Departments, M.W.S.S. & D.B. and the Forests Department, completed a review of recreation within catchments. The likely impact of the proposed South Canning storage was studied during the year. Issue 19 (November 1977) of *Forest Focus* entitled "Managing Jarrah Forest Catchments" describes the Department's activities in this field.

Salinity studies in State forest were continued mainly as part of the co-operative programme sponsored by the Hunt and Kelsall Steering Committees, which are concerned with the effects of bauxite mining and woodchipping respectively.

Trials to investigate planting procedures for reforestation in the Wellington catchment were continued. Agro-forestry trials in the Helena catchment were assessed during the current year as to their potential for rehabilitation of salt-affected catchments such as Murray, Wellington and Warren.

A Departmental representative participated in meetings of the Water Resources Council, and other officers of the Department briefed the Council on a number of aspects of catchment management.

Wood Production

Timber Production

During the year 31 218 ha of hardwood forest were cut over for sawlogs:

	ha
Jarrah forest	26 020
Karri forest	4 454
Wandoo forest	744

The production of 365 780 m³ of sawn timber, including hardwood and softwood, was a decrease of 20 056 m³ on the previous year's figure. Of the total output, 41 406 m³ came from private property, an increase of 3 363 m³ on the 1976–77 figure.

At 31 December 1977 there were 139 registered sawmills, of which 79 operated on Crown land and 60 on private property. Details of the annual intake of mill logs and production of sawn timber are given in the accompanying tables.

In accordance with provisions of Working Plan No. 86 of 1977 for reduction of the hardwood cut, two large sawmills closed during the year.

The annual intake of logs for the period 1968–1978 is given in Appendix 5.

Local plywood factories obtained the following quantities of peeler logs:

	m³
Karri	3 941
Jarrah	....
Pine	2 152
Total	6 093

Timber Inspection

The total quantity of timber inspected during the year was 61 148 m³, as follows:

	m³
Railway Sleepers—	
Ex Crown land	35 392
Ex private property	6 181
Re-inspected	397
	41 970
Other sawn timber	19 178

PRODUCTION OF LOG TIMBER FOR YEAR ENDED JUNE 30, 1978
EXCLUSIVE OF MINING TIMBER, FIREWOOD, POLES AND PILES

Tenure	Sawlog Volume by Species (1) (m³)								Total	Other Log Material (2) (m³)		Total (m³)	Grand Total (m³)
	Jarrah	Karri	Wandoo	Yarri	Sheoak	Marri	Pine	Other		Hard-wood	Pine		
Crown Land	595 503	265 896	3 920	2 239	1 009	13 851	52 111	3 122	937 651	434 377	73 437	507 814	1 445 465
Private Property	62 085	39 262	7 157	2 467	....	6 466	1 677	592	119 706	....	....	....	119 706
Total	657 588	305 158	11 077	4 706	1 009	20 317	53 788	3 714	1 057 357	434 377	73 437	507 814	1 565 171

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

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

Year Ended June 30	From Crown Lands		From Private Property		Total Quantity
	Sawn Timber other than Sleepers	Sawn Sleepers	Sawn Timber other than Sleepers	Sawn Sleepers	
1977 m³	308 029	39 764	29 497	8 546	385 836
1978 m³	288 982	35 392	35 225	6 181	365 780

Sandalwood

Exports for the year, 1 266·5 tonnes, were only slightly higher than for the previous year (an increase of 44·5 tonnes).

Sandalwood received at the Spearwood depot of the Australian Sandalwood Co. Ltd. during the 1977/78 year totalled 1 475 tonnes, compared with 1 348 tonnes for the previous year.

These totals may be broken down as follows.

	1976/77 tonne	1977/78 tonne
Sandalwood from Crown land—		
Green sandalwood—		
Logwood (including roots and butts)	766	618
Dead sandalwood—		
Burnt wood	56	120
Cleaned wood	100	30
Pieces	403	686
Sandalwood from private property	23	21
Total	1 348	1 475

A feature of the field operations during the current year, 1977/78, has been the increasing number of pastoral lease holders who have obtained orders themselves to supply sandalwood from their properties.

The Forests Department has not applied strict quota restrictions to these operations, which provide a much needed cash inflow to assist the property holders to survive the economic recession in the pastoral industry which has been caused by drought. As a result, total production this year has been higher by 127 tonnes than the 1976/77 figure.

Although the tonnage gathered has increased, the Department has again been able to reduce still further the amount of green sandalwood obtained from Crown land.

Greater utilisation of dead sandalwood is reflected in the marked increase in the amount of burnt wood and pieces received. Even though the amount of cleaned dead sandalwood decreased, the total figure for dead sandalwood received rose by 277 tonnes over that for 1976/77.

Firewood

	Crown land (tonnes)	Private property (tonnes)	Total (tonnes)
Sawmills—			
General purpose and sleeper—			
For sale	43 347	....	43 347
Own use	5 143	....	5 143
Private property—			
For sale	....	8 076	8 076
Own use	....	296	296
Domestic—			
Local Firewood License	4 692	....	4 692
Forest Produce License	10 933	....	10 933
Industry—			
Wundowie	100 511	....	100 511
Kalgoorlie	2 724	....	2 724
Total	167 350	8 372	175 722

Other Forest Produce

Poles and piles obtained from Crown land during the year amounted to 370 874 lineal metres, compared with 498 193 lineal metres for the previous year. Supplies of piles and poles from private property are dwindling and accurate production figures are not available.

The number of fence posts and srtainers cut from Crown lands totalled 379 139. Records received show that 32 956 posts and strainers were obtained from private property, but this was only a small percentage of the total production from this source.

Following representations made, the Government directed that royalty be waived on fencing material for victims of Cyclone Alby.

OTHER FOREST PRODUCE

Description		South-west Division and Agricultural Areas		Goldfields Area Crown Land	Total
		Crown Land	Private Property		
Mining Timber South-West	m^3	3 785	....	....	3 785
Mining Timber Goldfields Areas	m	....	....	26 366	26 366
Piles, Poles and Bridge Timber	m	370 874	....	....	370 874
Fence Posts and Rails	No.	269 561	32 956	56 666	359 183
Strainers	No.	49 390	....	3 522	52 912
Boronia	Kg	3 490	56	....	3 546
Gravel and Stone	m^3	357 640	....	....	357 640
Sand	m^3	88 329	....	....	88 329
Sawdust as fuel	Tonnes	35 739	....	....	35 739
Bean Sticks	No.	5 000	....	20	5 020

Woodchip Operations

A total of 434 377 m^3 of marri and karri chip logs were received at the W.A. Chip and Pulp Company's mill near Manjimup for the production of woodchips. The intake consisted of 76 per cent marri and 24 per cent karri.

This material, unsuitable for sawmilling, came from a total area of 3 250 ha of which 2 955 ha were marri/karri forest and 295 ha were of jarrah/marri forest.

In addition, 89 390 tonnes of prepared chips were purchased from other mills, an increase of 58 240 tonnes over the previous year.

Softwood Production

Pine log production from Departmental plantations, mainly in the form of thinnings, amounted to 125 548 m³, which was an increase of 4 689 m³ (3·9 per cent) on last year's figure. The following figures show the trend in pine log removals in recent years.

Year ended 30 June	m³ (U.B.)
1950	8 440
1955	20 131
1960	28 394
1965	48 766
1970	81 281
1971	86 245
1972	90 761
1973	100 420
1974	123 393
1975	129 086
1976	105 567
1977	120 859
1978	125 548

Removals by category were as follows:

	Total (m³)
Sawlogs and peeler logs	52 111
Other log material	73 437
Total	125 548

Production from the various plantations was as follows:

	m³
Wanneroo (Gnangara)	19 564
Metropolitan (Collier and Somerville)	11 830
Mundaring	....
Gleneagle	....
Manjimup	381
Harvey	11 506
Collie	15 223
Kirup (Grimwade)	46 222
Nannup	7 863
Busselton—	
Ludlow	97
Keenan	8 393
Pemberton	4 032
Miscellaneous	437
Total	125 548

Sawn production from all sources was 18 669 m³, which is an increase of 1 984 m³ on 1976/77 production.

Harvesting in Plantations After Cyclone Alby

On 4 April 1978, winds of unprecedented strength swept through part of the south-west as a result of Cyclone Alby. Recently thinned plantations were severely damaged and large volumes of timber were lost.

Damage occurred to plantations in the Kirup, Nannup, Harvey and Collie divisions, with the most extensive damage at Grimwade (Kirup) and Bussells (Collie). The area affected was classified by degree of damage into three categories:

70–100 per cent broken	399 ha
Bent (felling necessary)	418 ha
Slightly bent	333 ha

The volume of timber lost was calculated in terms of log diameters smaller than 30 cm or larger than 30 cm, as follows:

Division	Volume (m³)			
	70%–100% broken		Bent	
	Small	Large	Small	Large
Kirup	14 300	30 500	13 700	25 200
Collie	15 000	14 300	26 300	20 400
Harvey, Nannup	3 500	3 700	2 000	4 500
Total	32 800	48 500	42 000	50 100

	m³
Small logs—	
Total loss	74 800
Volume salvaged	7 000
Nett loss	67 800
Large logs—	
Total loss	98 600
Volume salvaged	12 000
Nett loss	86 600

Further salvage will be possible in some areas, but much of the remainder is permanent loss. Of more importance in the longer term is the loss of future growth of established trees, estimated to exceed 300 000 m³ by 1995.

The quantity of salvaged pine logs, was well in excess of sawmill capacity. Over 5 000 m³ of logs were stockpiled at Greenbushes under continuous water sprays to prevent degradation by fungi and drying checks. This trial of low-cost storage using recycled water may lead to a substantial increase in stockpiling and hence greater flexibility in logging programmes.

Utilisation

In line with State Government policy, two of the Department's pine sawmills at Grimwade and Margaret River were sold during the year to private interests. The sale specified construction of two new softwood mills with a capacity for an annual intake of 50 000 m³ of pine logs by 1982 to 1985. The projected development will be re-assessed as a result of extensive plantation losses caused by Cyclone Alby. A third mill at Pemberton was leased to a private operator. The change-over from State to private management took place on 1 March 1978.

One sawmill at Harvey has been retained under Forests Department management as an experimental mill to supply timber to the new high-temperature kiln. The mill and the kiln are primarily used to establish the characteristics of, and the specifications for, Pinus pinaster timber. Initial problems with the kiln have now been overcome and a programme of experimental seasoning has commenced in co-operation with the C.S.I.R.O. Division of Building Research.

Timber Industry Regulation Act, 1926–1969

The number of mills registered under the provisions of the Act at 31 December 1977 totalled 139 (79 on Crown land and 60 on private property).

The average number of persons employed in the timber mills each month throughout the year was 2 170, a decrease of 72 compared with last year's figure of 2 242.

The District and Workmen's Inspectors made 900 mill inspections and 486 bush inspections.

There were 137 notifiable accidents for the year ending 30 June 1978; four of these were fatal. The number of accidents per 100 persons employed was 6·31, a decrease compared with last year's figure of 7·45.

The cost of administering the Timber Industry Regulation Act for the year ending 30 June 1978 was:

	$
Salaries	37 068.81
Mileage, allowances, office rent, plant cost and sundries	19 403.00

Recreation and Tourism

Camps

The Department continued to develop nature trials at the Lewana and Wellington Mills camps. These camps, and the camps at Myalup, Pimelea and Dryandra have proved very popular. The camps are leased to organisations providing recreational facilities, such as the Community Recreation Council, for public use.

Walking Tracks

The Department agreed to co-operate with the Shire of Kalamunda in its promotion of a special Bibbulmun Track Walk as part of the celebration for western Australia's 150th Anniversary in 1979.

Self-guiding Tours

The two self-guiding motor tours in the karri forest were re-designed and the routes effectively signposted. A similar tour of the Donnybrook Sunkland is in preparation.

Visitor Surveys

A visitor analysis based on both road traffic counters and questionnaires over the whole of State forest was begun during the year. Over 50 per cent of the questionnaires were returned, providing a most satisfactory response.

Flora and Fauna

The Department retained responsibility for implementation of the Native Flora Protection Act because the 1976 Amendments of the Wildlife Conservation Act, which transfer the responsibilities to the Department of Fisheries and Wildlife, have yet to be proclaimed.

Several meetings of the Wildlife Authority—Flora Committee have been attended by representatives of the Department, and submissions have been made toward the compilation of lists of rare and endangered flora.

Conservation of flora continued to be provided for by the Department's Management Priority Areas, which are strategically distributed throughout the main forest area. Additional protection has been provided for the rarer species in Departmental arboreta, and in the various reserves managed by either the Department, the National Parks Authority or the W.A. Wildlife Authority, beyond the main forest zone.

Field Study Centres

Study centres are now operating at Jarrahdale and Mundaring Weir with the co-operation of the Education Department. Some programmes have been compiled by Departmental staff, and both centres have been provided with display materials which identify trees, flowers, birds and animals of the northern jarrah forest.

Use of these centres by secondary schools and Primary schools for the study of geography and biology continues to increase.

Mining Rehabilitation

Reforestation after Bauxite Mining

A total of 223 ha of bauxite pits in State forest were rehabilitated at Jarrahdale and Dwellingup.

At Jarrahdale 95 ha were replanted by the Forests Department following site preparation by Alcoa. At Dwellingup, the Company replanted 128 ha to Departmental specifications.

Species planted include *Eucalyptus wandoo, E. resinifera, E. accedens, E. patens, E. maculata, E. robusta, E. marginata, E. saligna, E. diversicolor* and *E. calophylla.* In one area at Dwellingup, 40 ha were planted with a mixture of *E. accedens, E. wandoo* and *E. marginata.*

Seed of mixed native shrub species, mostly acacias, was applied to all areas at the rate of 1 kg/ha with 300 kg/ha of zinc-copper-superphosphate fertiliser.

The inter-departmental working group continued to visit both major mine sites during the year to determine methods of erosion control and revegetation and to monitor the progress of rehabilitation work.

An area of 203 ha of eucalypts planted on pits at Jarrahdale between 1969 and 1973 was thinned to prescription. Stem numbers were reduced by 50 per cent and unthinned controls were retained. Plots of *Eucalyptus saligna* and *E. resinifera* were thinned to 75 per cent, 50 per cent and 25 per cent of original stem numbers, and controls at 100 per cent were retained. All thinned areas were re-fertilised with a combined nitrogen and phosphate fertiliser at the rate of 100 g/tree. Unfertilised controls were retained for monitoring purposes.

Mineral Sands and Coal Mining

The initial stage of a programme to develop part of an abandoned open-cut coal mine in State forest as a recreation site has been completed. Work included the contouring of tailing dumps; the construction of a boat ramp, access road, and parking area; the development of an island and a beachfront. The surrounds were direct seeded with suitable indigenous shrub and tree species.

A total of 26 ha of rye grass and lupins were established as a cover crop on areas mined for mineral sands.

Reforestation after Gravel Mining

A total of 55 gravel pits covering 74 ha were reforested. Of these, 20 were former Main Roads Department pits, and were rehabilitated using funds supplied by that Department.

Catchment Rehabilitation

During 1977–78 the Forests Department co-operated with Public Works Department and the C.S.I.R.O. in studies in the Helena Catchment which were designed to give a better understanding of the effect which reforestation may have in lowering the groundwater table and reversing the discharge of salts.

Sixty-two ha of farmlands purchased in the Wellington Catchment by the Public Works Department and the State Energy Commission have been planted with trees to help control salinity.

The plantings, carried out on behalf of the client departments, included experimental strip plantings of trees aimed at assessing their effectiveness in lowering the groundwater table and preventing the spread of salt scald.

Monitoring of the groundwater table fluctuations was carried out by means of 50 boreholes established by the Public Works Department.

Monitoring the Effects of Agricultural Clearing

The major research programme was continued in conjunction with the C.S.I.R.O. and P.W.D. in State forest within the Collie River Catchment, where five small forested catchments have been extensively monitored by the C.S.I.R.O. and the P.W.D. since 1974 to collect basic meteorological and hydrological data.

Two of the catchments are in the western part of the Collie River, close to the wall of the Wellington Reservoir, and the other three are located some 40 km eastwards.

In the 1976/77 summer, one of the western and two of the eastern catchments were cleared for pasture establishment as part of the experiment. The other catchments will remain uncleared.

Data will be recorded on all areas for several years to monitor changes. The cleared catchments will then be reforested.

Protection: Fire

All of the 1 997 605 ha of land under the control of the Department was protected from fire. Other public lands and private property are also given some measure of protection.

The Fire Season

The fire season was exceptionally hot and dry. Rainfall was below average in November, December, January and April with total deficits over the six-month period of 41 mm for Perth, increasing to 126 mm for Pemberton. The summer was the hottest on record for the forest area with above average maximum temperatures throughout the six months.

The drought and the exceptionally hot weather continued well into April, when the season culminated in a series of disastrous fires which accompanied Cyclone Alby.

The following data were recorded at forest weather stations at Dwellingup and Pemberton for the year 1977–78.

	Dwellingup (Jarrah)		Pemberton (Karri)	
	Average	1977/78	Average	1977/78
Rainfall—				
Annual (mm)	1 307*	1 040	1 245*	1 025
October to April inclusive	283	216	355*	284
Number of Wet Days—				
Annual	137	140	169*	140
October to April inclusive	39	44	80*	65
Temperature—				
Mean Maximum October to April °C	25·3*	27·2	22·7*	24·6
Relative Humidity—				
Days of 15% minimum or less (No.)	8	3	0·2	0
Days between 16% and 25% (No.)	29	47	4	3
Fire Hazard—				
Number of Dangerous Days	9	19	1	1
Number of Severe Days	20	22	5	3

*Bureau of Meteorology

Prescribed Burning

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

	Season				
	1973/74	1974/75	1975/76	1976/77	1977/78
State Forest—					
Hand burning	74 716	78 686	64 497	49 405	36 567
Aircraft burning	253 699	287 925	215 513	185 236	233 931
Total	328 415	366 611	280 010	234 641	270 498
Advance, Top Disposal and Regeneration Burns	12 035	2 378	4 532	3 563	3 764
Plantations—					
Clearing burns	1 139	3 088	2 872	2 752	2 530
Burning under pine canopy	1 028	2 494	1 958	2 284	1 779
Total	2 167	5 582	4 830	5 036	4 309

Most of the burning programme for spring was completed, but that for autumn was not completed owing to the prolonged drought and the unsuitable weather.

The Department carried out an aerial burn for the Army at Bindoon training area and participated in large co-operative burns with bush fire brigades, shires and the Bush Fires Board at Denbarker. The programme of co-operative burns has, over the years, reduced fuel hazards over large areas of land outside State forest.

Detection

The period between first and last watches for fires was longer for pine plantations and jarrah forest than for karri forest.

	Pine	Jarrah	Karri
First Watch	20/10/77	22/10/77	15/11/77
Last Watch	12/5/78	13/5/78	12/4/78

Nine spotter aircraft and four towers provided efficient fire detection over State forest and adjacent land.

Wildfires

General

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

	Season				
	1973/74	1974/75	1975/76	1976/77	1977/78
Number of fires attended—					
Indigenous State forest	104	139	99	120	221
Adjacent private property and Crown land	86	79	64	86	150
Pine plantation	76	36	20	21	11
Total Number	266	254	183	227	382
Area of State forest fires (hectares)—					
Indigenous	1 017	8 850	3 883	5 553	8 211
Pine plantation	19	40	8	17	364
Total Area	1 036	8 890	3 891	5 570	8 575

The severity of the fire season was reflected in the high number of fires (382) attended by the Department's forces. This was the highest since 1961–62, when 463 fires were recorded, including the Dwellingup fires.

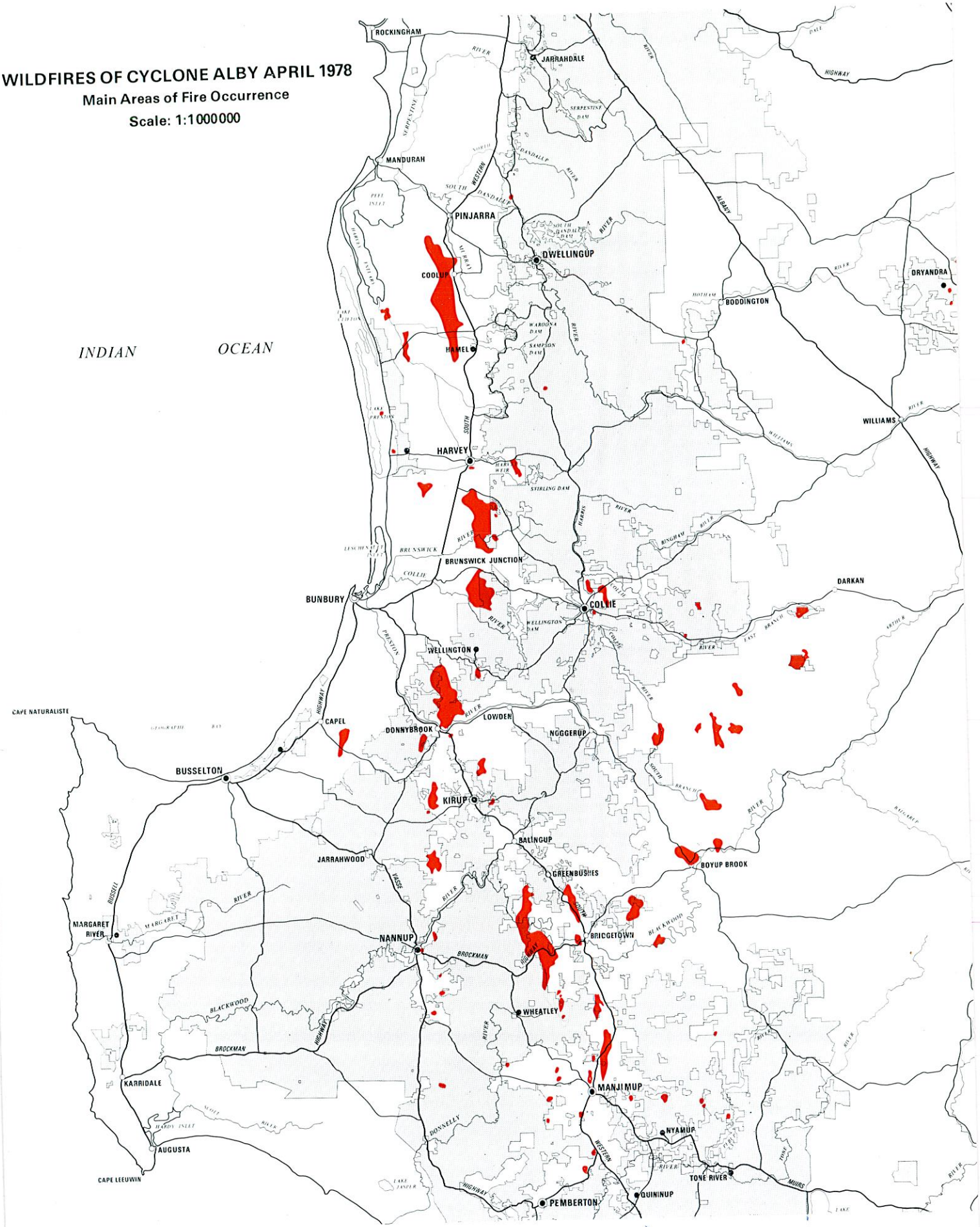
The high incidence of fire in 1977/78 was partly due to lightning strikes, which caused 98 fires; this was well above the average of 24 lightning strikes per season. Escapes from burning-off in lands adjacent to State forest caused 87 fires, and 68 fires were apparently deliberately lit within the forest.

Despite the severity of the fire season, the average size of fires in State forest was small and was lower than that for any of the previous five seasons except 1973/74.

WILDFIRES OF CYCLONE ALBY APRIL 1978

Main Areas of Fire Occurrence

Scale: 1:1000000



Fires Associated with Cyclone Alby

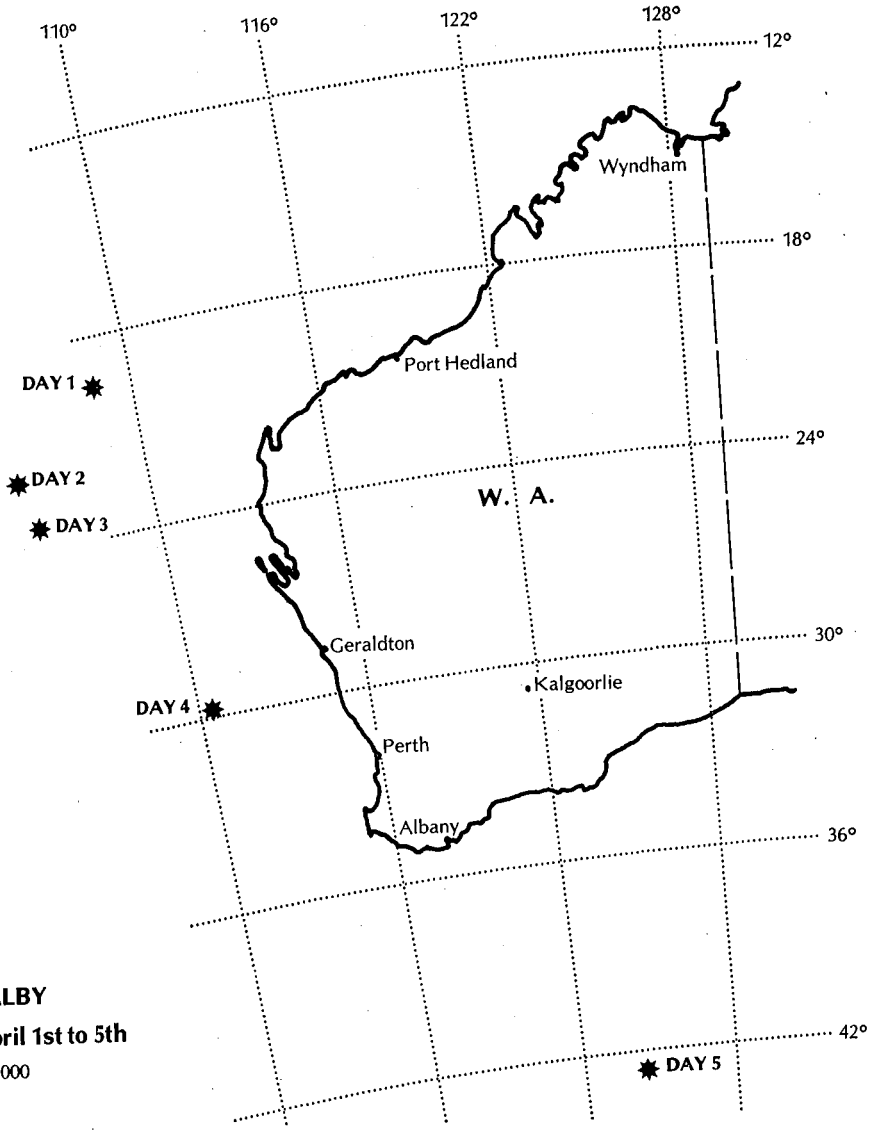
On 1 April 1978 Cyclone Alby was located over the Indian Ocean, about 700 km west-north-west of Exmouth. The accompanying map shows the southward movement of the cyclone on 2 and 3 April, its path roughly parallel to the west coast. On 4 April the cyclone moved rapidly across the south-west corner of the State, past Cape Leeuwin, accompanied by gale-force winds. Considerable damage resulted from wind and from fires that escaped mainly from incomplete burning-off on private property. Many buildings were destroyed and there was widespread fire damage to farming properties. Several towns were threatened during the peak of the cyclone.

As the cyclone approached Cape Leeuwin gale force winds developed with gusts in excess of 112 km/h. Dwellingup, Kirup and Pemberton recorded wind gusts over 100 km/h between 1600 and 2100 hours. Several centres in the south-west registered new records, with gusts between 130 and 140 km/h. (Ref. Bureau of Meteorology, monthly weather review, Western Australia, April 1978).

Cause of Fires

Most of the fires accompanying the cyclone escaped from burning operations on farmland. Many of these burns had been carried out one to two weeks earlier and would have been safe under normal April weather conditions. Other fires resulted from burns lit on 4 April and their escape may have been prevented had it been possible to provide earlier weather warnings of strong winds. The origin of 90 fires which burnt in and near State forest is given below. These fires were generally within 10 km of State forest boundary.

Escapes from Forests Department prescribed burning operations	8 fires
Escapes from controlled burning in private property	66 fires
Escapes from sawmill waste heaps	4 fires
Escapes from S.E.C. powerlines	8 fires
Miscellaneous causes—rubbish heaps, machinery, travellers	4 fires



CYCLONE ALBY

Diurnal Positions April 1st to 5th

Scale 1:25000000

Location of Fires

The most widespread damage to private property in forest areas was caused by fires located near Donnybrook, Bridgetown, Brunswick and Manjimup.

Area of Fires

The table below shows the number of fires recorded at each of the Department's headquarters and of fires attended by the Department's forces. Many fires were fought in c-ooperation with organisations such as bushfire brigades, the Army and the Bush Fires Board. Other fires, more remote from the forest, also caused considerable damage but are not included in the table.

The table also shows the extent of the fires; the area burnt is divided into State forest, State-owned pine plantations, privately owned pine plantations, and other private land, most of which was farmland.

Escapes of fire from burning operations within State forest were confined to 120 ha. The rest of the damage in State forest resulted from fires entering from private property and other land outside State forest boundaries.

AREAS BURNT BY FIRES 4 TO 11 APRIL 1978

Division	No. of fires	Fires with F.D. involvement	Area burnt—(ha)				
			F.D. plantations	State forest	Privately owned plantations	Other lands	Total
Wanneroo	2	1	....	....	....	800	800
Mundaring	7	5	....	529	....	1 284	1 813
Kelmscott	....	....	....	....	....	....	....
Dwellingup	2	1	....	....	....	39	39
Narrogin	3	3	....	117	....	....	117
Harvey	10	5	60	320	50	13 996	14 426
Collie	10	7	....	2 380	400	5 900	8 680
Kirup	19	13	278	2 382	320	18 981	21 961
Nannup	5	2	....	2	....	116	118
Busselton	2	....	....	....	....	85	85
Pemberton	6	5	....	85	....	40	125
Manjimup	21	18	....	993	60	2 272	3 325
Walpole	3	2	....	44	....	50	94
Total	90	62	338	6 852	830	43 563	51 583

Effectiveness of Prescribed Burning

Suppression forces demonstrated great competence and dedication during the cyclone, in conditions made extremely difficult by gale-force winds and very rapid fire spread. Trees were blown down, blocking access and making travel dangerous.

The table below lists seven instances when potentially dangerous fires burnt into forest areas where fuels had been recently reduced by prescribed burning. Suppression forces were able to leave these sections for up to four days and concentrate on more dangerous fires.

FIRES REDUCED BY PRESCRIBED BURNING DURING CYCLONE ALBY

Fire identification	Area of S.F. burnt (ha)	Total area burnt (ha)	Fire contained in *(fuel age)	Date fire started	Date fire first attacked in S.F.
Brunswick PP 16	320	3 760	1 y.o.	4/4	4/4
Gervasse C 60	1 320	2 730	3 y.o.	4/4	4/4
Maranup K 27	1 000	5 280	2 y.o.	4/4	4/4 main fire 8/4 2 y.o.
Argyle K 29	370	400	1 & 2 y.o.	4/4	7/4
Bedford K 33	40	400	1 y.o.	4/4	Not attacked; inspection only
K 37	30	800	1 y.o.	4/4	6/4
Hester K 41	400	800	1 & 2 y.o.	4/4	8/4

* Number of years since the last prescribed burn for sector where the fire was contained in State forest.

General

Two advanced fire courses were conducted for field officers, and included staff from the Bush Fires Board. Special training courses in fire control were provided for staff of the Bush Fires Board and Alcoa.

Protection staff gave talks on fire control to shires and other organisations and assisted with fire courses conducted by the Bush Fires Board.

Fire protection for *Pinus radiata* plantations was reviewed and plans were prepared for sub-dividing large plantations and making wider fuel-reduced buffers to ensure effective fire suppression even under severe conditions. Fuels within the buffers will be reduced by burning, grazing grass areas, and modifying silvicultural techniques.

Eight new pumpers for fire fighting were built in the Department's workshops to replace worn-out equipment.

Protection: Disease

Additional forest disease risk areas were proclaimed on 16 December 1977, bringing the forest now under quarantine to 719 561 ha or some 36 per cent of the total forest area.

Training in dieback hygiene and quarantine procedures was increased after these disease risk areas in the southern forest region were declared.

Ground patrols have reported 191 illegal motor vehicle entries on roads in quarantine areas during the year. In 113 different places where illegal entry had previously been recorded, there have been no further entries for periods ranging from 12 months to 2 years. All places and dates of entry are recorded for future interpretation.

Co-ordinated aircraft and ground patrols were used 21 times to cover areas where regular illegal penetration was suspected. Wash-down ramps were built at 6 more centres for efficient cleaning down of vehicles and equipment.

A simple dieback hygiene manual for roadwork, prescribed burning and fire suppression was produced for training of departmental staff and employees. Further pamphlets are being produced for inclusion in the Foresters' Manual.

Forest Offences

Eighty-nine breaches of the Forests Act and Regulations were reported during the year; of these 74 related to forest diseases and 15 were more general.

Four cases were settled without prosecution in accordance with the Act and Regulations, two led to prosecution and conviction for breaches of quarantine, and 83 warnings were issued.

One further conviction resulted from proceedings which were instituted last year.

SUPPORT SERVICES AND RESEARCH PROGRAMMES

The Research Branch continued its very wide field of investigations. Each of the five research centres covered projects relevant to their particular location, with Como providing supporting services.

A considerable proportion of the Department's research activity was carried out in co-operation with other State Government Departments, C.S.I.R.O., Universities, Western Australian Institute of Technology and Alcoa. Co-operative studies have been encouraged in recent years so that a multi-disciplinary approach can be adopted towards problems in Western Australian forests.

Research: Como

The Como group continued to provide support services for the Research Branch as a whole and to carry out ecological research, primarily associated with conservation of flora. The support services include editing and organisation of publications, chemical analysis and data analysis.

The editorial section was expanded during the year with the appointment of an editorial assistant and the output of publications has increased significantly (Appendix 6).

Data Analysis

Some 20 major data analyses and computing projects have been undertaken during the past year, and 11 of these have been completed. A wide variety of topics has been covered, including plant ecology, the ecology of ants, hydrology and salinity, native plants for freeways, sandalwood regeneration, a forest visitor survey, tree provenance trials, fertiliser experiments, seed germination, and the habitat of a small freshwater fish, the mud minnow (*Lepidogalaxias salamandroides*).

Soils and Nutrition

Analytical work associated with studies being carried out by the Hunt and Kelsall Committees was again an important laboratory function. This work included the analysis of soil cores and further analysis of bore and weir water samples from Mundaring, Dwellingup and Manjimup.

The nutrient load of stream water samples from areas within the forest cut over for sawlogs and woodchips near Manjimup and the pine plantation project near Jarrahwood was compared with that from nearby unaffected catchments. The analysis indicated that only traces of phosphate and nitrate were entering the streams.

Numerous foliar samples of *Pinus radiata* and *P. pinaster* growing on experimental plots were analysed to provide an indication of the residual effects of applied fertilisers.

Two new projects were begun towards the end of the year. The first is concerned with the general nutrition of *P. radiata* on Sunkland soils. Detailed sampling has been carried out to evaluate the effect of an agro-forestry management system on the properties of Sunkland soils and to determine the persistence of applied fertilisers.

The second project is associated with the dieback disease research programme. A large number of soil samples are being analysed to determine the effect of native legume understorey species on the organic matter in the soil.

Sandalwood

Further field trials for regeneration of sandalwood (*Santalum spicatum*) are being carried out at Dryandra State Forest, near Narrogin. Some 4 000 seedlings have been raised in containers with nurse plants to encourage early attachment of the parasitic roots of the sandalwood; this will help the sandalwood seedlings to survive the critical phase after transplanting in the field before they become attached to mature hosts.

Wanneroo

Tree Improvement

The genetic improvement programme for *P. pinaster* continues to show success. The improved stem straightness and greater uniformity of stands established with first generation orchard seed has reduced the number of trees planted per hectare from 1 700 to 625. This has resulted in large savings in costs in the nursery, in planting and in early tending.

Hydrology

Groundwater table levels under the Gnangara pine plantation and adjacent native woodland have been monitored since 1942. Below-average rainfall during seven of the last 10 years has resulted in a general lowering of the groundwater table, and in April 1978 the average depth was 4·6 m, the lowest level ever recorded. This has resulted in extreme symptoms of drought stress and widespread pine deaths due to drought in areas that had not been subjected to heavy early thinning.

Manjimup

Hydrology

Monitoring of streams continued in the four experimental areas logged for sawlogs and woodchips in the summer of 1976/77. Changes in groundwater levels and salinity have so far been insignificant. As expected, increases in streamflow were recorded during the first winter after logging. A full report on the project has been released by the Department of Conservation and Environment (Bulletin No. 31, April 1978).

During the year additional holes were drilled to calibrate probe readings with absolute measures of soil moisture. Results are still being examined.

Stream sampling throughout the winter in catchments affected and unaffected by logging indicated a wide range in turbidity. Although in most catchments affected by logging there was a temporary localised rise in turbidity, there were exceptions. Higher turbidity was also observed in some streams not affected by logging, apparently as a result of the topography and soils within the catchments.

Water samples collected during spring completed the mapping of base-flow salinity levels throughout the woodchip licence area.

Ecology

Investigations into the effect of fire on understorey shrub species of southern hardwood forests have been in progress for seven years. Several projects were concluded during the year and the results are being prepared for publication. Two trials concerned with the long-term effects of rotational fuel-reduction burning on the forest understorey are being continued. A new project to study the influence of autumn prescribed burning on the flora and its associated fauna in Dryandra Forest has been initiated; this forest has a very high conservation value and the problems of management are different from those of the main forest zone.

Long-term studies on the southern bush rat (*Rattus fuscipes*) and the bird population are continuing in the karri forest near Pemberton. Other work in the karri forest concerns the effect of logging on the quokka (*Setonix brachyurus*) and the mud minnow (*Lepidogalaxias salamandroides*).

The quokka has been found to be widely though sparsely distributed throughout the southern forest area. It is confined mainly to broad flat valleys such as those on the upper and lower reaches of small streams. A detailed study of the effect of clear felling on quokka distribution is in progress along the lower Dombakup Brook. The effectiveness of unlogged stream buffers for protection of quokka populations during and after logging operations is being studied by means of trapping and radio tracking.

The mud minnow is one of the very few vertebrate species whose range is almost entirely confined to the woodchip licence area. A survey indicates that its occurrence is associated with the southern acid, peaty heath "flats" and that it rarely occurs in karri forest streams. Logging operations are therefore unlikely to affect it in any way.

Research related to the management of Fauna Priority Areas has received considerable attention. A study by P. E. Christensen on the biology of the woylie (*Bettongia penicillata*) and the tammar (*Macropus eugenii*) in relation to fire has been accepted as a Ph.D. thesis by the University of Western Australia. This work was financed jointly by the Forests Department and a Commonwealth Post-Graduate Research Award administered by the Forestry and Timber Bureau, Canberra.

The study suggests that site and vegetation factors have a major influence on the distribution of the woylie and tammar. Both species are well adapted to periodic occurrence of fire in the forest, surviving fire and re-colonising the post-fire vegetation succession successfully without any obvious specific adaptations to fire. Both exhibit a marked degree of "fire dependence", in that the species on which they depend for food and cover are adapted to certain specific fire regimes. Frequent mild fuel-reduction burns are unfavourable to the woylie and tammar. The feasibility of using infrequent and relatively severe fires for the management of areas inhabited by these species is under investigation.

In another study attempts were made to re-establish the woylie in an area from which it had recently disappeared. Fifty-two individuals, six fitted with radio transmitters for tracking purposes, were released in the area. Eight months later there were very few survivors. Four of the six animals fitted with the radio units were taken by foxes. It is believed that the decline in woylie numbers was due to poor shrub cover and an increase in the fox population, and this emphasises the need for control of foxes in any area to be managed for conservation of small native fauna.

Investigation into the fauna of *P. radiata* plantations established on former farmland in the Blackwood Valley indicated a paucity of native mammals, a moderate population of reptiles and amphibia, but a surprisingly high bird population. One bird, the red-eared firetail finch (*Emblema oculata*), recently added to the rare species listed by the W.A. Department of Fisheries and Wildlife, was found to be common in most plantation areas. It is a seed-eater and its occurrence there may be associated with the introduced grass and weed species which are allowed to set seed without interference in many areas. Remnant strips of river/stream-side native vegetation in the plantation areas formed an important habitat for many species of birds.

Fire

During the year, the overwhelming emphasis of fire research has been on the reduction of fire hazard in the Departmental plantations of the Blackwood valley. Initially, attention was focused on measuring the amount of debris left on the ground after thinning. A line-intercept method was tested and found to be accurate, but too cumbersome for field use. Currently a simple ocular instrument is being developed for the assessment of the debris weight and distribution from a sample point.

Mechanical crushing of thinning debris proved very effective in reducing fire hazard, increasing the fuel bulk density by up to 300 per cent and converting most of the aerial flash fuels to safer ground fuels. Experimental fuel reduction burns in areas where crushing has been carried out are planned to measure the decrease in rate of spread and flame height.

Eucalypt Silviculture

Research continued into various aspects of karri (*E. diversicolor*) seed supply. Several field trials have been established to study seed production in young stands. Unfortunately, the largest trial, which involved heavy thinning, was severely damaged by Cyclone Alby.

Research into provenance variation in karri and marri (*E. calophylla*) has continued, the major effort being devoted to seed collection.

The nutrition of karri seedlings was studied in a comprehensive trial involving variations in type, quantity, method and frequency of fertilisation.

Research into artificial seeding methods for karri has continued. The emphasis this year has been on spot seeding rather than broadcast seeding, in order to utilise the most favourable sites and to improve efficiency of seed use.

Rehabilitation After Logging

Research into methods of evaluating soil disturbance due to logging in mixed marri-karri stands and into methods of alleviating damage has continued. Soil damage is associated with high soil moisture content and is influenced by logging practice.

Soil compaction caused by logging can extend to 50 cm depth and greatly reduce the survival and early growth of seedlings. Successful rehabilitation of compacted sites has been shown to be possible, at least in the short term. Initial survival of seedlings in compacted areas was influenced far more by ripping than by ash-bed effect, but conversely, subsequent growth was influenced more by ash-bed effect than by ripping. Application of a nitrogen-phosphate fertiliser resulted in satisfactory seedling height growth, but only where ripping had been carried out.

Dwellingup

Jarrah Dieback Research

Studies of the suppressive effect of native leguminous species on *Phytophthora cinnamomi* (the causal organism) have been the major area of research. In two field studies, significant suppression of sporulation under understories of *Bossiaea aquifolium* and *Acacia pulchella* was recorded; this was the first field demonstration of this effect. Parallel laboratory and greenhouse studies have continued in an attempt to isolate the factors responsible for the suppression.

Two separate co-operative studies have been undertaken to determine whether the observed suppression of the disease is caused by chemicals present in the roots of the legumes. A research officer from the C.S.I.R.O. Division of Food Research in N.S.W. has isolated a volatile substance originating from the roots of *Acacia pulchella*, and tests carried out at Dwellingup have shown that this volatile substance suppresses sporulation, induces marked lysis of mycelium in sterile and non-sterile media and reduces germination of sporangia. A second study of the chemical characteristics of legume roots is being carried out in conjunction with scientists from the Department of Chemistry of the Western Australian Institute of Technology. A preliminary chemical characterisation of the roots of *A. pulchella* has been completed. Phenolic compounds from the roots have been found to suppress sporulation of *P. cinnamomi*. These studies suggest that it may be possible, by promoting a legume understorey over a period of years, to build these chemicals up to levels which can suppress *P. cinnamomi*.

The rate of spread of the disease has been monitored on 20 plots in the jarrah forest over a period of 10 years. The average rate of spread of the disease upslope from existing infections, measured by death of the *Banksia* understorey, is relatively slow. Jarrah mortality on the plots during the ten-year period was also slow, and only eight per cent of the jarrah trees, all of which were located in diseased areas, died during the same period.

On a few of the sites where the disease has been monitored, spread and intensification is much higher. This variation which cannot be explained by differences in the soil moisture and temperature has led to a detailed study on the effect of soil type on *P. cinnamomi*. If the factors responsible for suppression of the fungus can be identified, it may be possible to incorporate them into susceptible soils by cultural techniques such as fertilisation or establishment of legumes. Preliminary results indicate that low nitrogen status and low microbiological activity are associated with high disease susceptibility.

Fire ecology

A number of experimental burns have been carried out to determine the effect of fire intensity and the season of a burn on the regeneration of legumes and other understorey species of the jarrah forest ecosystem.

So far it has been found that on almost all sites which were subjected to medium/high-intensity fire, significant regeneration of leguminous species occurred, whereas before the fires, legumes occurred only as a scattered and minor component of the shrub and understorey layer. There is an association between site type and the species of legume which regenerated. It is possible to achieve regeneration of legumes using fire intensities which do not cause significant damage to the boles of crop trees.

Significant reduction in the density of the *Banksia grandis* understorey can be achieved by high to medium-intensity fire. This species is highly susceptible to *P. cinnamomi* and is a major factor in the spread and intensification of the disease.

Jarrah growth is stimulated by high to medium-intensity fire: Growth rates on plots subjected to high-intensity and medium-intensity fire over a 12-month period were four times greater than in unburnt and mildly burnt plots.

Jarrah Silviculture

The jarrah silviculture research programme has been maintained, but no new experiments were initiated.

Rehabilitation

A vigorous research programme has been developed around the central issue of rehabilitation after bauxite mining. The goal of this programme is to develop the means to prevent or minimise hydrologically undesirable effects arising from forest disturbance due to bauxite mining and activity of *Phytophthora cinnamomi*. The two main aspects of the programme are rehabilitation of the western forest where salinity does not present a problem, and rehabilitation of the eastern forest where there is ample evidence of increased stream salinity after disturbance of the forest.

Many of the technical problems encountered in the revegetation of western forest areas have been solved. A range of methods for landscaping, erosion control and revegetation has been developed. A system of broadcasting seeds of shrub and tree species which has been developed over the past five years at the Dwellingup research station has been adopted as a standard operational procedure by Alcoa and the Department. The final trial carried out during 1977 showed that it is possible to establish a diverse understorey and shrub layer on bauxite mine sites by aerially applying a mixture of seed at the rate of 1 kg/ha.

Rehabilitation of the eastern jarrah forest, where large quantities of salt are stored, presents more complex problems. The main thrust of research here has been the evaluation of the suitability of various tree species for rehabilitation. One approach followed was the establishment of large arboreta covering a range of sites, on which future detailed evaluation can be carried out. Two such arboreta were planted in the current year. Each comprises 70 species of eucalypts selected for general utility and for adaptation to semi-arid, saline environment. A second approach involved the use of existing stands of trees, despite their limitations of inadequate size and limited range of species. Useful, though incomplete information has been obtained from them in the current year on such aspects as rooting patterns and use of water.

Excavation of the roots of trees established on former bauxite mine pits has made some comparison possible of the rooting patterns formed under these conditions with the known rooting patterns of the jarrah trees. Twelve excavation pits were dug, in 4–7 year old stands. It was possible to examine 47 trees belonging to nine different species. In most species there was some deep root development, generally along structural weaknesses in soil such as old root channels and cracks. Overall, however, this root development did not match the root patterns found under native jarrah forest, indicating the need for further assessment when the trees are older.

A method of root mapping using a radioactive isotope of phosphorus was tested and found to be worthy of further development.

Preliminary investigations into the diurnal fluctuation of leaf diffusive resistance and xylem pressure potential have shown there are wide variations in the patterns of water consumption of several eucalypt species. Deep root penetration and high water usage in summer are considered desirable for salinity stabilisation.

Hydrology

Monitoring of streamflow quantity and salinity in the South Dandalup and Yarragil Catchments has been maintained for the third successive year. Rainfall was again below average during 1977, and water yields in the western micro-catchments of the South Dandalup River were equivalent to 1976 values. In the drier eastern portion of the catchment yields were extremely variable and adjacent micro-catchments varied greatly in their response to rainfall. Yields in the Yarragil Catchment were approximately double those for 1976 owing to a single heavy fall of rain. Overall salinity values for both catchments were the same as the 1976 levels.

Monthly monitoring of borehole water level and salinity in the Yarragil Catchment and along the Dwellingup transect has continued. The published results of these studies show that there are considerable volumes of soluble salts stored in jarrah forest soils. A rapid response of groundwater level and salinity to rainfall has also been observed in these bore-fields.

Combination V-notch weir located on a tributary of Marrinup Brook, West of Dwellingup. This is one of seven weirs designed to provide information on the potential to increase water yield in the high-rainfall zone of the northern jarrah forest. The weirs were designed by the P.W.D. Water Resources Section and were constructed by Forests Department personnel.

The six weirs constructed during 1976 in the Little Dandalup and North Dandalup Catchments have been monitored continuously for streamflow. In addition, weekly salinity and sediment samples have been taken. This project will determine whether it is possible to increase water yield in non-saline jarrah forest sites by reducing stand densities. The catchments will be monitored for another five years before a variety of stand manipulation treatments are applied. As an adjunct to this project, a weir has been constructed on a partially cleared tributary of the Marrinup Catchment west of Dwellingup to provide an estimate of the maximum yield likely from a western scarp catchment.

Busselton

Pine Nutrition

During the year, new aspects of plantation establishment of *Pinus radiata* were investigated in the Donnybrook Sunkland.

The emphasis has changed from early stages of establishment to maintenance of growth throughout the rotation. Trials using rock phosphate fertiliser have so far given no conclusive results concerning its long-term effect.

Re-fertilisation trials using mixed fertilisers have been established on the Harvey coastal sands and on the older Sunkland plots. Further trials are planned to determine the necessary frequency and rate of re-fertilisation. The response of *P. radiata* to inorganic nitrogen and phosphorus fertilisers on similar Collie coal basin soils has been only transitory (see table), probably owing to the leaching of nitrogen.

Diameter Increments as a percentage of the control (no fertiliser), Preston Road Plot (planted 1969, Fertilised September 1973).

NP Fertiliser Level	1973/74	1974–75	1975–76	1976–77
0·25 kg/tree	147	128	110	104
0·50 kg/tree	166	141	119	108
1·00 kg/tree	175	163	212	107

This transitory response to inorganic mixed fertilisers and the rapid growth on trial agro-forestry sites in the Sunkland indicate that an agro-forestry sytem, which provides a biological source of nitrogen, may be a more effective method of satisfying a plantation's fertiliser requirements.

Integration of Grazing and Agriculture

This field of research received increased attention during the year in line with its increasing importance in operational practice. Most current projects are directed towards the evaluation of tree growth under very wide spacing conditions and towards the development of cultural techniques to ensure wood quality is not impaired.

A spacing experiment set up in 1973 indicated that up to the stage where low pruning takes place, average branch size does not vary significantly over the tree stocking range of 250 to 750 stems per hectare but two earlier spacing experiments clearly showed that branch size above the low-pruned zone increase with wider spacing. Strictly timed high pruning is essential to avoid large knots in the lower part of the bole.

One large new experiment was initiated during the year to study the interactions of tree stocking and degree of pruning on tree growth and herbage production. The table gives data for the first year's herbage yield in part of this experiment, which is located in a nine-year-old stand of *P. radiata.*

FIRST YEAR HERBAGE YIELDS (kg/ha),
WONNERUP, PINES AGED NINE YEARS

All trees pruned to 4·5 m		All plots at 750 stems per ha	
Stocking (No. per ha)	Yield (kg/ha)	Number High Pruned (No. per ha)	Yield (kg/ha)
750	1 176	200	571
375	1 379	375	617
200	1 922	750	1 176

This indicates that the yield of herbage decreases with the increase in the number of trees retained unpruned. Highest herbage yield occurs when only a small number of high-pruned trees is retained.

Nurseries

Continuing problems with post-emergent weed control in the *P. radiata* nursery at Nannup led to a re-evaluation of weedicides. Several successful treatments were identified, all of which gave good control of weeds, and particularly the most intractable species, *Echinochloa crus-galli.*

Hydrology

Monitoring of streamflow and water quality in the Sunkland continues. A large representative basin in St. Pauls Brook Catchment is being calibrated in conjunction with the Public Works Department, prior to conversion to pine plantations.

The preliminary study of the salt content of soil profiles and groundwater levels and salinity in the Apostles Brook Catchment has been completed and the results are being prepared for publication.

Inventory and Planning

Hardwood Inventory

In Dwellingup, Collie, Kirup, Nannup and Busselton divisions 1 912 ha of management-level assessment provided information on 57 000 ha. In the marri chip licence area 116 ha of management-level assessment provided information in sawlog and chiplog volumes in 12 coupes covering 4 300 ha.

One hundred and forty-two permanent inventory plots were established and 21 established plots were re-measured. Inventory control systems relating estimated volumes to actual removals were established in Dwellingup and Busselton divisions.

Assessment of wind-blown losses in the native forest after Cyclone Alby has been incorporated in routine hardwood inventory. An aerial assessment revealed a marked reduction in wind scorch 5–10 km inland from the edge of the Darling Scarp.

Softwood Inventory

Temporary plots were established in the main plantation areas to provide information on stem numbers, mean diameter and height, so that thinning schedules can be drawn up. Throughout all divisions 779 permanent plots were established and 1 277 existing plots were re-measured. Measurements were taken for the production of revised log volume tables for both *P. radiata* and *P. pinaster.*

Trials were undertaken for high-pruning classification at Harvey and Kirup. The relationship of thinning intensity and site treatment to fodder production in agro-forestry trials at Mundaring was measured. A large programme to map and assess cyclone damage in plantations is continuing.

Other Projects

Logging plans: The integrated sawlog and chiplog plan has been revised for the southern region.

Weight to volume ratio: The conversion factor relating the weight of chipwood produced to the volume of chiplogs producing it continues to be monitored.

Survey of forest users: Assistance was given with the forest-user survey carried out in selected weekends during the year.

Treen Brook Chip Yield Plots: Treen Brook karri chip yield plots were measured for the third time since thinning. The diameter growth of trees on the thinned plots indicates a response to thinning.

Diamond Block Karri Chip Yield Trial: Two plots established in October 1976 were extensively damaged by Cyclone Alby on 4 April, 1978. These will be re-established in an adjoining area.

Plantation areas: A revised statement of plantation areas was produced using the Department's standard computer programme.

Plantation Operations Thinning Schedules: Revised thinning schedules incorporating various management alternatives were prepared for most plantations.

Data base: Further investigation of a computer-oriented land data base was carried out.

Photography: Oblique 35 mm photographs taken from spotter aircraft provided valuable information for the hardwood operational control system as well as a mapping aid for karri regeneration burns. They have also been used for determining the location and extent of the area burnt in wildfires, and as an aid in planning the management of recreational areas.

Future operations in areas currently under quarantine depend on the satisfactory mapping of dieback so that effective forest hygiene operations can be employed. After several years of intensive development, large-scale 70 mm colour transparencies are now the basis for detecting and mapping dieback in quarantine areas, and will be used for at least the next 6 years.

Operational trials this year produced satisfactory photographs over 40 000 ha of the jarrah forest. These trials also showed that with suitable weather (high cloud hiding the sun and so preventing the occurrence of tree shadows which would obscure the indicator species), it is possible to photograph 15 000 ha of forest in one day per aircraft photography unit. In one autumn season there could be enough suitable weather to photograph 120 000 to 150 000 ha of jarrah forest. Satisfactory performance trials of a more reliable transponder navigation system indicate that this target is a practical possibility.

Economics

A number of economic studies were undertaken and the reports were reviewed in relation to softwood plantations. Predictions were also made of future employment in the timber industry, and the best ways of indexing royalties, stumpages, timber prices, piecework rates and contract rates were determined.

Automatic Data Processing (A.D.P.)—Scientific Applications

The Interdata 7/32 computer installed by the Department in 1977 was upgraded during the early months of 1978. The improvements include a two-fold increase in memory and the installation of a magnetic tape unit and a large disc unit.

The magnetic tape unit has been used almost exclusively as a data backup medium. With the development of computer systems for scientific applications, the unit will provide a means of data input alternative to keyboard entry.

The Section has helped with the preparation of specifications for a pine log marketing system, and will liaise with the consultants who have undertaken programming of the system.

The Section is preparing specifications for a fire control system which will operate on the Interdata computer. The aims are to supply local weather forecasts and local fire danger index ratings direct to divisional offices. The system will assist in the implementation of the prescribed burning programme by matching local ratings against burn prescriptions and selecting a list of possible burns for a particular day. In wildfire situations, the system will provide options for the dispatch of gangs and equipment.

Several mathematical models of tree form, biological growth, hydrological systems, fire behaviour and the drift of smoke generated by forest fires were adapted for computer application.

New volume tables have been developed in response to changing patterns in pine log production. In order to rationalise and extend the system, large log samples (consisting of more than 1 200 logs) were taken from many areas and measured; analysis of the results suggests that variations between localities and age classes are relatively minor, but that silvicultural practice significantly affects log taper.

Mapping

Progress has been made with the introduction of a metric map system. Twelve sheets at a scale of 1:50 000 have been published and a further 15 are being prepared for printing. In the coming fire season Harvey, Collie and Kirup Divisions will have complete map cover at that scale. Publication of map sheets now in the preparatory stages will allow Dwellingup, Kelmscott and Mundaring Divisions to convert to metric scale.

The revision of imperial scale map sheets of areas not at present covered by the metric system has continued. Six sheets have been republished and a further five are in course of preparation. The proclamation of Southern Region dieback quarantine has necessitated the overprinting of four map sheets.

The mapping of Murray and Stockton plantations and Dwellingup settlement from aerial photographs, with ground survey control, was completed. Areas of 4-year-old *P. radiata* and 5-year-old *P. pinaster* as well as Brunswick plantation were remapped from recent photographs. Large-scale colour photographs were obtained to locate drought-affected pines, and these were mapped.

The preparation of plans necessary for the implementation of the Hardwood Operations Control System is proceeding. Northern and Central Region Divisions have been supplied with their essential requirements and plans for Southern Region are being prepared.

A major annual task is the preparation of plans of forest areas which are to be subjected to prescribed aerial burning. During the year 84 such burns were planned.

Extension

Exhibits were provided for the Royal Show both on the Department's display area and at the Committee for Understanding the Environment display on System 6. A display caravan depicted aspects of fire control and agro-forestry and was used at the Royal Show and at a number of country shows in the south-west. A small display on ants in the jarrah forest was provided for the annual wildlife show at Wanneroo, and the Department was represented at the Dowerin Machinery Field Days.

A booklet dealing with planning of gardens to conserve water was published during the year and generated many enquiries from the general public about the use of native plants and seeds.

Private Plantations

Private interests advised that they planted 1 621 ha of pine in 1977. Together with late advice received of plantings in earlier years, the total area planted by private interests at 31 March 1978 was 11 140 ha. Some 484 ha were lost to fires (mainly those associated with Cyclone Alby) in autumn 1978, reducing the total area of private pine forest to 10 656 ha.

A Western Chapter of the Australian Forest Development Institute (A.F.D.I.) was inaugurated in June 1977 to represent private forestry interests in this State.

The Forests Department and the A.F.D.I. organised a field day for private growers to study establishment and early tending in the Blackwood Valley pine forests.

Education

A heavy demand for speakers to primary, secondary and tertiary educational institutions was met by Departmental staff. Visual and other lecture aids were provided for various speakers.

Kimberley and Pilbara Regions

Kimberley

In early July 1977 the Government approved the establishment of a small Forests Department section in the Kimberley region.

The section will initially consist of a professional forester and two assitsants, and will be based at Kununurra.

The programme will include a broad-scale study of the composition, extent and distribution of the native woodlands of the area. Trial plots of both ornamental and commercial tree species will be established on a range of sites throughout the region.

Pilbara

In November 1977 the Department, in conjunction with the Office of Regional Administration and the North West, took over the Karratha nursery from the Shire of Roebourne.

This nursery supplied plants mainly for the townsite of Karratha, which Departmental officers have visited during the year in order to assess the success of past plantings.

Library

During the year there was a general increase in library activities, made possible by the assistance of temporary and part-time staff. However, periodical circulation was continued on a restricted basis only, owing to the increased demand for other services which often had to be given priority.

Forest Engineering

Roading

During the year 236 km of roads, tracks and firelines were constructed and 3 861 km of roads were maintained.

Plant and Equipment

Thirteen workshops staffed by a total of 40 tradesmen and 18 apprentices maintained the Departmental fleet of 415 items of automotive plant and 130 items of industrial plant.

Seven additional Holden-powered fire pumper units of 3 kl capacity, as well as one mounding plough, two mounding plough rollers, one root pruner and five tractor-mounted planting machines were made.

Housing and Building

Construction of a new Regional Headquarters at Bunbury was well advanced at the end of the year and is scheduled for completion by September 1978 to accommodate staff in administration, protection, operations, and inventory and planning in the Central Region.

New Head Office buildings to be located in the Collier Pine Plantation at Como were designed. A complex of standard modules and garden courts establishes an interesting relationship between the proposed buildings and the surrounding pine plantation.

Extensions and modifications were made to offices at Harvey, Como and Margaret River. A new regional store and single officers' quarters were completed at Manjimup.

In addition to the normal programme of housing and building maintenance, including upgrading of single men's quarters at Pemberton, a special Government fund allocation for the employment of local contractors and tradesmen increased the maintenance carried out.

Communications

Repeater Stations: The repeater system for V.H.F. was improved by fitting standard equipment at Mt. Frankland, Stewart Tower and Gloucester Tree, and was expanded to cover Narrogin. Further improvements were achieved by replacing wind generators with solar panels at five repeater stations.

Single side band transceivers (S.S.B.) operating in the high frequency band were installed at Como, Dwellingup, Kirup, Bunbury and Manjimup, replacing the Audio Modulated system. In order to reduce radio noise in Divisional offices, remote extensions were provided with telephone-type handsets. The S.S.B. radio is alerted by a tone calling system which enables each station to have its own identification number, thereby further reducing radio noise.

Some 30 V.H.F. portable kits and five portable repeaters were developed and constructed at the Communications Branch. This equipment is used in remote areas and to provide additional radio channels at prescribed burns or wildfires.

Two twin-engined aircraft and ten spotter aircraft were fitted with Departmental radios for use in control burning and fire detection.

The annual maintenance check of all vehicles wired for radio was carried out and 68 new vehicles were wired.

There is an increasing diversity of technical activities with the introduction of sophisticated navigation equipment for aerial photography, new incendiary machines for prescribed burning and various other specialised equipment requiring installation and maintenance by the Branch.

An increasing level of vandalism at many remote repeater sites is causing concern and will necessitate improved security facilities.

ADMINISTRATION

Finance

All territorial and Departmental revenue is paid into the Consolidated Revenue Fund. An allocation is made from the Consolidated Revenue Fund for Forest Maintenance and from the General Loan Fund for Forest Development and is paid into the Forestry Fund together with funds directly obtained for Forestry purposes.

Source and Application of Funds

	1977/78 $
Source	
Consolidated Revenue Fund	12 232 761
Reduction in unexpended balance	150 977
General Loan Fund	2 250 000
Commonwealth Aid Road Grant	321 849
Commonwealth Softwood Forestry Agreement	473 531*
Mining Compensation	307 998
Sundry Revenue	185 806
Conservator's Borrowings	1 000 000
	16 922 922
Application	
Forest Development	4 660 692
Forest Maintenance	12 262 230
	16 922 922

* Funded by an advance from the W.A. Government pending renewal of the Softwood Forestry Agreements Act.

Accounting Computer

Activities throughout the year centred on the design and implementation of a General Ledger System which has the following aims:—

To replace the ledger machines currently in use, which are no longer practical.

To upgrade the general management and control of accounts information in order to cope with increased demands for effective monetary/cost control, greater volumes and more urgent and timely information.

To provide for improved information retrieval, manipulation and access by utilising computer technology.

To bring about savings in staff time and effort through improved methods of entering data, less process handling, easier retrieval of reports and faster preparation of source documents.

Departmental Staff

Public Service Act

Mr. W. H. Eastman transferred to the position of Assistant Conservator—Special Duties, with particular responsibility for the Kalgoorlie and North West areas.

Mr. F. J. Campbell was promoted to the positon of Assistant Conservator.

Messrs. P. E. S. Christenson, G. W. Heberle, I. D. Scambler and R. J. Sneeuwjagt, were reclassified as Senior Divisional Forest Officers.

Messrs. D. A. Haswell, D. P. Meehan, J. H. Murch and M. E. Sanderson, were reclassified as Divisional Forest Officers.

Mr. W. E. Grove and Mr. W. S. Peart, retired from the Public Service during the year.

During the year a total of 17 new officers were appointed under the Public Service Act to fill vacant positions within the Department.

Forests Act

Mr. B. T. Cowcher was reclassified to Senior Forester.

Mr. T. J. Court was promoted to District Forester.

Mr. G. P. Nicoll resigned from the position of Project Development Officer.

Messrs. G. E. A. Barham, P. C. Choyce, A. Malajczuk, A. B. Selkirk, R. L. Starkie and D. Watson, retired from their positions with the Department.

It is with regret that the death of Mr. R. Loorits is reported.

Training Programme

During the year 12 cadets commenced the first year of training at Mt. Lawley, and 13 completed their first year and commenced their second year at Dwellingup.

Before their graduation in December the 12 1976–77 cadets received individual safety awards in recognition of two years free of accidents.

Thirty candidates were successful at the staff promotional examinations held in August.

Training schools were conducted during the year in fields such as Basic Instructor Training, Advanced Fire Courses and Safety Appreciation.

Conference and Study Tours

During the year, 16 Departmental officers attended a total of 21 interstate conferences, courses and study tours covering subjects such as pine planting techniques, softwood logging, soil erosion, fire management and water conservation.

In addition, Dr. S. R. Shea of the Dwellingup Research Station was awarded the Joseph William Gottstein Memorial Trust Fund Scholarship for travel and study in the United States and Britain. Dr. Shea undertook extensive study on the plant pathogen, *Phytophthora cinnamomi* during late February and early March 1978,

Employment in Forestry and the Timber Industry

The number of wage earners directly employed in forestry and the timber industry was estimated at 3 521, as follows:

Forestry—		
Professional officers	73	
General field staff	287	
Clerical and drafting	94	
Cadets—		
Professional	6	
Field	25	
Wages employees	545	
Contractors and employees (estimated)	20	
		1 050
Timber Industry—		
* Sawmill employees including bush workers	2 170	
Firewood and mining timber cutters and pole getters working under permits	67	
Sandalwood workers	86	
Apiarists estimated (2 002 sites registered)	148	
		2 471
		3 521

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

ACCIDENT PREVENTION

The number of compensatable injury accidents in the Forests Department continued to decrease during the year.

There were 26 accidents leading to lost time and a corresponding frequency rate of 15, the lowest figure ever recorded.

The number of man-days lost increased by 111 when compared with those for the previous year. However, of the 731 days lost, 300 days were carry-overs from accidents incurred the year before. The number of Medical Treatment accidents involving medical treatment but not lost time also decreased from 157 in the previous year to 151 in 1977/78. During the year the Walpole, Mundaring, Pemberton, Busselton, Narrogin, Nannup, Dwellingup and Kelmscott Divisions, Head Office and the Cadet Training School achieved accident-free periods of 12 months. Special mention should be made of Walpole Division, who surpassed their own previous record by completing their seventh consecutive accident-free year. This is the longest accident-free period recorded by any organisation in the Western Australian forest and timber industries.

A number of Accident Prevention Schools were conducted during the year, including two 3-day accident control courses for professional staff and Divisional Safety Officers, a defensive driving school, a karri fallers' school and a shotfirers' course.

The table below sets out in more detail the Department's Safety Record over the last 11 years.

Year	M.H.W.	L.T.A.	M.T.A.	Total Accidents	Frequency Rate			Man Days Lost	Duration Rate	Severity
					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	900
1968/69	2 019 568	96	155	251	48	76	124	1 738	18	860
1969/70	1 901 020	70	129	199	37	67	104	721	10	379
1970/71	1 808 406	48	158	206	27	76	110	458	9	253
1971/72	1 759 888	40	128	168	23	72	95	275	6	156
1972/73	1 728 577	45	112	157	26	64	90	414	9	239
1973/74	1 651 621	45	119	164	27	72	99	359	8	217
1974/75	1 748 219	55	127	182	31	72	104	634	11	362
1975/76	1 762 693	31	113	144	17·5	64	82	383	12	217
1976/77	1 707 635	32	157	189	19	92	111	620	19	363
1977/78	1 764 519	26	151	177	15	86	100	731	28	414

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

APPENDIX 1A

Statement of Revenue Paid into Consolidated Revenue Fund for the year ended June 30, 1978

1976/77	Revenue	1977/78
$		$
	Royalties	
4 438 430	Logs	4 885 803
286 514	Chip Logs	290 383
38 305	Sleepers	34 565
356 493	Poles and Piles	328 313
12 299	Mining Timber	12 709
15 577	Firewood	16 215
36 584	Posts	36 791
23 474	Sandalwood	31 358
25 854	Miscellaneous	25 959
5 233 530		5 662 096
	Pine Conversion	
1 601 875	Pine Logs	1 296 420
1 261 452	Sawn Pine	1 452 919
2 863 327		2 749 339
	Hardwood Conversion	
203 644	Sawn Hardwood	137 590
203 435	Logs	222 110
3 164	Posts and Other	4 534
410 243		364 234
	Other Sales and Fees	
112 618	Seeds and Trees	106 069
70 203	Inspection Fees	65 388
43 398	Rents and Leases	46 354
497 734	Miscellaneous	813 802
723 953		1 031 613
	Recoupable Projects	
80 819	Miscellaneous	161 068
80 819		161 068
9 311 872		9 968 350

APPENDIX 1B

Forestry Fund Account for Year ended June 30, 1978

	$	$
Expenditure—		
Hardwood Forests—Establishment and Tending		1 227 595
Softwood Forests—Establishment and Tending		2 327 307
Access Roads Construction		347 561
Land Purchases		80 638
Plant and Equipment		365 317
Housing and Buildings		188 060
Sawmilling and Seasoning Plant		124 214
Forest Protection		1 802 990
Access Roads Maintenance		495 329
Research and Other Services		922 227
Commercial Operations		2 024 155
Trade Operations		116 291
Recoupable Projects		237 236
Salaries	5 601 381	
Less Charged to Development	1 384 000	
		4 217 381
Administration Expenses	2 987 152	
Less Charged to Development	570 000	
		2 417 152
Cash Order Balance		29 469
		16 922 922
Source of Revenue—		
Balance B/F		543 381
Commonwealth Aid Road Grants		321 849
Commonwealth Softwood Agreement 1976/77		14 831
Commonwealth Softwood Agreement 1977/78		458 700
Mining Compensation		307 998
C.R.F. Contribution		12 232 761
General Loan Funds		2 250 000
Conservator's Borrowings		1 000 000
Sundry Revenue Pine Plant Disposals etc.		185 806
		17 315 326
Less Balance C/F		392 404
		16 922 922

APPENDIX 2A

Exports *from Western Australia of Timber, Tanning Substances and Essential Oils for the Year ended June* 30, 1977

	Item and Destination	Quantity	Value
		m³	$
1	Wood, in the rough or roughly squared—		
	Conifer	....	....
2	Wood, in the rough or roughly squared, non-conifer (including poles, piling, posts and other wood in the rough)—		
	Interstate—		
	Victoria	153	10 653
	South Australia	118	10 628
	Total	271	21 281
	Overseas—		
	China—Taiwan Prov. only	43	4 300
	U.S.A.	....	65
	Total	43	4 365
3	Sleepers—		
	Interstate—		
	South Australia	5 508	783 225
	Total	5 508	783 225
	Overseas—		
	Christmas Island	240	489
	Hong Kong	1 439	253 442
	South Africa, Rep. of	9 305	1 035 472
	Sweden	12	1 382
	United Kingdom	19 428	2 912 353
	Total	30 424	4 203 138
	Timber sawn lengthwise, sliced or peeled, but not further prepared, of a thickness exceeding 5 mm—Non-conifer.		
4	Jarrah—		
	Interstate—		
	New South Wales	541	59 745
	Victoria	1 856	198 256
	South Australia	11 549	1 241 649
	Northern Territory	120	40 203
	Total	14 066	1 539 853
	Overseas—		
	Bahrain	8	2 889
	Christmas Island	4	986
	Greece	21	5 897
	Libyan Arab Republic	16	2 976
	Mauritius	14	2 147
	Netherlands	30	5 188
	South Africa, Rep. of	992	181 787
	United Kingdom	61	11 428
	U.S.A.	9	2 407
	Total	1 155	215 705
5	Karri—		
	Interstate—		
	New South Wales	4 339	477 065
	Victoria	279	32 223
	South Australia	13 638	1 520 716
	Northern Territory	426	46 327
	Total	18 682	2 076 331
	Overseas—		
	Canada	35	7 622
	Germany, Fed. Rep. of	475	75 671
	South Africa, Rep. of	1 533	253 274
	South West Africa	15	2 010
	United Kingdom	741	108 102
	U.S.A.	601	146 430
	Total	3 400	593 109
6	Other—		
	Interstate—		
	Overseas—		
	Bahrain	19	5 746
	Malaysia	....	44
	Singapore, Republic of	....	50
	Total	19	5 840
	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—		
7	Flooring—		
	Interstate (*a*)—		
	New South Wales	1 851	307 840
	Victoria	1 143	223 152
	South Australia	524	96 403
	Northern Territory	153	45 370
	Total	3 671	672 765
	Overseas (*b*)—		
	Christmas Island	4	455
	Total	4	455
8	Other (*c*)—		
	Interstate—		
	Northern Territory	3	931
	Total	3	931
	Overseas—		
	Christmas Island	7	2 533
	Greece	16	5 328
	Italy	26	5 292
	Libyan Arab Republic	21	8 688
	United Kingdom	36	11 186
	Total	106	33 027
	Total Timber Items 1-8	77 352	10 150 025
		m²	$
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—		
	Interstate	N.R.S.	N.R.S.
	Overseas—		
	Ireland	583	1 300
	Singapore, Republic of	3 395	8 370
	United Kingdom	1 340	5 522
	Total	5 318	15 192
10	Reconstituted wood (also known as particle board, chip board, sliver board, shaving board, flake board, residue board and wood waste board)—		
	Interstate	(*d*)	(*d*)
	Overseas	(*d*)	(*d*)
11	Casks, vats, barrels, etc., Empty (*e*)—		
	Overseas—		
	United Kingdom	....	9 007
	Total	....	9 007
12	Manufacturers of wood (except furniture), N.E.I. (*f*)—		
	Interstate—		
	New South Wales	....	8 819
	Victoria	....	108 794
	Queensland	....	18 255
	South Australia	....	37 180
	Tasmania	....	795
	Northern Territory	....	2 187
	Total	....	176 030
	Overseas—		
	Christmas Island	....	3 527
	Hong Kong	....	284
	Netherlands	....	200
	South Africa	....	240
	United Kingdom	....	125
	U.S.A.	....	568
	Total	....	4 944
13	Tanning substances of natural origin—	N.R.S.	N.R.S.
		kg	$
14	Essential oils; concretes and absolutes; resinoids—		
	Interstate—		
	Victoria	4 610	41 744
	Queensland	484	3 983
	Total	5 094	45 727
	Overseas—		
	Singapore	15	40
	Total	15	40
	Total value of exports on this return	....	10 400 965

(*a*) Relates to interstate exports of non-conifer flooring only.
(*b*) Relates to overseas exports of conifer flooring only. Overseas exports of non-conifer flooring included in Item 8.
(*c*) See Footnotes (*a*) and (*b*). Item also includes conifer timber, sawn lengthwise, sliced or peeled, but not further prepared, of a thickness exceeding 5mm
(*d*) Details not available for publication.
(*e*) Interstate exports included in Item 12.
(*f*) Includes cork manufactures.

"N.E.I." means "not elsewhere included".
"N.R.S." means "not recorded separately".
Basis of Value—F.O.B. at point of final shipment.
(Information supplied by the Australian Burea of Statistics)

APPENDIX 2B

Imports *into Western Australia of Timber, Timber Products, Tanning Substances and Essential Oils for the Year ended June* 30, 1977

	Item and Origin	Quantity	Value
		m³	$
1	Sawlogs and veneer logs, in the rough or roughly squared, non-conifer, (including poles, piling, posts and other wood in the rough) (*a*)—		
	Overseas	(*b*)	(*b*)
2	Railway Sleepers—		
	Overseas—	....	....
	Timber, sawn lengthwise, sliced or peeled, but not further prepared, of a thickness exceeding 5 mm—Conifer (*c*)—		
3	Douglas Fir (*d*)—		
	Overseas—		
	New Zealand	72	7 679
	U.S.A.	1 179	244 929
	Total	1 251	252 608
4	Other—		
	Interstate (*e*)—		
	South Australia	232	47 176
	Total	232	47 176
	Overseas—		
	New Zealand	184	12 362
	South Africa, Rep. of	18	1 534
	U.S.A.	245	51 147
	Total	447	65 043
	Timber, sawn lengthwise, sliced or peeled, but not further prepared, of a thickness exceeding 5 mm—Non-Conifer (*c*)—		
5	Meranti (*f*)—		
	Overseas—		
	Indonesia	109	13 214
	Malaysia	4 015	396 747
	Singapore, Rep. of	652	54 597
	Total	4 776	464 558
6	Ramin (*f*)—		
	Overseas—		
	Indonesia	29	3 353
	Malaysia	655	93 406
	Singapore, Rep. of	702	96 572
	Total	1 386	193 331
7	Teak (*f*)—		
	Overseas—		
	Thailand	384	175 857
	Total	384	175 857
8	Kapur (*f*)—		
	Overseas—		
	Indonesia	40	3 395
	Malaysia	6 950	714 622
	Singapore, Rep. of	403	42 045
	Total	7 393	760 062
9	Keruing (*f*)—		
	Overseas—		
	Indonesia	8	826
	Malaysia	7 847	650 765
	Singapore, Rep. of	163	9 924
	Total	8 018	661 515
10	Nyatoh (*f*)—		
	Overseas—		
	Indonesia	23	2 911
	Malaysia	16 361	2 010 318
	Singapore, Republic of	152	21 458
	Total	16 536	2 034 687
11	Other (*g*)—		
	Interstate—		
	Victoria	24	3 638
	South Australia	57	8 526
	Total	81	12 164
	Overseas—		
	Indonesia	3 377	170 236
	Malaysia	2 604	245 598
	Philippines, Rep. of the	85	5 699
	Singapore, Republic of	92	11 405
	U.S.A.	35	8 199
	Total	6 193	441 137
12	Shooks and staves, sawn lengthwise, sliced or peeled, but not further prepared of a thickness exceeding 5 mm (*h*)—		
	Overseas	....	....
13	Wooden beadings and mouldings (including moulded skirting and other moulded boards) (*i*)—		
	Overseas—		
	Belgium-Luxembourg	....	828
	Canada	....	14 487
	China—Taiwan Prov. only	....	8 902
	Germany, Fed. Rep. of	....	21 639
	Italy	....	4 068
	Japan	....	12 394
	Malaysia	....	24 591
	Singapore, Republic of	....	7 243
	South Africa, Rep. of	....	4 789
	United Kingdom	....	33 543
	U.S.A.	....	1 727
	Total	....	134 211
	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—		
14	Flooring (*j*)—		
	Overseas—		
	U.S.A.	1	1 725
	Total	1	1 725
15	Other—		
	Interstate (*k*)—		
	Overseas—		
	China—Taiwan Prov. only	12	2 736
	Germany, Fed. Rep. of	3	3 971
	Indonesia	109	9 373
	Malaysia	2 507	508 570
	New Zealand	131	11 089
	Singapore, Republic of	91	18 934
	South Africa, Rep. of	25	6 095
	Thailand	....	15
	U.S.A.	239	30 864
	Total	3 117	591 647
	Total Timber Items 2-15	....	5 835 721
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—	m²	$
	Interstate—		
	New South Wales	118 214	362 012
	Victoria	97 139	270 520
	Queensland	174 359	438 883
	South Australia	115 813	162 946
	Total	505 525	1 234 361
	Overseas—		
	Brazil	....	48
	China—Taiwan Prov. only	3 639 589	1 035 862
	Fiji	181 552	76 158
	Finland	6 421	2 320
	Germany, Fed. Rep. of	510	1 142
	India	....	41
	Italy	15 490	11 390
	Korea, Rep. of	343 657	97 597
	Malaysia	322 432	66 566
	Singapore, Republic of	927 386	417 519
	South Africa, Rep. of	203 142	77 351
	Thailand	22 214	26 418
	United Kingdom	7 484	8 947
	Total	5 669 877	1 821 359
17	Reconstituted wood (also known as particle board, chip board, sliver board, shaving board, flake board, residue board and wood waste board)—		
	Interstate (separate State details not available for publication)		
	Total	1 408 851	4 259 707
	Overseas—		
	Korea, Rep. of	....	27 922
	Sweden	....	21 591
	Total	....	49 513
	Total Timber Items 16-17	....	7 364 940
	Total Timber Items 2-17	....	13 200 661
18	Match splints (*i*)—		
	Overseas—	....	....
19	Rulers, Wooden (*a*)—	Number	
	Overseas—		
	Netherlands	490	614
	United Kingdom	1 952	3 701
	Total	2 442	4 315
20	Table mats, Wooden	N.R.S.	N.R.S.
21	Wood Flour (*i*)—		
	Overseas—	....	....
22	Clothes Pegs, Wooden	N.R.S.	N.R.S.
23	Tool handles, Wooden		
	Interstate (*k*)—		
	New South Wales	....	1 914
	Victoria	....	2 366
	Queensland	....	118 747
	South Australia	....	451
	Total	....	123 478

APPENDIX 2B—*continued*

Imports *into Western Australia of Timber, Timber Products, Tanning Substances and Essential Oils for the Year ended June* 30, 1977

	Item and Origin	Quantity	Value
		Number	$
	Overseas—		
	France	4	1
	Germany, Fed, Rep. of	147	73
	Switzerland	24	2
	United Kingdom	40	19
	U.S.A.	16 263	18 588
	Total	16 478	18 683
24	Doors not incorporating locks, hinges or similar fittings—		
	Interstate—		
	New South Wales	44 011	1 163 288
	Victoria	792	7 919
	South Australia	54 103	390 189
	Total	98 906	1 561 396
	Overseas—		
	Canada	16	1 843
	China—Taiwan Prov. only	89 374	444 373
	India	3	1 312
	Malaysia	30	906
	Total	89 423	448 434
25	Manufactures of wood (except furniture) N.E.I. (*m*)—		
	Interstate—		
	New South Wales	....	432 132
	Victoria	....	1 038 376
	Queensland	....	166 640
	South Australia	....	256 870
	Tasmania	....	486
	Total	....	1 894 504
	Overseas—		
	Belgium-Luxembourg	....	1 560
	Bulgaria	....	75
	Canada	....	263 795
	China-Excl. Taiwan Prov.	....	2 834
	China-Taiwan Prov. only	....	279 925
	Denmark	....	22 337
	Ecuador	....	2
	Finland	....	4
	France	....	39
	Germany, Fed. Rep. of	....	1 900
	Hong Kong	....	19 081
	India	....	12 549
	Indonesia	....	5 318
	Italy	....	20 745
	Japan	....	29 457
	Korea	....	765
	Malaysia	....	15 907
	Mexico	....	239
	Morocco	....	21
	Netherlands	....	2 127
	New Zealand	....	12 451
	Norway	....	501
	Pakistan, Islamic Rep. of	....	113
	Papua, New Guinea	....	497
	Philippines, Rep. of the	....	118 190
	Poland	....	112
	Portugal	....	34
	Singapore, Rep. of	....	19 144
	South Africa, Rep. of	....	80
	Spain	....	14 184
	Sri Lanka	....	730
	Swaziland	....	22
	Sweden	....	125 714
	Switzerland	....	309
	Tanzania	....	4 669
	Thailand	....	60 219
	United Kingdom	....	28 249
	U.S.A.	....	226 761
	U.S.S.R.	....	297
	Yugoslavia	....	14
	Total	....	1 290 970
26	Furniture, wood or wood framed (*n*)—		
	Interstate—		
	New South Wales	....	599 815
	Victoria	....	1 792 864
	Queensland	....	1 759
	South Australia	....	1 343 994
	Tasmania	....	1 091
	Total	....	3 739 523
	Overseas—		
	Australia (Re-imported)	....	32
	Belgium-Luxembourg	....	13 984
	China-Excl. Taiwan Prov.	....	33 118
	China-Taiwan Prov. only	....	835 905
	Denmark	....	17 464
	Finland	....	2 645
	France	....	4 359
	Germany, Fed, Rep. of	....	42 747
	Hong Kong	....	75 449
	India	....	13 031
	Indonesia	....	295
	Iran	....	27
	Israel	....	58
	Italy	....	307 425
	Japan	....	89 647
	Korea, Rep. of	....	23 179
	Malaysia	....	80 342
	Netherlands	....	4 861
	New Zealand	....	14 045
	Norway	....	3 183
	Pakistan, Islamic Rep. of	....	457
	Papua New Guinea	....	53
	Philippines, Rep. of the	....	25 732
	Poland	....	586
	Singapore, Rep. of	....	184 974
	South Africa, Rep. of	....	11 730
	Spain	....	7 180
	Sri Lanka	....	644
	Sweden	....	1 863
	Tanzania	....	295
	Thailand	....	6 538
	United Kingdom	....	668 076
	U.S.A.	....	82 783
	U.S.S.R.	....	4
	Yugoslavia	....	23 117
	Total	....	2 575 828
27	Tanning Extracts of Vegetable Origin		
	Wattle Bark Extracts (*o*)—	kg	
	Overseas—		
	South Africa, Rep. of	945 000	350 182
	Total	945 000	350 182
28	Other (*o*)—		
	Overseas—		
	Italy	26 400	16 262
	United Kingdom	5 524	5 829
	Total	31 924	22 091
29	Synthetic Tanning Substances, Artificial Bates for Pre-Tanning; Tanning (Tannic Acids) and their Salts, Esters and Other Derivatives—		
	Interstate (*p*)—		
	New South Wales	37 373	80 910
	Victoria	122 204	114 237
	Queensland	5 756	6 274
	South Australia	240	175
	Total	165 573	201 596
	Overseas—		
	Belgium-Luxembourg	2 000	10 754
	United Kingdom	9 921	19 196
	Total	11 921	29 950
30	Essential Oils; concretes and absolutes; resinoids—		
	Interstate—		
	New South Wales	119	1 035
	Victoria	3 765	37 198
	South Australia	591	862
	Total	4 475	39 095
	Overseas—		
	United Kingdom	1	48
	Total	1	48
	Total value of imports on this return	....	25 500 754

(*a*) Interstate imports are not recorded separately.
(*b*) Details are confidential, included in Item 11.
(*c*) Overseas imports exclude shooks and staves—see Item 12.
(*d*) Interstate imports included in Item 4.
(*e*) See Footnote (*d*). Item also includes imports of conifer timber, planed tongued, grooved or the like.
(*f*) Interstate imports included in Item 11.
(*g*) See Footnote (*b*) and (*f*).
(*h*) Interstate imports included in Item 4 (Conifer) and Item 9 (Non-conifer).
(*i*) Interstate imports included in Item 25.
(*j*) Figures relate to overseas imports of conifer flooring only, interstate imports of flooring included in Item 4 (Conifer) and Item 15 (Non-conifer).
(*k*) Relates to non-conifer timber only. All conifer timber, planed, tongued, grooved, etc. included in Item 4.
(*l*) Includes Brush and broom handles and the like.
(*m*) Includes imports of wooden packing cases, casks, domestic articles of wood, and similar products.
(*n*) Excludes imports, if any, of wooden medical, dental, surgical or veterinary furniture, non-domestic wooden chairs, and wooden legs imported separately as parts.
(*o*) Interstate imports included in Item 29.
(*p*) See Footnote (*o*).

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

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

APPENDIX 3

SUMMARY OF EXPORTS OF FOREST PRODUCE

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†				

* Tanning materials not recorded separately since 1967.
† Not Available.

APPENDIX 4

SUMMARY OF IMPORTS OF FOREST PRODUCE

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†			

† Not available.

APPENDIX 5

SUMMARY OF LOG PRODUCTION

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	1 459 978
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

* Includes 18 783 746 cubic metres 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 PAPERS AND BULLETINS PUBLISHED DURING THE YEAR ENDED JUNE 30, 1978.

Research Papers

27—A. B. Hatch, Yoke Lin Wong and Colleen Stone	A comparison of several techniques for the microestimation of sulphate in water samples. 1976.
28—E. J. Herbert and P. Ritson	Small streamflow measurements in the northern jarrah forest, Western Australia. 1976.
29—D. Ward	Tree removal and salinity in Helena Catchment, Western Australia. 1977.
30—A. B. Hatch and S. R. Shea	Water quality in Allan Road Catchment, Western Australia. 1977.
31—R. Hindmarsh and J. D. Majer	Food requirements of mardo (*Antechinus flavipes* (Waterhouse)) and the effect of fire on mardo abundance. 1977.
32—E. J. Herbert, S. R. Shea and A. B. Hatch	Salt content of lateritic profiles in the Yarragil Catchment, Western Australia. 1978.
33—F. E. Batini, A. B. Hatch and A. B. Selkirk	Variations in level and salinity of perched and semi-confined groundwater tables, Hutt and Wellbucket experimental catchments. 1977.
34—J. McGrath	Phosphate and zinc nutrition of young *Pinus radiata* D.Don in the Donnybrook Sunkland. 1978.
35—A. B. Hatch, Y. L. Wong and C. P. Stone	Variation in surface water pH in forest catchments in Western Australia. 1978.
36—P. M. Jones	The development of an electrical ignition system for forest regeneration burning. 1978.
37—P. C. Kimber	Increased girth increment associated with crown scorch in jarrah. 1978.
38—P. Christensen and P. Skinner	The ecology of *Boronia megastigma* (Nees.) in Western Australian forest areas. 1978.
39—F. E. Batini	Screening of *Pinus pinaster* Ait. seedlings for resistance to *Phytophthora cinnamomi* Rands in pot trials. 1978.
40—C. J. Schuster	A preliminary investigation of the relationship between *Phytophthora cinnamomi* and soil types in the southern forests of Western Australia. 1978.
41—R. J. Underwood	Natural fire periodicity in the karri (*Eucalyptus diversicolor* F. Muell.) forest. 1978.

Bulletins

89—A. B. Hatch....	Some chemical properties of forest stream waters in Western Australia. 1976.

106247/10/78—950 WILLIAM C. BROWN, Government Printer, Western Australia