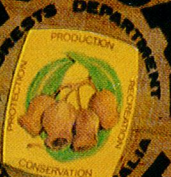




1979 ANNUAL REPORT



PLUMB
U. S. A.



*Forests Department
PERTH, W.A. 6000*

THE HON. 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, 1979.

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

Front Cover:

The old and the new. The old broad-axe carries the reflection of one of the modern Tree Harvester logging machines. Photograph of JD 743 Tree Harvester supplied courtesy of Chamberlain John Deere Pty Ltd.

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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	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	F. H. McKinnell, Ph.D. (A.N.U.), B.Sc. (For.), Dip. For. (Canb.)
Superintendent	P. N. Hewett, B.A., B.Sc. (Adel.), Dip. For. (Canb.)
Superintendent	A. C. van Noort, B.Sc. (For.), Dip. For. (Canb.)
Chief Draftsman (Acting)	D. E. Cox, M.A.I.C., Dip. Cart.
Secretary	K. G. Hide, B.A., Dip. Pers. Mgt.
Accountant	V. K. Combs, A.A.S.A., A.P.A.A., A.A.I.M.

*As at 30 June, 1979

STATISTICAL SUMMARY OF MAJOR OPERATIONS

Sawn Wood Production

Total Production of Sawn Timber 349 280 m³

Trends in Production and Consumption

Year ended 30 June	Production (cubic metres)				Total Export	Local Avail- ability	Number of Sawmills	Monthly Average No. of Employees
	Hardwood	Softwood	Hewn Hardwood	Total				
1938	331 928	.....	72 883	404 811	213 695	191 116	134	3 112
1946	251 194	.....	398	251 592	95 524	156 068	128	2 876
1951	356 029	.....	33	356 062	66 339	289 723	256	4 047
1956	544 134	.....	150	544 284	129 367	414 917	274	5 804
1960	470 833	.....	.....	470 833	174 643	296 180	265	5 037
1965	460 246	22 667	.....	482 913	133 565	349 348	206	3 615
1966	475 642	16 499	.....	491 141	68 885	423 256	203	3 518
1967	461 176	17 085	.....	478 261	138 723	339 537	202	3 173
1968	469 818	16 531	.....	486 349	84 569	401 779	188	3 209
1969	413 666	19 643	.....	433 309	86 455	346 854	191	3 233
1970	425 295	16 893	.....	442 188	96 275	345 914	163	2 869
1971	420 777	21 595	.....	442 372	79 437	362 935	150	2 401
1972	379 006	21 733	.....	400 739	101 191	299 548	154	2 533
1973	375 135	23 283	.....	398 418	111 547	286 871	145	2 825
1974	374 899	26 534	.....	401 433	98 200	303 233	140	2 215
1975	368 844	27 086	.....	395 930	100 127	295 803	129	2 228
1976	383 010	16 258	.....	399 268	94 136	305 132	129	2 211
1977	369 151	16 685	.....	385 836	77 352	308 484	136	2 242
1978	347 111	18 669	.....	365 780	58 833	306 947	139	2 170
1979	331 135	18 145	.....	349 280	N/A	N/A	133	2 033

Log Production* (m³)

	Crown Land	Private Property
Saw Logs Hardwood	858 474	123 538
Saw Logs Softwood	51 261	6 127
Other Logs Hardwood	454 096	.....
Other Logs Softwood	125 683	.....

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

Forest Area

Total Area of State forest	1 854 173 ha
Additions to State forest	301 ha
Excisions from State forest	4 ha
Land purchased for pine planting	Nil

Pine Establishment

Areas planted with pines 1978	2 810 ha
<i>Pinus radiata</i>	2 254 ha*
<i>Pinus pinaster</i> and other species	556 ha

* Includes 333.5 ha of replanting areas burnt by fires associated with cyclone Alby.

Total area of pine plantation established as at 31 December 1978	45 731 ha
<i>Pinus radiata</i>	22 284 ha
<i>Pinus pinaster</i> and other species	23 447 ha
Total experimental areas (additional)	465 ha

Management

Area covered by hardwood assessment	74 000 ha
Engineering, new works—	
Roads and tracks	308 km
Houses	1

Protection

Area of prescribed burning	337 335 ha
Fire outbreaks—	
Number of fires	235
Area burnt	2 992 ha

Nurseries (Hamel and Narrogin)

Produced for private buyers	.....	.....	.....	.....	.....	.....	.....	.....	242 128 trees
Produced for Forests Department	305 469 trees

Sandalwood

Quantity exported	1 501.5 t
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Chiplogs (hardwood)

Quantity produced	454 096 m ³
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THE FOREST AREA

State Forest (Forests Act 1918-1976)

The area of State forest at 30 June 1979 was 1 854 173 ha, an increase of 297 ha compared with the area at 30 June, 1978.

Timber Reserves (Forests Act 1918-1976)

The area held under Timber Reserves at 30 June, 1979 was 118 401 ha, an increase of 884 ha compared with the area at 30 June, 1978.

Freehold land held at 30 June, 1979 in the name of the Conservator of Forests totalled 26118 ha.

Land Alienations and Leases

There were 52 applications for alienations during the year involving 6 679 ha and 13 applications for forest leases involving 764 ha.

During the year the Department agreed to the following:

(a) *Alienations*

Timber zone—		Number	Area (ha)
State forest	.....	2	539
Crown land	.....	3	45
Outside timber zone	.....	1	3 000

(b) *Leases*

Timber zone—			
State forest	.....	11	162
Crown land	.....	1	476
Outside timber zone	.....	.....	.....

	30 June 1978	30 June 1979	Change
	(ha)	(ha)	(ha)
State forest (Forests Act 1918-1976)	1 853 876	1 854 173	*297
Timber Reserves (Forests Act 1918-1976)	117 517	118 401	*884
Freehold land held in the name of the Conservator of Forests	26 212	26 118	†94
	1 997 605	1 998 692	*1 087

* Increase. † Decrease.

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

Type	Area (ha)
Jarrah	1 449 000
Karri	140 000
Wandoo	106 000
Mallet	10 000
Tuart	3 000
Goldfields species	30 000
<i>Pinus radiata</i>	22 000
<i>Pinus pinaster</i>	24 000
Very open areas	215 000
	1 999 000

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.

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.

LAND MANAGEMENT

System 6 Participation

System 6 extends from the wheatbelt to the Indian Ocean between Moore River in the north and Blackwood River in the south.

The vegetation maps for System 6, prepared by Departmental officers, have reached the printing stage. They comprise 3 map sheets at a scale of 1:250 000 and cover the entire area (2 600 000 ha).

Pictorial representation of the very large number of vegetation complexes described proved a difficult task but the maps provide a comprehensive overview of the vegetation of the region.

The vegetation maps, together with corresponding maps depicting the geology, geomorphology, pedology and land use in the region, have been the basis for recommendations to System 6 and evaluation of the economic impact of the proposals, in which departmental officers were heavily involved. This work is now largely completed and the activity is now concentrated in the Conservation and Land Use Committee, whose task is to examine and reconcile conflicting demands.

The Forests Department General Working Plan No. 86 of 1977 classified some 20 per cent of State forests and Timber Reserves of System 6 as Management Priority Areas for flora and fauna conservation. The selection of the Management Priority Areas was directed to adequate coverage of the full range of vegetation types and long term protection against adverse factors, in particular the dieback disease caused by *Phytophthora cinnamomi*. The Management Priority Areas will be subject to review in the System 6 study.

Land Use Management Plans

A draft land use management plan for the northern jarrah forest was prepared by the Department and circulated to 13 government agencies and C.S.I.R.O. for comment. Generally, the response was excellent and subsequent discussions led to incorporation of the requirements of these bodies in the draft.

It is now intended to produce land use plans for the central and southern forest regions. These should enable the whole of the State forest to be reviewed from a land use management concept during preparation of the next General Working Plan.

The concept of land use management plans was found acceptable to members of the Mining and Management Liaison Committee set up to guide mining developments on State forest and was used to assist evaluation of bauxite mining proposals for the Wagerup project. The Group has also shown interest in examples of a computerised map information and display system (MIADS) and McHarg overlays used by the Department to test procedures suitable to detailed planning.

A Departmental planning officer was co-opted by the Technical Advisory Group set up by the Environmental Protection Authority to assist in appraising plans for bauxite mining in the Darling Range.

THE ESTABLISHMENT AND TENDING OF FORESTS

Jarrah Forest

Extensive stand improvement operations were suspended in 1974 because of the threat posed by dieback disease and the need to ascertain boundaries of areas proposed to be mined for bauxite. There is now evidence to indicate that the provision of an understorey of selected leguminous species may afford some degree of resistance to the disease. Long term mining proposals have now also become much better defined. In view of these facts, a forest improvement and reforestation scheme (FIRS) has re-commenced in conjunction with ALCOA.

Two hundred and forty hectares of a 500-hectare trial area in the catchment of the Wungong Brook have been treated to favour water production with timber production as a compatible use. ALCOA of Australia has funded this operation in areas adjacent to mining operations and the Forests Department has carried out the treatment.

The area adjoins the Seldom Seen tributary of the Wungong Brook and was selected because effects of the treatment can be examined against previous records of vegetative cover from aerial photographs dating back to 1941 and records of water quantity and quality.

The treatment includes erosion control, reduction of *Banksia grandis* (a host plant for *Phytophthora cinnamomi*), thinning of jarrah and marri regrowth, and rehabilitation of dieback sites including some tree planting and understorey enrichment with selected legumes.

In addition, 152 ha of dieback affected forest has been rehabilitated in areas not proposed for bauxite mining elsewhere.

Karri Forest

A large regeneration programme in cut-over karri and karri-marri forest was successfully achieved in 1978.

During winter 1978 a total of 1 999 ha were regenerated by various methods. Due to a poor karri seed crop only 288 ha were established naturally using seed trees. Three hundred and fifty ha were broadcast seeded by hand resulting in a most satisfactory plant stocking. One thousand three hundred and sixty-one ha were hand planted and fertilised. Planting assessments indicated excellent survival rates for all coupes. Operational trials of aerial seeding were conducted with considerable success in May, 1979.

Planting stock for this large programme was raised at the West Manjimup nursery. Three million plants were grown—an increase of 20 per cent on the previous year.

Rehabilitation Work

A large programme of rehabilitation work took place on karri logging landings and associated snig tracks. Some 247 landings and associated snig tracks were ripped and replanted. Arrangements have been made for the preparatory work to be continued by the industry.

To cater for the increased rehabilitation of landings and gravel pits, a total of 380 000 containerised karri plants was raised at West Manjimup nursery in 1979, an increase of more than 100 per cent on the previous year.

Wandoo Forest

One hundred and forty hectares of wandoo forest have been prepared for regeneration in a trial area within the Helena Catchment. This area will also be used to study the effect on the ground-water table of a heavy cutting regime.

In the Julimar State forest, two hectares of forest which have been affected by salinity from adjacent farms have been planted with salt tolerant species *Eucalyptus camuldensis*, *E. sargenti* and *Tamarix articulata*.

Mallet Forest

Dryandra contains the bulk of mallet forest under Departmental control. The area was managed for flora and fauna conservation the continuation of which has been recommended by the Environment Protection Authority.

Treatments included re-introduction of wandoo into areas where mallet was planted outside its normal soil range and experimental burning to increase the diversity of understorey species.

Thinning to produce mallet posts and mallet tool handle material was carried out on 318 ha and 118 ha respectively.

Tuart Forest

Regeneration in the tuart forest included clearing and burning of the peppermint understorey and replanting tuart on some 25 ha of resulting ashbed.

Softwood Forest

Pine Planting

During the year the Department planted 2 810 ha including 335 ha of replanting of areas destroyed by fires associated with Cyclone Alby. The total area of State pine plantations is now 45 731 ha. Some 153 ha of mature plantation were clear felled.

Planting fell somewhat short of the target of 3 000 ha due to limitations on available finance.

Tending Pine Plantations

During the year the following plantation tending was carried out:

	ha
Scrub control	3 006
Fertilising with Superphosphate and/or Agras	2 801
Fertilising with minor elements	1 439
High pruning	4 090
Low pruning	3 952
Culling	4 062
Non-commercial thinning	979

Departmental Plantation Areas

The areas of plantations (by Divisions) as at December 1978 were as follows:

AREAS OF PLANTATIONS (ha)

Division	<i>P. radiata</i>	<i>P. pinaster</i> and other species	Total
Wanneroo	747.0	17 904.4	18 651.4
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	3 384.2	2 244.5	5 628.7
Collie	2 368.7	83.5	2 452.2
Kirup	6 092.3	77.3	6 169.6
Nannup	6 049.8	109.4	6 159.2
Busselton	1 454.4	1 174.2	2 628.6
Manjimup	207.9	.....	207.9
Pemberton	207.6	44.2	251.8
Total	22 284.6	23 447.0	45 731.6
Experimental Planting	226.1	238.6	464.7
Grand Total	22 510.7	23 685.6	46 196.3

Areas planted in 1978 totalling 2 810 ha are detailed below:

1978 PLANTING (ha)

Division	<i>P. radiata</i>	<i>P. pinaster</i> and other species	Total
Wanneroo .....	.....	509.5	509.5
Harvey	234.7	.....	234.7
Collie	186.6	.....	186.6
Kirup	617.1	.....	617.1
Nannup	745.8*	.....	745.8
Busselton	469.8	46.5	516.3
Total	2 254.0*	556.0	2 810.0

* Includes 333.5 ha of replanting areas destroyed by fires associated with Cyclone Alby.

Tree Nurseries

Forests Department nurseries at Hamel and Narrogin sold some 242 128 trees for shelter and amenity planting in rural areas.

A further 305 469 trees, mainly eucalypts, were raised for Departmental use for rehabilitation of forest areas affected by dieback and mining operations.

Nursery production for the year is summarised in the following table.

NUMBER OF TREES SUPPLIED

Nursery	For Sale				Departmental Use	Total Plants
	Pots	Trays	Open rooted	Total	Eucalypts	
Hamel	63 459	37 715	27 593	128 767	289 195	417 962
Narrogin	95 491	6 570	11 300	113 361	16 274	129 635
Total	158 950	44 285	38 893	242 128	305 469	547 597

Seed Collection and Use

Seed was collected from Departmental seed orchards, high quality plantations, State forests, and Timber Reserves.

The value of sales from the seed store was \$7 681 for the year. Some re-organisation of seed collection and processing occurred, and an improved package of seed for public sales was adopted.

RESOURCE MANAGEMENT

Water

Most of the managed water supplies in the south west of Western Australia arise from catchments on State forests. For this reason the Department continues to place a high priority on catchment management.

Close co-operation and liaison continued with the Metropolitan Water Supply, Sewerage and Drainage Board (M.W.S.S. & D.B.) in the use of groundwater in the Gnangara Mound. To minimise the impact of water withdrawal on the productivity of pine plantations and to maximise the replenishment of shallow aquifers, early, heavy thinning of young stands was carried out.

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 respectively with the effects of bauxite mining and logging operations in the karri region. Both committees published progress reports in the current year. Departmental contributions to the joint research efforts are dealt with in the research section of this report.

A Departmental representative participated in meetings of the Water Resources Council, and other officers briefed the Council on a number of aspects of catchment management during an extensive field trip.

Wood Production

Timber Production

During the year 29 392 ha of hardwood forest were cut over for sawlogs.

Jarraah forest	ha
	25 541
Karri forest—	
(i) clear felled or cut to seed trees	2 707
(ii) removal of seed trees	607
(iii) thinnings	12
Wandoo forest	525

The production of 349 280 m³ of sawn timber, including hardwood and softwood, was a decrease of 16 500 m³ from the previous year's figure. Of the total output, 40 864 m³ came from private property, an increase of 542 m³ on the 1977-78 figure.

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, three sawmills operating on Crown land, closed during the year.

The annual intake of logs for the period 1968-1979 is given in Appendix 5.
Local plywood factories obtained the following quantities of peeler logs:

							m ³
Karri	.....	.....	.....	.....	.....	.....	2 071
Jarrah	.....	.....	.....	.....	.....	.....	.....
Pine	.....	.....	.....	.....	.....	.....	1 837
Total	.....	.....	.....	.....	.....	.....	3 908

Timber inspection

The total quantity of timber inspected during the year was 75 315 m³, as follows:

Railway Sleepers—						m ³
Ex Crown land	.....	.....	.....	.....	.....	45 905
Ex private property	.....	.....	.....	.....	.....	7 755
Re-inspected	.....	.....	.....	.....	.....	.....
						53 660
Other sawn timber	.....	.....	.....	.....	.....	21 655

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

Year Ended 30 June	From Crown lands		From Private property		Total Quantity
	Sawn Timber other than Sleepers	Sawn Sleepers	Sawn Timber other than Sleepers	Saw Sleepers	
1978 m ³	288 982	35 392	35 225	6 181	365 780
1979 m ³	262 511	45 905	33 109	7 755	349 280

PRODUCTION OF LOG TIMBER FOR YEAR ENDED 30 JUNE, 1979 EXCLUSIVE OF MINING TIMBER, FIREWOOD, POLES AND PILES

Tenure	Sawlog volume by species (1) (m ³)								Total	Other log material (2) (m ³)		Total (m ³)	Grand Total (m ³)
	Jarrah	Karri	Wandoo	Yarri	Sheoak	Marri	Pine	Other		Hard-wood	Pine		
Crown land	537 932	306 079	3 047	1 001	839	7 238	51 261	2 338	906 833	454 096	125 683	579 779	1 489 515
Private property	74 417	27 579	3 535	1 431	.....	.....	6 127	1 148	114 424	15 241	.....	15 241	129 665
Total	612 349	333 838	6 582	2 432	839	7 245	57 388	3 486	1 021 257	469 337	125 683	595 020	1 619 180

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

Woodchip Operations

A total of 454 096 m³ 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 78 per cent marri and 22 per cent karri.

This material, unsuitable for sawmilling, came from a total area of 3 642 ha of which 3 271 ha were marri-karri forest and 371 ha were of jarrah-marri forest.

In addition sawmills supplied 114 766 tonnes of chips prepared from offcuts, an increase of 25 376 tonnes over the previous year.

Sandalwood

Exports for the year amounted to 1 501.5 tonnes.

Sandalwood received at the Spearwood depot of the Australian Sandalwood Co. Ltd. during the 1978-79 year totalled 1 364.37 tonnes, compared with 1 475 tonnes for the previous year.

These totals may be broken down as follows:

Sandalwood from Crown land—	1977-78	1978-79
Green sandalwood—	tonne	tonne
Logwood (including roots and butts)	618	781
Dead sandalwood—		
Burnt wood	120	99
Cleaned wood	30	26
Pieces	686	431
Sandalwood from private property	21	27
Total	1 475	1 364

In addition to those producers who are pulling sandalwood as a regular business, a number of pastoral leaseholders are still involved in sandalwood production from their own leases. This activity has again provided them with a valuable cash flow to cushion the effect of the continuing recession in the pastoral industry in these areas.

The Forests Department has continued to provide supervision and control of all sandalwood production from Crown lands.

<i>Firewood</i>		Crown land	Private property	Total
Sawmills—		(t)	(t)	(t)
General purpose and sleeper—				
For sale	.....	41 391	.....	41 391
Own use	.....	1 884	.....	1 884
Private property—				
For sale	.....	.....	11 995	11 995
Own use	.....	.....	268	268
Domestic—				
Local Firewood License	.....	3 421	.....	3 421
Forest Produce License	.....	7 478	.....	7 478
Industry—				
Wundowie	.....	94 886	.....	94 886
Kalgoorlie	.....	2 071	.....	2 071
Total	.....	151 131	12 263	206 669

Other Forest Produce

Poles and piles obtained from Crown land during the year amounted to 282 681 metres, compared with 370 874 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 strainers cut from Crown lands totalled 356 714. Records received show that 40 378 posts and strainers were obtained from private property, but this was probably only a small percentage of the total production from this source.

OTHER FOREST PRODUCE

Description	South-west Division and Agricultural Areas		Goldfields Area Crown land	Total
	Crown land	Private property		
Mining Timber South-west	2 407	.....	.....	2 407
Mining Timber Goldfields Area	.....	.....	12 143	12 143
Piles, Poles and Bridge Timber	282 681	.....	.....	282 681
Fence Posts and Rails	267 871	34 139	56 747	358 757
Strainers	29 044	.....	3 052	32 096
Boronia	6 152	82	.....	6 234
Gravel and Stone	326 983	.....	.....	326 983
Sand	74 773	.....	.....	74 773
Sawdust as fuel	26 676	.....	.....	26 676
Bean Sticks	12 250	.....	.....	12 250

Softwood Production

Pine log production from Departmental plantations, mainly in the form of thinnings, amounted to 176 944 m³, which was an increase of 51 396 m³ (40.9 per cent) on last year's figure. The following figures show the trend in pine log removals in recent years.

Year ended 30 June	m ³ (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
1979	176 944

Removals by category were as follows:

	Total (m ³)
Sawlogs and peeler logs	51 261
Other log material	125 683
Total	176 944

Production from the various plantations was as follows:

	m ³
Wanneroo	31 889
Mundaring .....	.....
Gleneagle .....	.....
Manjimup	465
Harvey	14 179
Collie	23 429
Kirup (Grimwade)	50 463
Nannup	44 166
Busselton—	
Ludlow	676
Keenan	8 360
Pemberton	2 426
Miscellaneous	891
Total	176 944

Sawn production from all sources was 18 145 m³, which is a decrease of 524 m³ on 1977-78 production.

Softwood Utilisation

With improvement in the market early in the year full pine milling operations recommenced at the Forests Department Mill at Harvey. The experimental programme of high temperature seasoning continued with very satisfactory results in terms of behaviour of the unique ferro cement kiln and of control of the drying of distortion prone core wood. The validity of the kiln structure and of drying results to date have been confirmed by C.S.I.R.O. which recommended that a separate steaming chamber is essential to the further experimental programme.

Over 5 000 tonnes of pine logs were extracted over a period of 12 months from the spray storage stockpile established after Cyclone Alby. No checking or staining degrade occurred and sawn recovery and seasoning behaviour was as for green logs. A small spray storage facility is under construction at Harvey and a private company has installed equipment for a spray storage programme. The main benefit of spray storage of pine logs is the elimination of serious storage degrade problems and improved flexibility in log procurement under difficult winter logging conditions.

The Department has continued to promote quality control in the softwood industry and has supported the establishment of a W.A. Producers Sub-committee of the Radiata Pine Association of Australia. This Sub-Committee will monitor and service the needs of the softwood industry with respect to production, marketing, technical support and promotion. It is funded from the softwood log levy which is now paid into the Sub-committee's account. A close liaison was maintained with the Forest Products Association.

Timber Industry Regulation Act, 1926-1969

The number of mills registered under the provisions of the Act at 31 December 1978 totalled 133 (75 on Crown land and 58 on private property).

The average number of persons employed in the timber mills each month throughout the year was 2 033, a decrease of 137 compared with last year's figure of 2 170.

The District and Workmen's Inspectors made 1 085 mill inspections and 625 bush inspections.

There were 101 notifiable accidents for the year ending 30 June 1979; two of these were fatal.

The number of accidents per 100 persons employed was 4.97, a decrease compared with last year's figure of 6.31.

The cost of administering the Timber Industry Regulation Act for the year ending 30 June 1979 was:

	\$
Salaries	38 971
Mileage, allowances, office rent, plant cost and sundries	17 382

Recreation and Tourism

Picnic Areas

The level of use of established picnic areas continued to increase and the demand tended to exceed the availability of facilities.

Walking Tracks

Maintenance and minor modifications to the Bibbulmun Bushwalking Track were carried out to facilitate present use and in preparation for the WAY '79 celebration walk from Albany to Kalamunda in October 1979. An adventure trail was completed at Diamond Tree picnic area, and a self-guiding nature trail designed for use by Primary school students was completed at Fred Jacoby Park at Mundaring Weir. This latter project was designed in liaison with the Nedlands College of Advanced Education.

Visitor Surveys

A forest visitor survey, begun in 1978, concluded early in 1979 and analysis of the data was commenced. The survey used a combination of questionnaires, recorded observations and traffic counter devices and was conducted in each administrative region. A total of 2 158 questionnaires were distributed for a return of 58.6 per cent, a result well in excess of the level expected from this type of survey.

Flora and Fauna

The Department continued to administer the Native Flora Protection Act. Necessary amendments to the Wildlife Conservation Act, which will transfer flora protection to the Department of Fisheries and Wildlife, are in train. Conservation of flora is a basic part of the Department's management of forests and is given particular attention in Management Priority Areas. Additional protection has been provided for rarer tree species in Departmental arboreta.

Mining Rehabilitation

Bauxite Mining Rehabilitation

At Jarrahdale the Forests Department reforested 117.5 ha of State forest following bauxite mining. Five hectares were rehabilitated by direct seeding and 112.5 ha were hand planted.

At Dwellingup, ALCOA rehabilitated and reforested 109 ha by hand planting. Fertilisers were applied at three and six weeks after planting with a nitrogen and phosphate fertiliser mix at the rate of 100 grams per tree on each application.

The reforested areas were also aerially seeded with natural understorey shrub species at a rate of 1 kg/ha of seed. The areas were fertilised at the rate of 300 kg/ha. The treatment gives 1-2 germinants (seedlings) per square metre and is applied to all areas except those where topsoil is rapidly replaced. This gives sufficient seed without the need for supplement.

Species planted include *E. saligna*, *E. wandoo*, *E. maculata*, *E. resinifera*, *E. muelleriana*, *E. diversicolor*, *E. marginata*, *E. gomphocephala*, *E. cladocalyx*, *E. calophylla*, *E. patens* and *E. accedens*.

Gravel Pit Rehabilitation

The Forests Department rehabilitated 32 gravel pits no longer used by the Main Roads Department. Finance for the work was provided by that Department. Fifty-eight other pits were also rehabilitated by the Forests Department.

Mineral Sand Mining Rehabilitation

In State forest east of Capel 40 ha of land where mining has been completed, were seeded with rye grass and lupins to a standard acceptable to the Forests Department.

Coal Mining Rehabilitation

The "old" Stockton mine workings rehabilitation programme has been completed by the Forests Department. Work included removal of small overburden heaps, smoothing of larger heaps, construction of internal access roads, tree planting, establishment of native understorey and the provision of picnic facilities.



Part of the Stockton open-cut mine.

Catchment Rehabilitation

During 1978-79 the Forests Department co-operated with the Public Works Department and the C.S.I.R.O. in studies in the Helena Catchment. These were designed to give a better understanding of the effects of reforestation in lowering the groundwater table and reversing the discharge of salts. The trials incorporate combinations of agriculture and forestry practice.

Two hundred and forty hectares 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 stream salinity.

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

Groundwater table fluctuations were monitored by means of boreholes established by the P.W.D.

Monitoring the Effects of Agricultural Clearing

The major research programme relating to the effects of agricultural clearing was continued in conjunction with the C.S.I.R.O. and P.W.D. in State forest on 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 vicinity of the Wellington Reservoir Wall, and the other three are located 40 km to the east.

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 pastures have been established and leased for grazing.

Changes in groundwater levels resulting from the clearing have already taken place. Some previously dry bores now contain groundwater.

Protection: Fire

The area of land under control of the Department and protected from fire was 1 998 692 ha.

Other public lands and private property were given a measure of fire protection in areas adjacent to State forest.

The Fire Season

The fire season was of average severity with maximum temperatures close to normal except during November, when average temperatures were higher than usual. Rainfall between October and April was below average in karri areas and slightly above average for jarrah. Rainfall was well below average in May and June which extended the fire season, particularly for the jarrah forest.

Weather data recorded at Dwellingup and Pemberton stations is shown in the table below:

	Dwellingup (Jarrah)		Pemberton (Karri)	
	Average	1978-79	Average	1978-79
Rainfall—				
Annual (mm)	1 307	1 022	1 245	1 112
October to April inclusive	275	287	355	277
Number of Wet Days—				
Annual	132	124	169	175
October to April inclusive	46	45	70	78
Temperature—				
Mean Maximum October to April °C	25.3	25.7	22.7	23.5
Relative Humidity—				
Days of 15% minimum or less (No.)	7.5	6	1.6	1
Days between 16% and 25% (No.)	32.3	38	8.3	13

Prescribed Burning

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

	Season				
	1974-75	1975-76	1976-77	1977-78	1978-79
State forest—					
Hand burning	78 686	64 497	49 405	36 567	57 801
Aircraft burning	287 925	215 513	185 236	233 931	311 733
Total	366 611	280 010	234 641	270 498	369 534
Advance, Top Disposal and Regeneration Burns	2 378	4 532	3 563	3 674	3 861
Plantations—					
Clearing burns	3 088	2 872	2 752	2 530	2 008
Burning under pine canopy	2 494	1 958	2 284	1 779	1 932
Total	5 582	4 830	5 036	4 309	3 940

The area of prescribed burning totalled more than 377 000 ha, the largest since 1970-71 when 380 000 ha were burnt. Although burning was restricted in November due to abnormally high temperatures, conditions were favourable for the remainder of spring and in autumn. This together with improved aircraft availability, particularly in autumn enabled most areas programmed for burning to be completed on schedule.

The Department participated in several large aerial burns in co-operation with National Parks Board at Walpole, Bush Fires Board and Shires of Plantagenet, Manjimup and Denmark and the Department of Defence (Army) at Bindoon. Other fuel reduction burns were undertaken for the Public Works Department at Harvey and the Bush Fires Board at Collie.

Through the Bush Fires Board, the Forests Department has entered into formal agreements called inter-agency agreements to provide an improved basis for planning and implementing co-operative burning programmes. These agreements define the tasks and responsibilities for each organisation involved in prescribed burning and in some cases for fire suppression within a defined area. An example of inter-agency agreement was set up to cope with the hazardous and steep terrain of the Avon Valley near Walyunga and negotiated between four Government departments and the Shires of Toodyay, Chittering and Swan. Other agreements apply with the Shires of Plantagenet, Denmark, Margaret River, Boddington, Collie and Manjimup.

Detection

The first extensive trials comparing spotter aircraft with towers for fire detection were held at Pemberton in 1973-74. The trials revealed that aircraft provided improved quality in detection and were more economic than towers. Use of aircraft was then expanded employing hired aeroplanes, and towers were put in a standby condition for emergency use only.

However, the types of aircraft most suited for fire spotting were not available for hiring in Western Australia and Government granted approval for the Department to purchase four Piper Super Cub aircraft. Purchase was completed between October 1978 and February 1979.

These aircraft offer adequate endurance and exceptional stall and short landing capability resulting in improved safety when flying long hours over forested areas. They also provide good visibility on both sides because of the tandem seating arrangement. Experience with the new Piper Super Cubs is in line with the recommendations of the United States Forest Service following their trials with a variety of aircraft in fire spotting.

In addition to the Departmental aircraft, five others were hired and the total of nine aircraft were flown for 7 300 hours on fire surveillance this year. All pilots contracted for fire spotting were given training in fire behaviour and detection procedures prior to commencement of the season.

The Department's own spotter aircraft were otherwise used for winter cloud location needed before dieback photography could commence, surveys for logging operations, patrol of dieback quarantine areas and other inspections of forestry practice.

The periods between first and last watch for fires were:

	Pine Plantations	Jarrah	Karri
First Watch	13 October, 1978	20 October	20 October
Last Watch	19 May, 1979	19 May	19 April

Wildfires

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

	Season				
	1974-75	1975-76	1976-77	1977-78	1978-79
Number of fires attended—					
Indigenous State forest	139	99	120	221	121
Adjacent private property and Crown land	79	64	86	150	101
Pine plantation	36	20	21	11	13
Total Number	254	183	227	382	235
Area of State forest fires (ha)—					
Indigenous	8 850	3 883	5 553	8 211	2 960
Pine plantation	40	8	17	364	32
Total Area	8 890	3 891	5 570	8 575	2 992

The total area of forest land burnt, 2 992 ha, compares favourably with the average for the past 10 years, which was 5 290 ha per season.

Most fires were apparently either deliberately or accidentally lit by members of the public. The three most difficult and costly fires for the season were at Wanneroo (7 950 ha), Dwellingup (1 720 ha) and Manjimup (2 150 ha). The fires at Wanneroo and Dwellingup originated outside State forest and the fire at Manjimup was deliberately lit on State forest by persons unknown.

General

Five pumpers were built in the Department's workshops, completing a three-year upgrading programme.

A start was made on renewing old slip-on pumpers and light gang truck units. A slip-on unit was built for the Bush Fires Board.

Two fire training courses were held in October 1978 and Departmental staff participated in several courses conducted by Bush Fires Board and one by the Victorian Forests Commission. The Department assisted ALCOA of Australia Ltd. and the National Parks Board with fire training programmes and participated in seminars, advisory meetings and training programmes for Bush Fire Brigades.

Protection: Disease

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

The areas currently proclaimed as disease risk areas extend from Mundaring to Walpole comprising 719 561 ha or 36.5 per cent of State forest and Timber Reserve. Proclamation of additional disease risk areas east of the Frankland River and west of the Darling Scarp south of Nannup is under consideration.

There were 835 patrols carried out to control entry into disease risk areas.

A total of 1 273 permits were issued to enter quarantine to maintain essential services.

In December 1977 a Working Group was reconvened to assist the Department's development of special measures necessary for post quarantine management of forest areas.

The group has found that the Dieback Task Force Report of 1974 which reviewed the dieback situation in Western Australia was well based. Subsequent major developments have been as follows:

Legislation has been developed for disease management. (Forests Act Amendment Act 1974, Part IV A—Control and Eradication of Forest Diseases.)

A large part of State forest has now been placed under quarantine to define the presence of the disease.

Introduction of broad scale internal and external publicity and training programmes. Dieback has been made everybody's concern.

An entry permit system required for the control of major forest users has been developed and demonstrated effectively.

The Hardwood Operations Control System (H.O.C.S.) has been developed to provide the necessary degree for planning and control required for management according to disease risk categories.

The aerial fire detection system has greatly improved the surveillance of forest activities.

The 70 mm photographic system using improved navigation methods has been developed to permit more accurate disease interpretation and mapping.

A basic system of management priority areas for conservation has been defined as a first attempt to preserve key ecological types.

A significant reduction in the hardwood cut was achieved and stockpiling of logs occurred which assisted management of areas at risk from *Phytophthora cinnamomi* attack.

Currently the group is concentrating on integrating the aerial dieback mapping programme with essential activities of the Department. This will facilitate the development of a disease mapping system to meet the requirement of all sections of the Department. Until this stage has been completed and fully appreciated, additional operational requirements cannot be clearly specified.

The control programme is a progressive and continuing process of monitoring and appraisal.

Forest Offences

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

General: Twenty-four offenders were reported during the year for other offences against the Forests Act and Regulations. Three cases were settled without prosecution. Action to prosecute one offender for contravention of the Forest Regulations is currently pending. Warnings were issued in all other cases.

SUPPORT SERVICES AND RESEARCH PROGRAMMES

Research

The work of the Research Branch continued to cover a very wide field.

Much of the work was carried out in co-operation with other State Government Departments, C.S.I.R.O., Universities, Western Australian Institute of Technology and private industry. The co-operation was particularly close in catchment protection and forest rehabilitation following mining. A notable development has been a major influx of funds from the mining industry. Under an interim arrangement the funds are administered by a management committee headed by the Conservator of Forests, and distributed on the basis of recommendations by an advisory committee drawn from State Departments, C.S.I.R.O., Universities and the industry. Additional funds have been obtained as a grant from the Rural Credits Development Fund of the Reserve Bank of Australia for research into the effect that mycorrhizal fungi may have on the vulnerability of *P. radiata* to *Phytophthora cinnamomi* attack.

Como

The Institute of Forest Research and Protection at Como continued to provide support services for the Research Branch as a whole and to function as the headquarters of the Branch.

Data Analysis

Data analysis has been carried out on 17 major projects including sandalwood regeneration, plant ecology, the karri flowering cycle, a forest visitor survey, pine growth plots, karri tree volume equation, site-vegetation typing, the effect of plant root extract on dieback disease spores and survival of plants on an urban freeway.

Editorial Section

Output of publications by the section continued at high level. The research papers published during the year are listed in Appendix 6. Four bulletins, dealing with large research projects, are currently being processed. The section also assisted research officers with the publication of articles in Australian and international journals, to ensure broader dissemination of research findings of major significance.

Soils and Nutrition

The major task was the large scale foliar analysis programme involved with the *Pinus radiata* plantations in the Busselton and Harvey Divisions. The findings indicated a very good persistence of nitrogen and phosphorus in the foliage following refertilisation with these elements. Zinc and manganese levels were still generally sub-optimal and copper levels barely adequate in many areas.

Analysis of soil cores associated with drilling programmes carried out for the Hunt and Kelsall committees was again an important function of the laboratory. Five hundred samples were analysed from the South Canning Dam catchment, from Collie and from Pemberton.

The study of the soil organic matter levels under a wide range of jarrah forest stands continued throughout the year. The data confirmed the very wide variation in soil organic carbon and nitrogen throughout the jarrah forest. The variation appeared to have very little relationship with stand type and previous fire history. The organic matter in the forest soil had a very wide carbon-nitrogen ratio and preliminary studies indicate that the production of inorganic nitrogen in these soils was very small.

Ecology

Much effort was devoted to finalising the mapping and description of the System 6 (Darling Range area) vegetation complexes and gathering data on management priority areas for flora and fauna, mainly in the northern jarrah forest. Work continued on the evaluation of the changes in natural vegetation in the northern Coastal Plain attributable to climatic variation and to withdrawal of groundwater for metropolitan water supply.

Sandalwood Research

The results of five years research on the regeneration of sandalwood are now being summarised.

Wanneroo

Tree Improvement

The Department is constantly endeavouring to improve the gene pools of both commercial pine species. In the case of *Pinus pinaster* there is active exchange of material with South Africa. In a progeny test containing 19 South African families, four-year-old seedlings of that origin compared favourably in terms of height with families of local and Portuguese origin.

Similarly, the gene pool for *Pinus radiata* has been diversified by the addition of collections made in California by C.S.I.R.O. Division of Forest Research. A provenance trial was established during the year in the Donnybrook Sunkland. One hundred and ninety-four kg of improved seed was collected from the West Manjimup seed orchard.

All *Pinus pinaster* seed used in Western Australia already comes from seed orchards, and is thus genetically superior.

Pine Silviculture

Results from three large scale trial plots established in 1967 indicated that in the coastal pine plantations near Perth drought deaths became more prevalent as rainfall decreased to the north but growth rates of thinned stands were much the same. This meant that heavier thinning in the lower rainfall areas is particularly important for growth of the pines and replenishment of underground aquifers.

Dwellingup

Jarrah Dieback Disease

Discovery that *Phytophthora cinnamomi* is persistent in the roots of *Banksia grandis* has allowed development of a reliable means of detecting the presence of the disease. Previously baiting techniques were concentrated on the soil and *P. cinnamomi* was recovered from less than five per cent of the samples. Sampling from the root collar region of *B. grandis* has resulted in recovery rates of 92 per cent.

During dry or cold periods, the fungus in the soil dies but survives in the roots. When the soil is both warm and moist, the fungus spreads from the root base and invades surrounding soil attacking any susceptible roots encountered.

The persistence of the fungus in the root means that it can be recovered virtually in any season, and a reliable method of detection is now available for the first time.

Field studies showed that sporangial development by *P. cinnamomi* was significantly suppressed when a legume understorey was present.

A co-operative study involving scientists at the Western Australian Institute of Technology, the C.S.I.R.O. Divisions of Forest Research and Food Research and the Forests Department was initiated to determine whether chemicals associated with native legume roots will suppress sporangial production by *P. cinnamomi*. Marked suppression of the fungus has been achieved in the laboratory and the work is now being extended to field trials.

The research into the dieback disease was restructured to provide a close integration of effort between the departmental research station at Dwellingup and the C.S.I.R.O. Division of Forest Research at Kelmscott.

Fire Ecology

Fire ecology studies were aimed primarily at determining the effect of fire intensity and season of burn on legume regeneration and *Banksia* mortality. Preliminary results indicated that broadscale regeneration of legumes and significant mortality of *B. grandis* could be achieved by burning at a moderate intensity in summer and autumn. Studies were initiated to develop safe methods to burn more extensively during late summer.

Rehabilitation

Three large arboreta were established, one on previous farm land, to test a large number of prospective tree species for rehabilitation of disturbed forest in the eastern forest zone.

Adaption to saline and semi-arid conditions were among the criteria used for the selection of species.

Sites were selected to cover the climatic gradient across the forest and to include upper and lower topographic positions. Where possible disturbance factors, such as *P. cinnamomi* infection, were included.

The establishment methods used were those anticipated to apply to future large-scale rehabilitation. Generous use was made of phosphate fertiliser and an under sowing of jarrah forest legumes took place. Light blasting of caprock on upper slopes was included.

A project was begun to provide information on the native forest eco-system and changes brought about by bauxite mining. The study was jointly undertaken by C.S.I.R.O., the Forests Department and ALCOA. Use will be made of a technique developed by C.S.I.R.O. whereby direct measurements of transpiration can be obtained by enclosing whole trees in large transparent chambers.

Hydrology

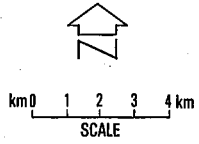
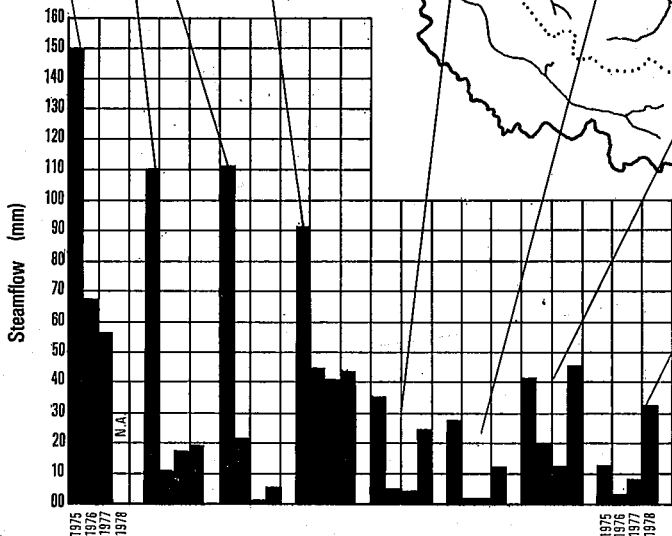
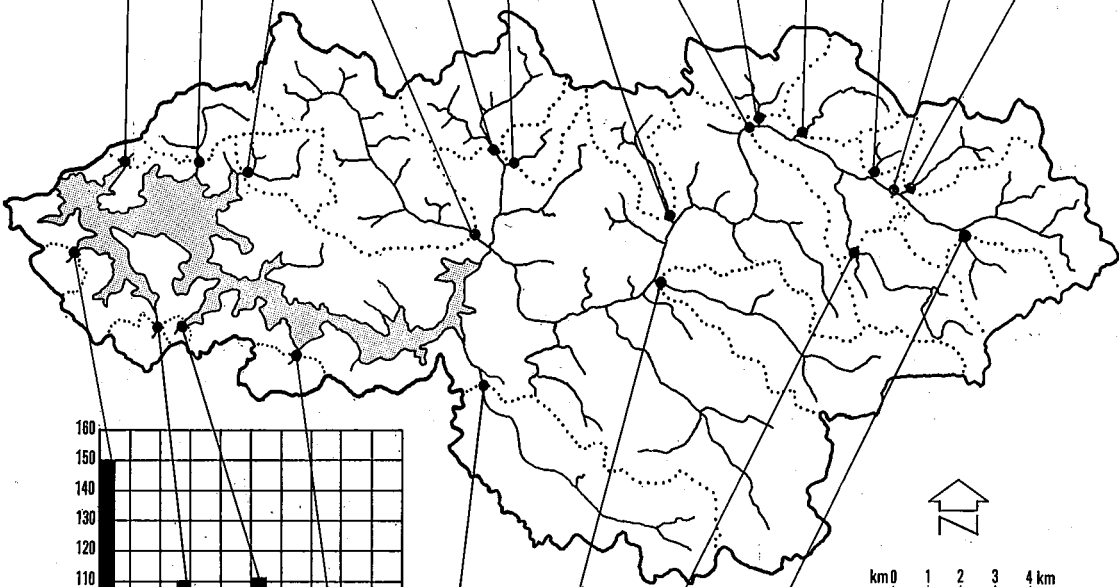
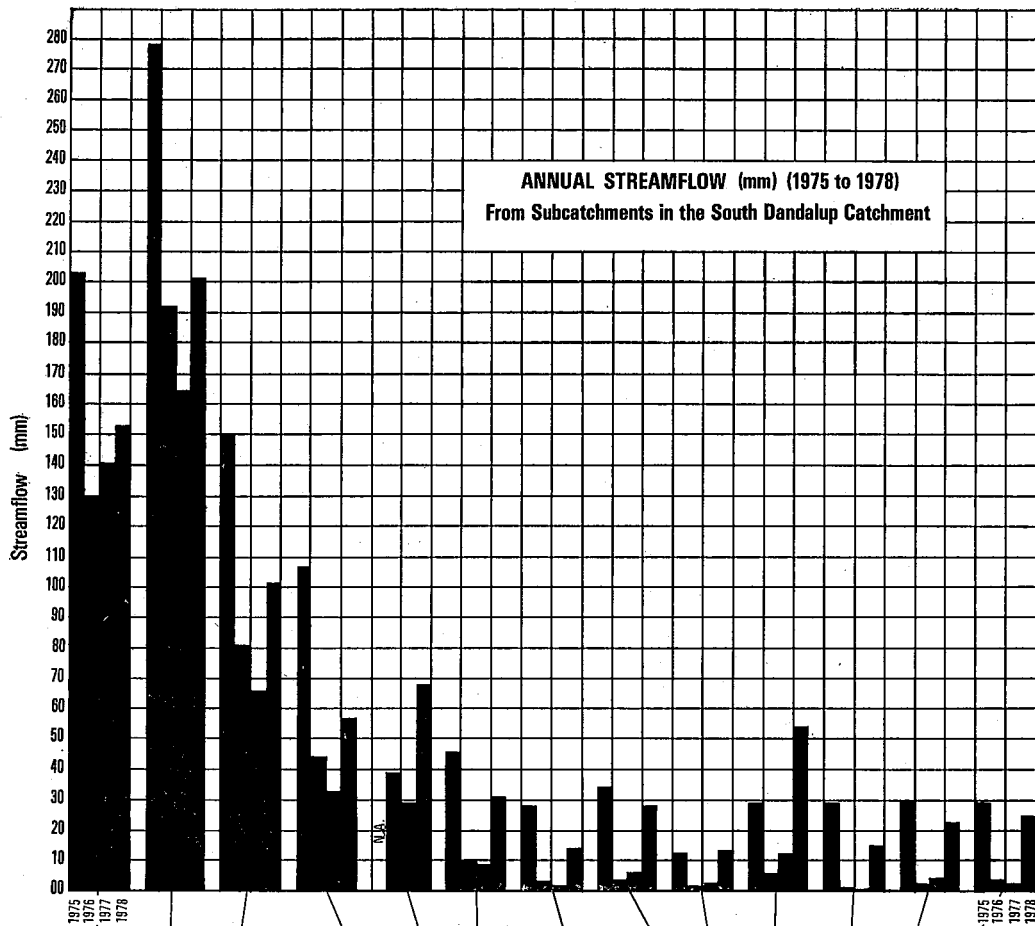
Field sampling in the South Dandalup Catchment ceased at the end of 1978 and data are being analysed and prepared for publication. Results showed that most water flowing into the reservoir was yielded by western subcatchments. Yields from the eastern subcatchments were comparatively very low but potential stream salinity increases following forest disturbance in many of these subcatchments could be large.

Data from groundwater studies in the Yarragil catchment indicate that deep aquifers in the valleys are semi-confined and recharged by rainfall on the uplands.

Broadscale sampling of stream salinity in the Harvey and Dwellingup divisions supported earlier observations of a west-east trend of increasing salinity. However, south of the Harvey River changes in the subsurface geology could be reflected in comparatively high salinities close to the Darling Scarp.

Hydrologic calibration of six subcatchments in the Little Dandalup Catchment continued for the second year. Following calibration, some of the subcatchments will be treated to determine the potential to increase water yield by silvicultural thinning in low salt areas of the northern jarrah forest.

Monitoring of water levels and salinity continued in the bores established under the Hunt Steering Committee's Project 4 Dwellingup.



LEGEND
 Streamgauging Weir ●
 Catchment Divide

Busselton

Pine Nutrition

The main emphasis has been directed towards refining techniques of establishment and early fertilisation of *P.radiata* on the Donnybrook Sunkland.

The possibility of improving the response of pines to initial nitrogen-phosphate fertilisers was investigated. The experiments included testing various forms of nitrogen, fertiliser placement methods and modification of the soil micro-environment by additions of lime, sulphur and atrazine. Results confirmed that "Agras", a mixture of ammonium sulphate and mono-ammonium phosphate, was the most suitable fertiliser tested. However, the effectiveness of initial fertiliser application depends on the placement method. Lime had detrimental effect on pine growth while sulphur increased the response of *P.radiata* to superphosphate. Trials, using planting machines, enabled the effectiveness under operational conditions to be assessed.

Studies were commenced to determine the most effective procedure for correcting zinc deficiencies. Although foliar application of zinc in the nursery greatly increased the level of zinc in the needles, there was a relatively rapid ten-fold drop following lifting and planting out of the seedlings. The need for spraying the planted seedlings has been postponed for three months, thus improving the flexibility of field operations. A Departmental officer commenced a post graduate study at the University of Western Australia to determine the fate of the applied zinc, its distribution and its mobility.

Refertilisation field trails in the Sunkland confirmed that significant growth responses could be obtained from subsequent application of "Agras" fertiliser.

Pines grown in areas where clover has been established had fewer nutrient deficiency problems and better overall growth rates. This has led to a change in research emphasis. Several new trials were initiated to determine the best variety of clover for different Sunkland soil types and management techniques. Other investigations included the timing of clover pasture establishment, and alternative methods of site preparation. The shade tolerance of several varieties of clover was also under investigation.

Hydrology

The study of Apostles Brook catchment indicated that the soils in this and other catchments in the region earmarked for plantation establishment had such low levels of chlorides that the potential for an increase in stream salinity was very low. The early stages of plantation establishment were associated with an increase in run-off but the magnitude of the increase varied from one subcatchment to another.

The emphasis of hydrological research in the Sunkland has now changed to studies of soil moisture recharge under pines managed according to a variety of silvicultural regimes.

Pine Silviculture

Silvicultural research was largely confined to the re-measurement of long-term thinning experiments. There was, however, further investigation into chemical thinning of pine stands on drought prone sites.

Agroforestry

Several agroforestry trials were monitored, and one trial was finalised to the stage of publication.

Recent measurements of field trials on *Pinus radiata* indicated that there was significant increase in average branch size when pines were grown under conditions suitable for the maintenance of pasture understorey, compared with branch size produced under more conventional silviculture.

Studies in areas grazed under pine established on former farm land in the Blackwood Valley showed that properly timed grazing resulted in a significant reduction in fire hazard, but more attention to maintenance of pasture quality was required to ensure even pasture utilisation.

Manjimup

Ecology

A biological survey of the Lower Shannon Conservation Priority Area was carried out during autumn. It was found that this area, with its varied habitats ranging from karri and jarrah forest through *Banksia* woodlands, sedgeland and swamps, contained a rich assemblage of vertebrate fauna. The honey possum, in particular, appeared to be common in the *Banksia* woodlands and on some of the flats.

Observations carried out during the year on the effectiveness of reintroduction of the rare marsupial woylie (*Bettongia pennicilata*) into the north Perup area have shown that the main cause of disappearance of this species is predation by the introduced fox, which also has very adverse effect on the numbat (*Myrmecobius fasciatus*). A report on the role of this predator has been submitted to the W.A. Wildlife Authority.



Woylie (*Bettongia pennicilata*) Credit, Darryl Blackshaw A.P.B

Development of prescribed burning plans for Fauna Priority Areas was commenced. One such plan, involving lower fire frequency and alternative spring and autumn burning has been adopted in the Perup area. Problems were experienced when attempting to introduce a similar burning plan in Dryandra forest because of the large area of fire-sensitive mallet (*E.astringens*) plantations. A temporary five-year burning plan which excludes the mallet was introduced pending the results of trial burns. These burns will determine the regeneration of mallet following fire and the best method by which a dense ground cover of legumes may be encouraged. The first of these trial burns was carried out in autumn and monitoring of the recovery of both vegetation and fauna is continuing.

Research on the ecological effects of fires of higher intensity than the normal prescribed burning was carried out in Harrington Block. The regeneration of hard seeded legumes and selected understorey species with rootstocks were studied following fires of different intensities.

Hydrology

Routine measurements continued in the four study areas Iffley, Crowea, Poole and Moorilup. Karri seedlings were planted in Crowea and Poole. No operations were carried out at Iffley or Moorilup, as these areas have not yet been burnt since logging.

In spring 1978, members of the Kelsall Steering Committee again visited Manjimup to inspect progress in the projects under their supervision.

Eucalypt Silviculture

Major emphasis of research has again been placed on regeneration of karri forest coupes.

An improved nitrogen-phosphate fertiliser regime was developed for the 1979 planting season. This regime may be further modified as a result of current trials using slow release fertilisers and various levels of nitrogen, phosphorus and potassium applications. The efficiency of seeding as a regeneration technique was proved by spot seeding at the rate of 27 000 seeds per ha. Newly established trials were aimed at determining the minimum seeding rate needed for satisfactory regeneration and at improving the yield of established seedlings from a given quantity of seed. Improvements have also been achieved in coating seeds so as to reduce damage by insect and fungi.

Broadscale trials covering 40 ha have shown that aerial seeding is also a cheap and effective regeneration technique.

Seed production is the key factor in the regeneration of karri. Trials studying the effect of spacing, fertilisation and irrigation on seed production in karri seed orchards were established. Work was also started on large scale karri seed orchards, which may begin producing seed by 1985.

Several karri provenance trials were established testing 128 families from several points in the range of the species from Boranup to the Porongurup Range. Families from all main ecological associations of karri were included. The trials were located at Boranup and in the Warren, Frankland and Gardner River Valleys.

Two trials were established to study the improvement of productivity of karri on marginal sites by the use of fertilisers and thinning.

Rehabilitation after Logging

Further trials were initiated to examine the effect of the various soil disturbances caused by logging on the establishment and growth of seeded and planted karri.

Fire

A technique for reducing the fire hazard in pine plantations by crushing thinning slash with a heavy tractor-mounted steel roller was tested and found to be workable. The fuel bed was dramatically reduced.

Fire behaviour studies were concentrated in the jarrah forest in the Kirup Division.

Twenty-four moderately intense experimental burns, designed to regenerate acacias, were carried out.

As a result of directing work to pine and jarrah protection, other studies of the effect of mild fires on karri regeneration were continued only at a very low level.

Inventory and Planning

The Northern Region Inventory and Planning Office was established at Kelmscott. Each of the three regions now has an Inventory and Planning Office with professional staff working directly under the Regional Planning Officer.

Hardwood Inventory

In the northern and central regions 1 071 ha of detailed assessment was carried out to provide logging plans for 36 538 ha of jarrah forest. A sample totalling 953 ha in the southern forests embracing the marri chipwood licence area was assessed to provide detailed information on sawlog and chiplog volumes for 37 465 ha.

Forty-two samples of areas logged by mill operations were carried out to relate the actual volumes removed to those previously determined by assessment. These regular marketability appraisals ensured that assessed volumes and mill utilisation were monitored at realistic levels.

Three plots in the Jarrahdale bauxite rehabilitation area were re-measured to assess tree survival and volume growth.

Softwood Inventory

The majority of the softwood inventory programme was carried out in cyclone damaged and drought affected areas. One hundred and fifty-six permanent plots were established and 1 625 existing plots re-measured.

One hundred and sixty-two temporary plots were measured in cyclone damaged areas to assess the severity of the damage.

In the northern region 60 agroforestry plots were re-measured.

Fifty-five plots established to monitor the development of stands which had received heavy early culling were re-measured and a further eight established to provide better coverage of this silvicultural approach. An inventory trial enumerating all stems in 5.4 ha of *P. radiata* receiving the above treatment at Talanalla provided an estimate of the expected yield from a first commercial thinning in stands developed with the culling practice.

Other Projects

Logging plans: The integrated five year hardwood logging plan taking into account both sawlogs and chipwood requirements was revised.

Karri thinning plots: The Treen Brook plots were re-measured for the fourth time since thinning and found to be suffering some damage from Cyclone Alby. Two plots damaged in the Diamond Chip yield series were replaced. A trial relating estimated standing volume and the actual volume and weight of sawlogs and chiplogs removed in thinning was completed. Excellent co-operation was given by industry.

Resource Statements: Summaries of the hardwood resources available from areas proposed for plantations in the Sunlands were prepared. Summaries of current data were compiled for all Conservation Priority Areas in the northern and central regions.

Dieback maps: Dieback occurrence maps were updated and dieback risk types mapped on Crown land and reserves in the central and southern regions.

Karri seed forecasting: Forecasts of seed yields for 87 proposed coupes proved to be a valuable aid in the preparation of the 1979-82 logging plan.

Photography: Oblique 35 mm photography continued to provide information for both the hardwood and pine operations control systems. Different films, filters, formats and scales were tested.

70 mm Dieback Photography

After several years of development and trials, the Department established an aerial photographic technique that could be used to locate early symptoms of dieback attack. This was a major breakthrough and involved recognition of the disease on single understorey species such as *Banksia* and *Zamia* in the photographs. Cloud cover is necessary during photography so that tree crown shadows do not obscure the plants close to the ground. Seventy millimetre photography and precise computerised navigational equipment fitted to the aircraft which operated at 450 m above the forest provided the required results. At the completion of flying, some 74 000 ha of quarantined forest had been photographed involving some 4 100 km of filmed flight line. The quality of the imagery and the accuracy of the flight patterns met expectations. The programme of 113 000 ha was not completed due primarily to the unusual autumn weather pattern. There were fewer than average cloudy days suitable for photography. The operation was technically successful and dieback mapping using 70 mm photography will continue in future seasons.

Interpretation of the aerial photography programme involved a total of eight interpreters. The interpreters required careful selection and training as distinguishing the early symptoms of dieback is an exacting and specialised task.

Economics

Pine stumpages and plantation costs were reviewed and a number of possible management strategies for plantations were evaluated. A study of possible future employment in forestry and wood processing was completed. Further research was carried out into the indexation of royalties, stumpages, piecework rates and contracts. Valuations for forest production purposes were carried out on two properties available for purchase.

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

Management Planning: A review of plantation management strategies was undertaken. The contributions made by the A.D.P. Section include a review of all the available pine growth and yield data, the verification of various growth and yield models developed by the section and the documentation of productive potential by plantation.

A Map Information and Display System (M.I.A.D.S.) developed several years ago was used to assist in a variety of research projects. The basic functions of the system are to store mapping information in a computer data base and to automate the process of map overlay preparation.

Mensuration: Volume and taper tables were prepared for *Pinus pinaster* of the Gngangara plantation and *Pinus radiata* of several localities. The tables were based on tree form models rather than traditional volume regression lines.

Mapping

The conversion of Departmental maps to the metric system is now about 50 per cent complete. Nine new maps were published and a further 17 are in various stages of preparation. Three divisions, Harvey, Collie and Kirup are now covered by metric maps.

The revision of Imperial scale maps of areas which will not be covered by the metric system for some time was continued and five sheets in the southern region were republished.

Plans were prepared for Savage Creek, Thompson Brook and Nelson pine plantations while Margaret River and Brunswick Plantations were re-mapped.

New clearing for bauxite mining at Jarrahdale and Dwellingup was mapped and areas determined for compensation purposes.

Interpreted photographs were received from the field showing soil type boundaries. These were plotted and mapped, together with demarcation lines for future clearing in the Sunlands area. The preparation of plans and prints required for the Hardwood Operation Control System is proceeding for the southern region and is expected to be completed during the coming year.

Forest fire protection involved the preparation of 14 co-ordination plans and six tower plans. In addition 77 maps were prepared for aerial burning operations and about 300 maps for use in the spotter aircraft.

Multi-coloured maps were prepared to illustrate departmental publications and reports such as Forest Focus and the Multiple Land Use Planning Project.

Manjimup research plots were mapped at 1:3168 and the Nannup Nursery at 1:500 and 1:1000. Plans were prepared for four arboreta and the Bingham Salt Salinity Study.

Preparation for re-mapping areas south of Collie to planimetric standard in connection with the 70 mm photography programme was commenced.

A new type of tenure plan was evaluated in Head Office and in the field. This plan is 0.18 mm Cronaflex transparency and is coloured using special inks. Advantages are better durability, easier amendment and suitability for taking prints.

Extension

An exhibit was provided for the 1978 Royal Show using a display caravan and an outdoor demonstration of agroforestry. The caravan display also toured seven country shows.

Other exhibits were displayed at the Dowerin Machinery Field Days, and on the occasion of the visit of His Royal Highness Prince Charles to Bunbury.

Private Plantations

Private interests advised that they planted 403 ha of new plantation in 1978, and re-planted 259 ha lost in fires in the previous summer and autumn. Advice was also received of previously unrecorded plantings, and the total area of private pine forest is now recorded as 11 107 hectares.

The Forests Department and Australian Forest Development Institute jointly organised two field days for private growers in Forests Department pine plantations; one to study tending and thinning at Wanneroo and the other to study agroforestry at Mundaring. The Department was also represented in an advisory capacity at nine other meetings of this Institute.

Education

A continuing demand for speakers to educational and common-interest groups was met by Departmental staff. Visual and other lecture aids were produced for various speakers.

WAY '79

The Department took part in a number of activities associated with "WAY '79". Preparation began during the latter half of 1978 for activities planned for the 150th Anniversary celebrations and included:

Distribution of trees to every local authority in the state for Arbor Day 1979.

Continuation of planning for the "Bibbulmun Walk '79" to be held in October-November 1979. The project requires regular liaison with the 14 local authorities along the route from Albany to Kalamunda using south coastal roads and the Bibbulmun Bush-walking Track.

Assistance was given to the WAY '79 committee in developing a plan for a "Day of Trees" during Western Australia Week 1979. This assistance included the selection of species, production of 40 000 selected seedlings and compilation of a tree planting guide for the Main Roads Department.

Display of the historic significance of forests and timber at the Agro '79 exhibition at the Claremont showgrounds.

Assistance in design and construction of large timber arches was given to the Department of Agriculture for the opening of the Avondale Research Station at Beverley.

Display on Agroforestry for the Apple Festival at Donnybrook.

Display of pine products including children's playhouse at the Back to Greenbushes festival. A display of the role of forests in the honey industry for the Honey Festival at Claremont showgrounds.

Planning and liaison for the water resources exhibition, Resource 1, to be held at Dumas House, West Perth in September 1979.

Kimberley and Pilbara Regions

Departmental officers visited both regions during the year.

Preparations were made for the establishment of the Kimberley Divisional Office at Kununurra.

The Department continued to share the running costs and technical direction of the Karratha nursery with the Office of Regional Administration and the North West. Departmental officers also carried out the 1978 planting in Area J in Bulgara, Karratha, for the Townsite Development Committee.

Library

With the appointment of an additional member of staff it was possible to re-organise and expand the system of circulation of periodicals.

Forest Engineering

Roading

During the year 308 km of roads, tracks and firelines were constructed and 4 489 km of roads were maintained.

Plants and Workshops

Fourteen workshops staffed by 44 tradesman and 18 apprentices maintained the Departmental fleet of 518 items of automotive plant and 101 items of industrial plant.

The following equipment was fabricated at Departmental workshops.

Fifteen heavy duty Holden Stalker pumping units with 3 000-litre tanks for fire fighting.

Hydraulic high pruning equipment.

Eight fertiliser dispensers for attachment to pine planting machines.

One mound plough and one planting machine for pine plantation establishment in the Sunklands area.

One electric pump to operate from deep (40 m) cased boreholes.

One pine slash reduction roller to fit a D4 tractor.

Housing and Building

The general programme of housing, building and settlement maintenance included the relocation and renovation of four houses in southern Divisions. Specific projects included extensions to the Jarrahdale and Dwellingup (Research) Offices, the provision of a staff house at Kununurra and the completion of a new Regional Headquarters at Bunbury, which was opened by the Hon. Minister for Forests on January 11, 1979.

Communications

The nineteen remote repeater stations operated and maintained by the Department's Communications Branch are all now powered by solar cells. A radio repeater was installed at Mornington tower to cover plantation areas in the Harvey Division. Further security measures have been adopted at the Mt. Dale repeater station following increased vandalism and lost equipment.

The new Regional Office at Bunbury was equipped with complete radio communication facilities and the installations at Harvey, Jarrahdale, Margaret River, Walpole and Yanchep were upgraded.

The single-side-band (SSB) high frequency equipment at Kalgoorlie was replaced with the latest solid state radios. Radio communication was provided for the Kimberley project with the installation of SSB transceivers.

The Department's four spotter aircraft were fitted with communication equipment. Two twin-engined aircraft needed for incendiary operations and aerial photography were also fitted with communications equipment for inter-communication and ground liaison.

Seven remote radar transponder stations were installed in forest locations to enable accurate position guidance of aircraft involved in dieback photography.

An annual maintenance check of all vehicle radio wiring was carried out and connections were installed in 73 new vehicles.

Seventeen locally manufactured radios were placed in service in January 1979.

ADMINISTRATION

Finance

All Territorial and Departmental Revenue is paid into the Consolidated Revenue Fund. Allocations are made from the Consolidated Revenue Fund for Forest Maintenance Activities and from the General Loan Fund for Forest Development.

Source and Application of Funds

Source—	1978-79 \$
Consolidated Revenue Fund	14 128 370
Reduction in unexpended balance	117 560
General Loan Fund	2 603 000
Commonwealth Aid Road Grant	313 876
Commonwealth Softwood Forestry Agreement	828 000
Mining Compensation	196 205
Sundry Revenue	53 106
Conservator's Borrowings	1 000 000
	<hr/>
	19 240 117
	<hr/>
Application—	
Forest Development	5 032 780
Forest Maintenance	14 207 337
	<hr/>
	19 240 117

Accounting Computer

The operational memory capacity of the Interdata 7/32 computer was expanded during the year to a capacity of 384K.

Remote terminals with V.D.U.s and printers were installed at Busselton, Kirup, Harvey, Nannup and Wanneroo.

Computerisation of the General Ledger system was completed and full live-running commenced on 1 January 1979.

Development of a system to manage both the accounting and resource information generated by pine procurement was commenced.

Department Staff

Public Service Act

Mr. J. J. Havel was promoted to the position of Chief of Division.

Dr. F. H. McKinnell was promoted to the position of Superintendent.

Messrs. F. E. Batini and R. J. Underwood were each promoted to the position of Inspector.

Mr. M. E. McKiggan was appointed to the position of Engineer.

Messrs. R. J. Chandler and P. D. Stirling were reclassified as Divisional Forest Officers.

Mr. R. M. Davis, Chief Draftsman, retired on April 16, 1979 after more than 50 years in the Public Service, the last 14 being with the Forests Department.

Forests Act

Mr. R. J. Edmiston was reclassified to the position of Technical Officer Grade 1.

Ms M. R. L. Lewis was reclassified to the position of Technical Officer Grade 2.

Messrs. A. Watson, L. F. Court and J. F. Walsh retired from their positions with the Department.

Training Programme

During the year, the first year of the field cadet training course was moved from the Mt. Lawley Technical College to Bunbury Technical College. Fourteen new students enrolled. The reasons for the move were lack of scope for any expansion and difficulties in arranging field work. At Bunbury, the students spent one day a week in the field on practical exercises organised and supervised by Departmental officers. The close proximity of the Bunbury Technical College to the Regional Office, and the reasonable proximity to several divisional offices, has facilitated administration and speeded up the integration of the students into the Department.

The Forests Department is grateful to the Mt. Lawley Technical College for the help and co-operation given over the years in providing the first year of the course.

The second year of the course continued to be centred at Dwellingup, with a shorter period at Manjimup. There are currently 14 field cadets in their second year of study.

In December, 12 field cadets graduated and also received individual safety awards in recognition of two years free of accidents.

Twenty-three candidates were successful at the staff promotional exams held in August.

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

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

Conference and Study Tours

During the year 27 departmental officers attended a total of 25 interstate conferences, courses and study tours covering such subjects as forest genetics, fire management, eucalypt dieback, land use and water resources and forest wildlife.

The Minister for Forests and the Conservator attended the 8th World Forestry Congress in Indonesia during October and November of 1978 and the Australian Forestry Council meeting in New Zealand in January, 1979.

The Deputy Conservator attended the 49th ANZAAS Congress in Auckland in January, 1979.

Inspector G. B. Peet participated in a two-month Fire Management Study Tour of the United States. The tour was arranged by the United States Forest Service and was based on an exchange of operational forest fire control officers between Australia and the United States. Inspector R. J. Underwood attended the 3rd Course on Planning and Management in Forestry conducted at the Commonwealth Forestry Institute, Oxford.

Divisional Forest Officers McArthur and Meehan returned from study leave overseas.

Employment in Forestry and the Timber Industry

The number of wage earners directly employed in forestry and the timber industry was estimated at 3 367, as follows:

Forestry—		
Professional officers	79	
General field staff	284	
Clerical and drafting	92	
Cadets—		
Professional	7	
Field	27	
Full time Wages employees	540	
Contractors and employees (estimated)	20	1 049
Timber Industry—		
*Sawmill employees including bush workers	2 033	
Firewood and mining timber cutters and pole getters working under permits	47	
Sandalwood workers	89	
Apiarists estimated (2 276 sites registered)	149	2 318
		<u>3 367</u>

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

ACCIDENT PREVENTION

On 22 September, 1978 the Forests Department was awarded the C.M.L. Trophy for industrial safety in Western Australia. The presentation was made by the Honourable the Premier of Western Australia. Subsequently the Department was named the winner of the C.M.L. National Award and Trophy for the foremost performance in industrial Safety in Australia for 1978, which is particularly pleasing as this was the inaugural award.

During the year 1 029 full time and 45 part time staff and employees worked 1 835 917 man hours, and suffered 44 Lost Time Accidents (L.T.A.) with a further 143 Medical Treatment Accidents (M.T.A.) not involving loss of working time. Compared to the previous year, this represents an increase in the number of L.T.A.'s and a decrease in M.T.A.'s. The combined frequency rate for the two, however, has remained static at 100. There was a 25 per cent decrease in the accident duration rate.

Special mention has to be made of Walpole Division which completed its 8th consecutive accident-free year. The following divisions also worked for one or more years without a Lost Time Accident: Mundaring (4 years), Jarrahdale (2), Narrogin (2), Kirup (1), and the Cadet Training School (6).

Two important accident prevention training courses were conducted by the Industrial Foundation for Accident Prevention. These were of accident investigation and financial aspects of accidents. National Safety Council instructors were engaged to train 600 personnel in Defensive Driving Techniques. Nominated personnel attended specialist safety schools for shotfirers, laboratory technicians and welders as well as seminars on hearing conservation, manual handling and abrasives.

The Forests Department Safety Officer attended the inaugural meeting of State Government forest service safety officers in Melbourne.

The Department's accident prevention administration which now places greater emphasis on regional and divisional responsibility for the day-to-day safety management, proved to be functional and successful.

The table below sets out in more detail the Department's safety record over the last 13 years.

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

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 30 June, 1979

1977-78		1978-79
\$	<i>Royalties</i>	\$
4 885 803	Logs	5 387 161
290 383	Chip Logs	398 397
34 565	Sleepers	16 475
328 313	Poles and Piles	248 638
12 709	Mining Timber	14 407
16 215	Firewood	11 196
36 791	Posts	41 566
31 358	Sandalwood	31 693
25 959	Miscellaneous	61 927
<hr/>		<hr/>
5 662 096		6 211 460
	<i>Pine Conversion</i>	
1 296 420	Pine Logs	2 052 120
1 452 919	Sawn Pine	328 098
<hr/>		<hr/>
2 749 339		2 380 218
	<i>Hardwood Conversion</i>	
137 590	Sawn Hardwood	162 521
222 110	Logs	251 622
4 534	Posts and Other	3 456
<hr/>		<hr/>
364 234		417 599
	<i>Other Sales and Fees</i>	
106 069	Seeds and Trees	161 452
65 388	Inspection Fees	89 782
46 354	Rents and Leases	58 588
813 802	Miscellaneous	982 209
<hr/>		<hr/>
1 031 613		1 292 031
	<i>Recoupable Projects</i>	
161 068	Miscellaneous	238 131
<hr/>		<hr/>
161 068		238 131
<hr/>		<hr/>
9 968 350		10 539 439
....	<i>Less</i> Transfer of Departmental Revenue in part repayment of Treasurers Advance against cost of Pine Log Salvage Operations associated with Cyclone Alby	140 702
<hr/>		<hr/>
9 968 350		10 398 737

APPENDIX 1B

Forestry Fund Account for year ended 30 June, 1979

1977-78		1978-79
\$	<i>Expenditure</i>	\$ \$
1 227 595	Hardwood Forests—Establishment and Tending	1 350 660
2 327 307	Softwood Forests—Establishment and Tending	2 755 136
347 561	Access Roads Construction	373 141
80 638	Land Purchases	5 608
365 317	Plant and Equipment	231 308
188 060	Housing and Building	316 927
124 214	Sawmilling and Seasoning Plant .....	.....
1 802 990	Forest Protection	1 880 625
495 329	Access Roads Maintenance	533 245
922 227	Research and Other Services	1 413 498
2 024 155	Commercial Operations.....	2 278 531
116 291	Trade Operations	140 507
237 236	Recoupable Projects	273 171
	Salaries	6 008 507
5 601 381	Less Charged to Development	1 300 000
1 384 000		4 708 507
4 217 381	Administration Expenses	3 522 286
	Less Charged to Development	622 000
2 987 152		2 900 286
570 000	Cash Order Balance	78 967
2 417 152		19 240 117
29 469		
16 922 922		
	<i>Source of Revenue</i>	
543 381	Balance Brought Forward	392 404
321 849	Commonwealth Aid Road Grants	313 876
473 531	Commonwealth Softwood Agreement 1978-79	828 000
307 998	Mining Compensation	196 205
12 232 761	C.R.F. Contribution	14 128 370
2 250 000	General Loan Funds	2 603 000
1 000 000	Conservator's Borrowings	1 000 000
185 806	Sundry Revenue, Pine Plant Disposals etc.	53 106
17 315 326		19 514 961
392 404	Less Balance Carried Forward	274 844
16 922 922		19 240 117

APPENDIX 2A

Exports from Western Australia of Timber, Tanning Substances and Essential Oils for the Year ended 30 June, 1978

	Item and Destination	Quantity	Value		Item and Destination	Quantity	Value
1	Wood, in the rough or roughly squared— Conifer	m ³	\$		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— Flooring—	m ³	\$
	Interstate	N.R.S.	N.R.S.		Interstate (b)—		
	Overseas				New South Wales	1 232	223 729
2	Wood, in the rough or roughly squared, non-conifer (including poles, piling, posts and other wood in the rough)— Interstate (a)			7	Victoria	1 093	233 407
	Victoria	511	39 072		South Australia	671	150 194
	South Australia	76	6 865		Northern Territory	172	54 023
	Total	587	45 937		Total	3 168	661 353
	Overseas				Overseas (c)—		
3	Sleepers— Interstate—			8	Other (d)— Interstate—		
	South Australia	4 959	760 904		Northern Territory	5	1 747
	Total	4 959	760 904		Total	5	1 747
	Overseas—				Overseas—		
	France	97	11 107		Algeria	65	22 885
	Germany, Fed. Rep. of	281	41 803		Total	65	22 885
	South Africa, Rep. of	21	3 472		Total Timber Items 1-8	58 833	8 809 324
	United Kingdom	22 620	3 737 271	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—		
	Total	23 019	3 793 653		Interstate	N.R.S.	N.R.S.
	Timber sawn lengthwise, sliced or peeled, but not further prepared, of a thickness exceeding 5 mm—Non-conifer.				Overseas—		
4	Jarrah— Interstate—				Canada	2	102
	New South Wales	13	1 927		Mauritius	500	3 250
	Victoria	982	133 747		Singapore, Rep. of	6 500	33 968
	South Australia	7 725	936 425		Total	7 002	37 320
	Northern Territory	38	7 582	10	Reconstituted wood (also known as particle board, chip board, sliver board, shaving board, flake board, residue board and wood waste board)—		
	Total	8 758	1 079 681		Interstate	N.R.S.	N.R.S.
	Overseas—				Overseas	(e)	(e)
	Bahrain	21	5 164	11	Casks, vats, barrels, etc., Empty (e)—		
	Christmas Island	3	936		Interstate	N.R.S.	N.R.S.
	Greece	43	7 824		Overseas—		
	Iran	186	76 723		United Kingdom		10 926
	Libyan Arab Republic	63	20 200		Total		10 926
	Mauritius	51	8 839	12	Manufactures of wood (except furniture), N.E.I. (f)—		
	Singapore, Rep. of	10	2 000		Interstate—		
	South Africa, Rep. of	243	41 464		New South Wales		1 301 716
	United Arab Emirates	23	4 838		Victoria		1 546 509
	United Kingdom	184	38 323		Queensland		376 862
	U.S.A.	141	9 165		South Australia		671 197
	Total	968	215 476		Tasmania		42 466
5	Karri— Interstate—				Northern Territory		379 524
	New South Wales	4 812	593 297		Total		4 318 274
	Victoria	340	40 114		Overseas—		
	South Australia	9 747	1 172 392		Christmas Island		878
	Northern Territory	1 037	145 220		Hong Kong		20
	Total	15 936	1 951 023		Japan		140
	Overseas—				Malaysia		209 301
	Canada	34	8 493		Singapore, Rep. of		900
	Christmas Island	8	1 030		United Kingdom		66
	Germany, Fed. Rep. of	364	64 584		U.S.A.		4 493
	Greece	16	2 511		Total		215 798
	Saudi Arabia	8	2 221	13	Tanning substances of natural origin—	N.R.S.	N.R.S.
	South Africa, Rep. of	534	87 891	14	Essential oils; concretes and absolutes; resinoids—		
	South West Africa	9	1 464		Interstate—		
	United Kingdom	35	5 716		Victoria		41 280
	U.S.A.	348	99 220		South Australia		72
	Total	1 356	273 130		Northern Territory		70
6	Other— Interstate—				Total		41 422
	South Australia		36		Overseas—		
	Northern Territory	12	3 499		Kenya	1 200	1 349
	Total	12	3 535		Total	1 200	1 349
	Overseas				Total value of exports on this return		13 434 413

(a) Includes exports of conifer wood in the rough; See Item 1.

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

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

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

(e) Details are not available for publication.

(f) Includes cork manufactures.

"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 Bureau of Statistics)

APPENDIX 2B

Imports into Western Australia of Timber, Timber Products, Tanning Substances and Essential Oils for the Year ended 30 June, 1978

	Item and Origin	Quantity	Value		Item and Origin	Quantity	Value			
1	Sawlogs and veneer logs, in the rough or roughly squared, non-conifer, (including poles, piling, posts and other wood in the rough)— Interstate Overseas (a)— France Germany, Fed. Rep. of Mexico Philippines, Rep. of the U.S.A. Total	m ³ N.R.S. 2 1	\$ N.R.S. 1 646 15 1 838 13 90 3 602	12	Shooks and staves, sawn lengthwise, sliced or peeled, but not further prepared, of a thickness exceeding 5 mm— Interstate Overseas	m ³ N.R.S.	\$ N.R.S.			
2	Railway Sleepers— Interstate Overseas— Malaysia Philippines, Rep. of the Singapore, Rep. of	N.R.S. 11 912 1 772 2 195 15 879	N.R.S. 2 146 791 271 953 487 863 2 906 607	13	Wooden beading and mouldings (including moulded skirting and other moulded boards)— Interstate (c) Overseas— Belgium-Luxembourg Canada China—Taiwan Prov. only India Italy Japan Malaysia United Kingdom U.S.A. Total	N.R.S. N.R.S. 358 18 956 10 924 109 3 671 18 173 52 773 58 262 262 163 488				
3	Timber, sawn lengthwise, sliced or peeled, but not further prepared, of a thickness exceeding 5 mm—Conifer (b)— Douglas Fir— Interstate Overseas— U.S.A. Total	N.R.S. N.R.S. 1 274 1 274	N.R.S. N.R.S. 246 473 246 473	14	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— Flooring— Interstate Overseas (d)	N.R.S. N.R.S.				
4	Other— Interstate Overseas— New Zealand U.S.A. Total	N.R.S. 36 176 212	N.R.S. 2 720 39 259 41 979	15	Other— Interstate Overseas— Canada China—Taiwan Prov. only Germany, Fed. Rep. of Indonesia Malaysia Singapore, Rep. of U.S.A. Total	N.R.S. N.R.S. 255 54 3 21 2 421 187 986 3 927	66 043 18 299 4 244 4 058 516 734 42 718 201 108 853 204			
5	Timber, sawn lengthwise, sliced or peeled, but not further prepared, of a thickness exceeding 5 mm—Non-Conifer (b)— Meranti— Interstate Overseas— Malaysia Singapore, Rep. of	N.R.S. N.R.S. 2 520 579 3 099	N.R.S. N.R.S. 270 534 58 704 329 238	Total Timber Items 2-15 (e) 8 588 376						
6	Ramin— Interstate Overseas— Indonesia Malaysia Singapore, Rep. of	N.R.S. 154 601 551 1 306	N.R.S. 21 233 88 706 57 307 167 246	16	Wood, sawn lengthwise, sliced or peeled, but not further prepared, veneer sheets and sheets for plywood, of a thickness not exceeding 5 mm; plywood, blockboard, laminboard and the like, inlaid wood, cellular wood panels, whether or not faced with base metal— Interstate— New South Wales Victoria Queensland South Australia Total	m ² N.R.S.	\$ N.R.S. 441 789 426 117 389 972 92 599 1 350 477			
7	Teak— Interstate Overseas— Burma, Soc. Rep. of the Union of Singapore, Rep. of Thailand Total	N.R.S. N.R.S. 23 3 209 235	N.R.S. N.R.S. 10 785 1 199 112 352 124 336		Overseas— Austria Canada China—Taiwan Prov. only Germany, Fed. Rep. of Hong Kong India Italy Ivory Coast Japan Korea, Rep. of Malaysia Singapore, Rep. of South Africa, Rep. of Thailand United Kingdom U.S.A. Total	3 038 713 3 600 665 2 23 426 2 000 17 774 11 252 16 351 52 442 774 459 728 459 301 667 13 120 8 364 3 656 5 557 388	2 507 3 484 1 018 218 202 6 716 1 606 15 540 4 480 8 940 15 942 214 742 275 149 164 808 20 907 16 538 1 493 1 771 272			
8	Kapur— Interstate Overseas— Malaysia Singapore, Rep. of	N.R.S. 6 384 173 6 557	N.R.S. 765 079 16 535 781 614	17	Reconstituted wood (also known as particle board, chip board, sliver board, shaving board, flake board, residue board and wood waste/ board)— Interstate (f) Total	N.R.S. N.R.S. 14 901 422 15 323	N.R.S. N.R.S. 1 990 957 57 018 2 047 975	Overseas— Canada Total	899 276 277 277	Total Timber Items 16-17 6 474 284 Total Timber Items 2-17 (e) 15 062 660
9	Keruing— Interstate Overseas— Malaysia Singapore, Rep. of	N.R.S. N.R.S. 6 418 76 6 494	N.R.S. N.R.S. 552 084 6 413 558 497	18	Match Splints— Interstate (c) Overseas	N.R.S. N.R.S.	N.R.S. N.R.S.			
10	Nyatoh— Interstate Overseas— Malaysia Singapore, Rep. of	N.R.S. N.R.S. 14 901 422 15 323	N.R.S. N.R.S. 1 990 957 57 018 2 047 975							
11	Other— Interstate Overseas— Malaysia New Zealand Papua New Guinea Philippines, Rep. of the Singapore, Rep. of United Kingdom Total	N.R.S. N.R.S. 1 846 63 36 160 221 22 2 348	N.R.S. N.R.S. 187 386 4 942 5 533 13 145 22 621 19 633 253 260							

APPENDIX 2B—continued

Imports into Western Australia of Timber, Timber Products, Tanning Substances and Essential Oils for the Year ended 30 June, 1978

	Item and Origin	Quantity	Value		Item and Origin	Quantity	Value	
19	Rulers, Wooden—	Number	\$	26	Furniture, wood or wood framed (i)—		\$	
	Interstate (c)	N.R.S.	N.R.S.		Interstate—			
	Overseas—				New South Wales		226 185	
	Hong Kong	600	376		Victoria		1 007 065	
	Netherlands	3 600	2 847		Queensland		1 059	
	Switzerland	50	89	South Australia		514 108		
	United Kingdom	3 247	6 869	Tasmania		550		
	Total	7 497	10 181	Total		1 748 967		
20	Table Mats, Wooden (c)	N.R.S.	N.R.S.	Overseas—				
21	Wood Flour—	N.R.S.	N.R.S.	Belgium-Luxembourg		298		
	Interstate (c)	N.R.S.	N.R.S.	Brazil		500		
	Overseas			China-Excl. Taiwan Prov.		6 573		
22	Clothes Pegs, Wooden (c)	N.R.S.	N.R.S.	China-Taiwan Prov. only		842 619		
	23	Tool handles, Wooden			Czechoslovakia		18 289	
		Interstate (g)—			Denmark		11 070	
		New South Wales		6 207	France		15 025	
		Victoria		4 595	Germany, Fed. Rep. of		1 829	
Queensland			138 977	Greece		956		
	Total		149 779	Hong Kong		36 052		
	Overseas—			India		1 790		
	Germany, Fed. Rep. of	190	114	Indonesia		2 058		
	Japan	48	67	Israel		30 255		
	Switzerland	35	36	Italy		546 545		
	United Kingdom	210	216	Japan		68 142		
	U.S.A.	8 996	12 425	Kenya		490		
	Total	9 479	12 858	Korea, Rep. of		6 567		
24	Doors not incorporating locks, hinges or similar fittings—			Malaysia		26 509		
	Interstate—			Netherlands		38		
	New South Wales	56 142	920 612	New Zealand		32 575		
	Victoria	18	124	Norway		1 593		
	South Australia	38 472	245 608	Philippines, Rep. of the		57 084		
	Total	94 632	1 166 344	Singapore, Rep. of		144 778		
	Overseas—			South Africa, Rep. of		7 334		
	China—Taiwan Prov. only	31 826	201 670	Spain		873		
	Singapore, Rep. of	5 961	29 979	Sri Lanka		463		
	Total	37 787	231 649	Sweden		954		
25	Manufactures of wood (except furniture) N.E.I. (h)—			Thailand		668		
	Interstate—			United Kingdom		467 023		
	New South Wales		792 964	U.S.A.		79 860		
	Victoria		881 150	Yugoslavia		13 427		
	Queensland		196 173	Re-import		455		
	South Australia		246 079	Total		2 422 692		
	Total		2 116 366					
	Overseas—			Tanning Extracts of Vegetable Origin				
	Albania		31	Wattle Bark extract—				
	Belgium-Luxembourg		16	Interstate (j)	kg	N.R.S.	N.R.S.	
	Canada		128 285	Overseas—				
	China-Excl. Taiwan Prov.		2 533	South Africa, Rep. of	563 000	251 280		
	China-Taiwan Prov. only		339 845	Total	563 000	251 280		
	Denmark		43 544					
	Finland		276	27	Other—			
	France		252	Interstate (j)	N.R.S.	N.R.S.		
	Germany, Fed. Rep. of		9 075	Overseas—				
	Hong Kong		15 344	Italy	49 000	24 832		
	India		4 579	South Africa, Rep. of	236 400	101 880		
	Indonesia		9 126	United Kingdom	7 425	19 716		
	Ireland		338	Total	292 825	146 428		
	Israel		7					
	Italy		30 019	28	Synthetic Tanning Substances, Artificial			
	Japan		40 853	Bates for Pre-Tanning; Tannings (Tannic				
	Kenya		1 192	Acids) and their Salts, Esters and Other				
	Korea, Rep. of		1 005	Derivatives—				
	Malaysia		79 919	Interstate (k)—				
	Mexico		296	New South Wales		109 348		
	Netherlands		1 924	Victoria		276 358		
	New Zealand		5 611	Queensland		2 127		
	Norway		854	South Australia		1 217		
	Pakistan, Islamic Rep. of		43	Total		389 050		
	Philippines, Rep. of the		111 485	Overseas—				
	Poland		120	Belgium-Luxembourg	2 000	10 999		
	Portugal		60	Germany, Fed. Rep. of	2 000	1 016		
	Singapore, Rep. of		15 453	New Zealand	15 428	6 800		
	South Africa, Rep. of		5 542	South Africa, Rep. of	10 000	3 945		
	Spain		12 159	United Kingdom	72 010	103 151		
	Sri Lanka		26	Total	101 438	125 911		
	Sweden		4 373					
	Switzerland		569	30	Essential Oils; concretes and absolutes; resin-			
	Thailand		58 882	oids—				
	United Kingdom		51 026	Interstate—	N.R.S.	N.R.S.		
	U.S.A.		143 430	Overseas—				
	Yugoslavia		364	Austria	50	548		
	Total		1 118 456	United Kingdom	4	72		
				Total	54	620		
				Total value of imports on this return		24 953 241		

- (a) Excludes overseas imports of veneer logs in the rough. Details are not available for publication.
- (b) Overseas imports exclude shooks and staves, see Item 12.
- (c) Details included in Item 25.
- (d) Relates to overseas imports of conifer flooring only.
- (e) Includes an interstate value of \$114 459 covering Items 1-12, 14 and 15.
- (f) State details are not available for publication.
- (g) Includes brush and broom handles and the like.
- (h) See footnote (c).
- (i) Excludes imports, if any, of wooden medical, dental, surgical or veterinary furniture, non-domestic chairs and furniture parts.
- (j) Details included in Item 29.
- (k) Includes details of Items 27 and 28.

"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	58 833	8 809 324	4 625 089	41 422
1979†				

* 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	24 039 952	912 669	620
1979†			

† 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	1 459 798
1969	1 143 705	160 771	1 304 476
1970	1 121 396	175 686	1 297 082
1971	1 145 161	161 990	1 307 151
1972	1 096 236	106 993	1 203 229
1973	1 060 359	102 992	1 163 351
1974	1 084 463	91 884	1 176 347
1975	1 096 356	87 957	1 184 313
1976	1 194 667	111 761	1 306 428
1977	1 429 493	106 848	1 536 341
1978	1 445 465	119 706	1 565 171
1979	1 489 515	129 665	1 619 180

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

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

APPENDIX 6

SUMMARY OF EXPORTS OF FOREST PRODUCTS
FORESTS DEPARTMENT RESEARCH PAPERS PUBLISHED

No.	Author	DURING THE YEAR ENDED 30 JUNE, 1979		Title
		Value	m ³	
42	P. Jones	2	2	Fuel-removal, fuel conditions and seedbed preparation in karri slash disposal burns. 1978.
43	D. Whiteley	8 236 932	13 081 830	Sediment in streams near logging areas in the Pemberton district. 1978.
44	C. Schuster	3 016 820	84 252 48	The effect of plant spacing on the early development of karri (<i>Eucalyptus diversicolor</i> F. Muell.). 1978.
45	F. E. Bunn and A. Kirk	3 306 600	101 191	Salinity sampling in the Helena Catchment, Western Australia. 1978.
46	D. Ward	3 110 802	100 127	Computer sorting of Western Australian site-vegetation types. 1978.
47	J. F. McGrath	2 309 241	28 833	Response to phosphorus fertilisation of <i>Pinus radiata</i> grown on the Donnybrook Sunkland. 1978.
48	G. S. McCutcheon	3 769 461	100 127	Broadscale forest site survey techniques used in the Donnybrook Sunkland. 1978.
49	J. D. Majer	1 322 278	100 127	Further notes on the food requirements of the mardo (<i>Antechinus flavipes</i> (Waterhouse)). 1978.
50	P. E. S. Christensen and C. J. Schuster	993 199	10 139 072	Some factors affecting the germination of karri (<i>Eucalyptus diversicolor</i> F. Muell.) seed. 1979.
51	F. H. McKinnell	202 173	17 222	Silviculture of <i>Pinus radiata</i> in an agroforestry management system. 1979.
52	P. D. Stirling	4 652 089	8 802 222	Subsurface sampling in a small subcatchment in the Donnybrook Sunkland. 1979.
53	J. F. McGrath	72 627	8 132 222	Initial fertiliser requirements of exotic eucalypts on the Donnybrook Sunkland. 1979.
54	C. J. Schuster	123 169	1 000 000	Rehabilitation of soils damaged by logging in south-west Western Australia. 1979.

† Not available

APPENDIX 5

SUMMARY OF LOG PRODUCTION

Year	Private Property m ³	Crown Land m ³	Total m ³
1979	12 422 498	44 466 201	78 702 712*
1978	528 281	1 231 217	1 429 978
1977	160 771	1 143 202	1 304 476
1976	172 686	1 121 396	1 297 082
1975	161 990	1 142 161	1 307 121
1974	106 993	1 066 236	1 203 229
1973	102 972	1 060 329	1 163 321
1972	91 884	1 084 463	1 176 347
1971	87 927	1 066 326	1 184 313
1970	111 761	1 194 667	1 306 428
1969	106 848	1 429 493	1 236 341
1968	119 706	1 442 462	1 262 171
1967	129 662	1 489 212	1 619 180

Note—As in previous years this total includes log material used for reconstituted wood and chipwood. * Includes 18 783 746 m³ estimated cut prior to 1977.