SOUTHERN REGION OPERATIONS

- TOUR NOTES -

FORESTS DEPARTMENT

WESTERN AUSTRALIA

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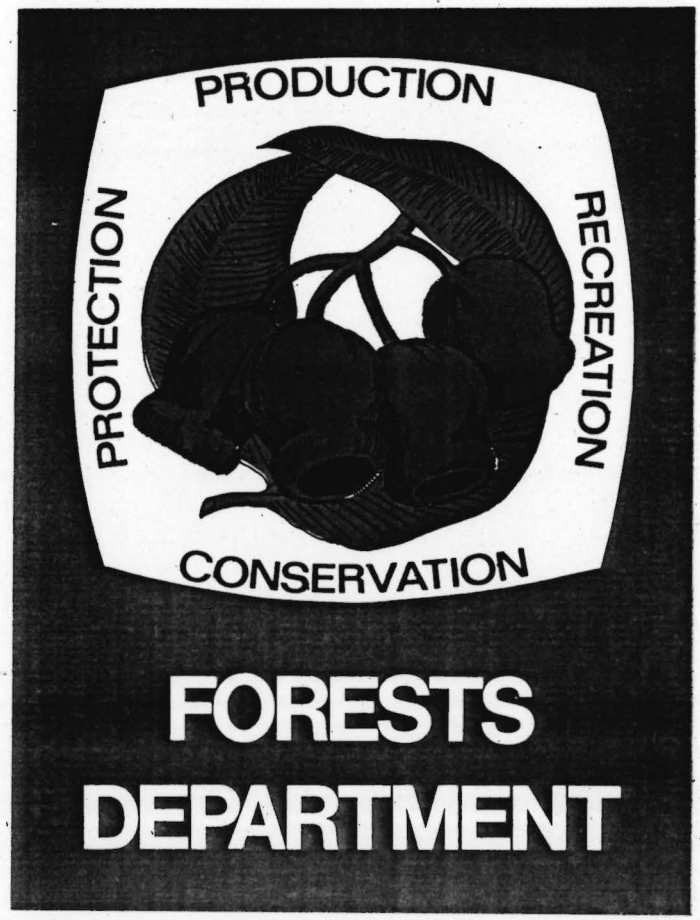

CONTENTS

BRIEFING NOTES

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OPERATIONS IN THE SOUTHERN REGION

The Southern Region encompasses the main Karri belt and a substantial area of "Southern" jarrah. Southern jarrah differs from northern jarrah in that in general it occurs on podsols rather than laterite, has a higher proportion of marri in mixture and higher proportion of acacias in the understorey.

The area of State Forest and Timber Reserve is 627,000ha (Under F.D. Control). Within the region there are 11 major sawmills and together with some smaller mills cut 384,000 m^3/annum. A chipmill cuts 395,000 m^3/annum. (1982)

Other than small local supplies there are no major active water catchments.

Tourism is steadily growing, with a significant number being from other states.

About 60% of the local economy is based on the timber industry, the remainder being mainly intensive agriculture, beef and sheep.

Forests Department staff is: 19 professionals
81 field and technical staff
102 employees

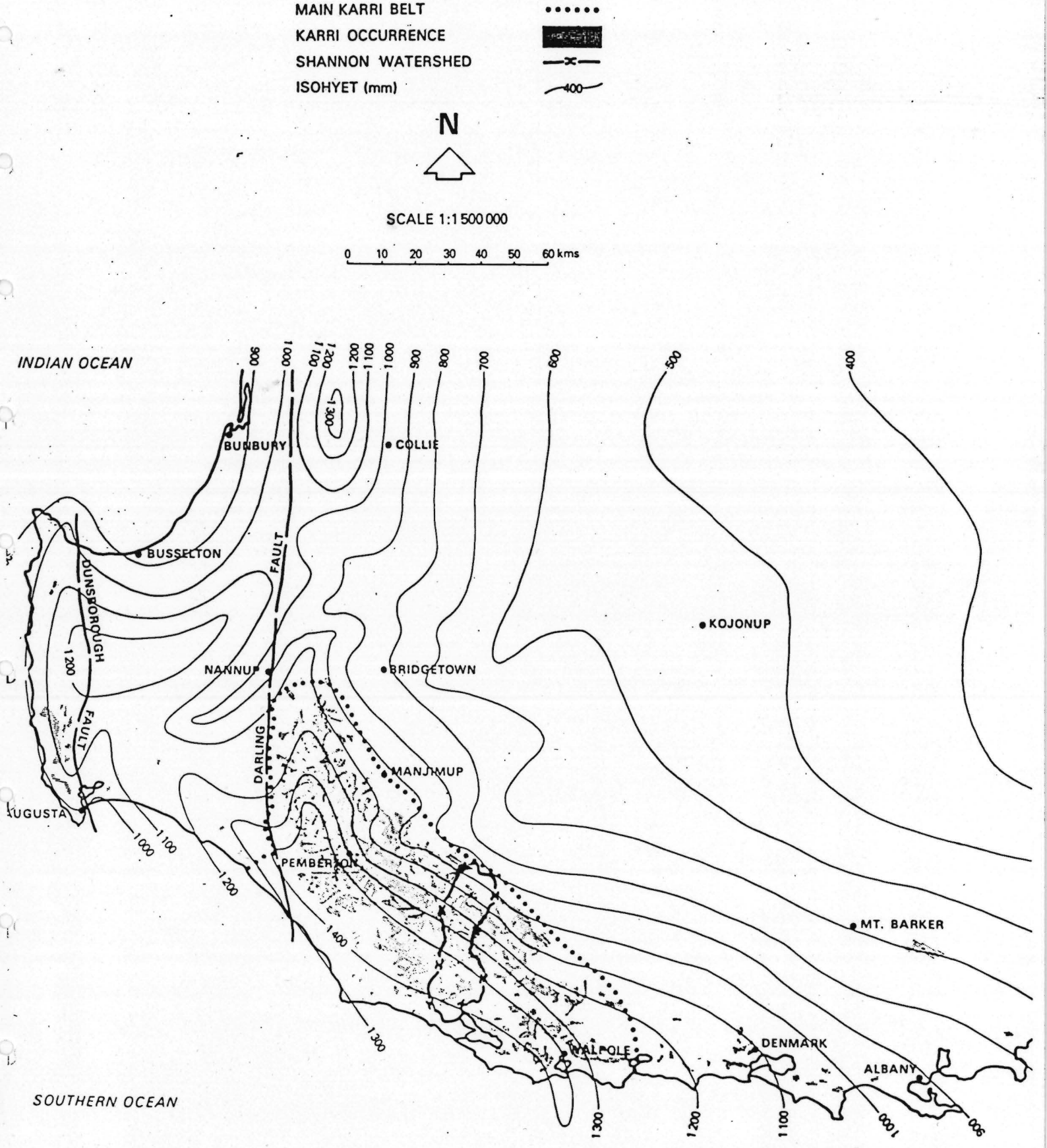
KARRI OCCURRENCE:

Within the main belt, karri does not occur in large continuous tracts but in discrete stands where favourable soils occur. The stands of karri are interspersed with jarrah and jarrah-marri forests and treeless flats and swamps (Table 1).

TABLE 1 VEGETATION TYPE IN THE MAIN KARRI BELT

	CROWN LAND *Hectares*	PRIVATE PROPERTY *Hectares*
Pure Karri	59 000	2 500
Karri mixed with other species.	104 000	7 500
Cleared land (Previously Karri)	2 500	33 000
Cleared land (Previously Other Type)	2 000	26 000
Other Forest	200 000	14 000
Other native vegetation	135 500	15 500
Mobile dunes	10 500	150

KARRI DISTRIBUTION



FOREST USES:

The forest area is divided into a number of priority uses. These are summarised below for the main Karri belt.

SUMMARY OF MANAGEMENT PRIORITIES AND NATIONAL PARKS IN MAIN KARRI BELT

	PERCENTAGE		
	KARRI FOREST	OTHER	TOTAL
ALLOCATION			
1. Preservation, recreation, road, river and stream reserves.	26.3%	19.4%	20.9%
2. Wood production	57.5%	45.5%	49.7%
3. Forest values, catchment protection, scientific, silviculture.	6.7%	8.6%	8.7%
4. National Park and Proposed National Park.	8.0%	22.4%	17.5%
5. Other Crown Land	1.5%	4.1%	3.2%
TOTAL	100%	100%	100%

For convenience, the operations will be considered in terms of the area covered by the Chipwood Licence area.

PLANNING:

The basis for planning is the multiple use concept, expressed in terms of priority uses. (The overriding objective is to maintain the entire forest as a viable conservation unit and not, as seen by some people, as separate areas for exclusive uses, each being viable in their own right as if they were separate islands.

TABLE 1 LAND USE WITHIN WACAP LICENCE AREA

	KARRI TYPE	OTHER TYPE	TOTAL
Flora, Fauna, Landscape			
*a) Preservation	8.2%	5.2%	5.9%
b) Fauna Management	-	6.7%	5.1%
c) Silviculture	3.1%	0.7%	1.3%
* Recreation	1.2%	0.1%	0.4%
* Road, River & Stream	17.2%	11.5%	12.9%
Scientific Research	0.4%	0.7%	0.6%
Catchment Protection	0.3%	15.4%	11.9%
Forest Protection	1.6%	7.6%	6.2%
Wood Production	59.0%	36.0%	41.3%
* National Park and Proposed National Park	7.6%	13.3%	12.0%
Other Crown Land	1.4%	2.8%	2.4%
TOTAL CROWN LAND	160,750ha (100%)	526,451ha (100%)	687,201ha (100%)
(TOTAL OF *)	34.2%	30.1%	31.2%

PLUS PRIVATE PROPERTY 162,704 ha

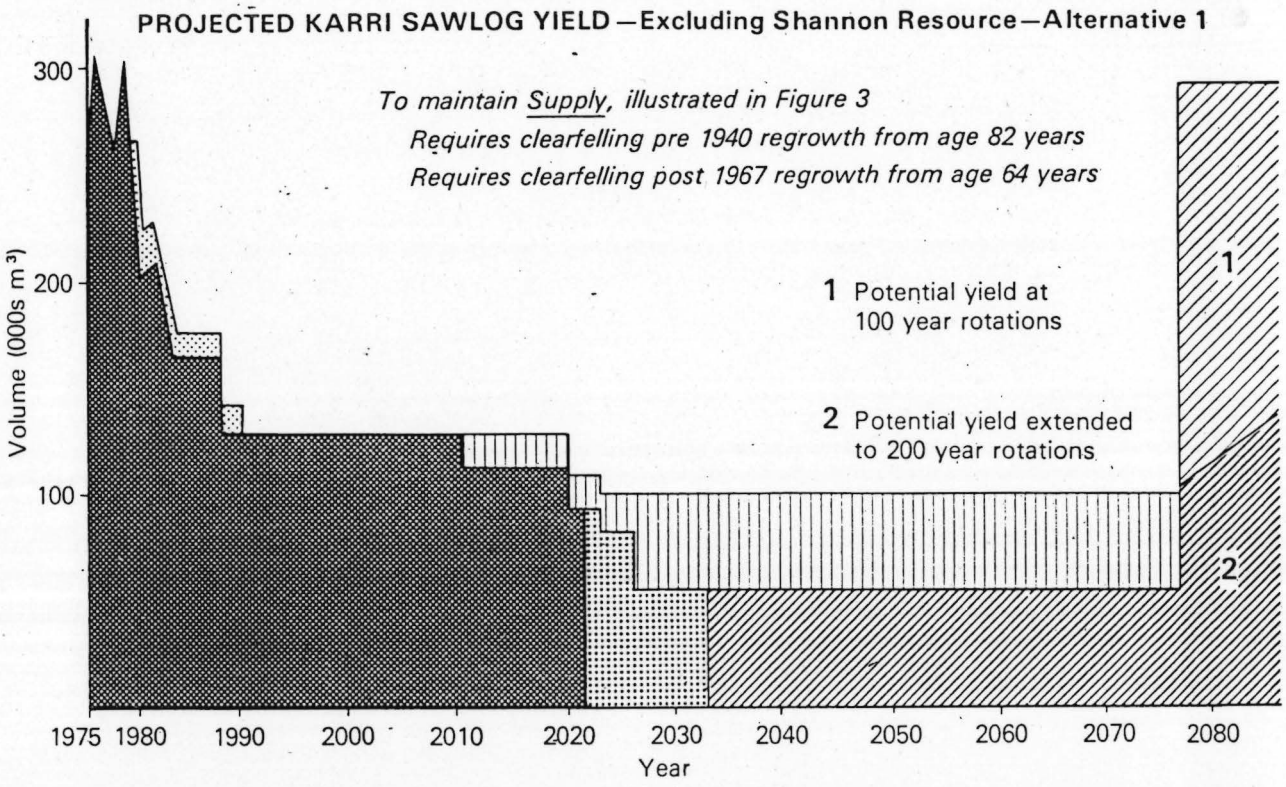
The logic behind the selection of these priority use areas and their management objective is explained in "Conservation of the Karri Forest".

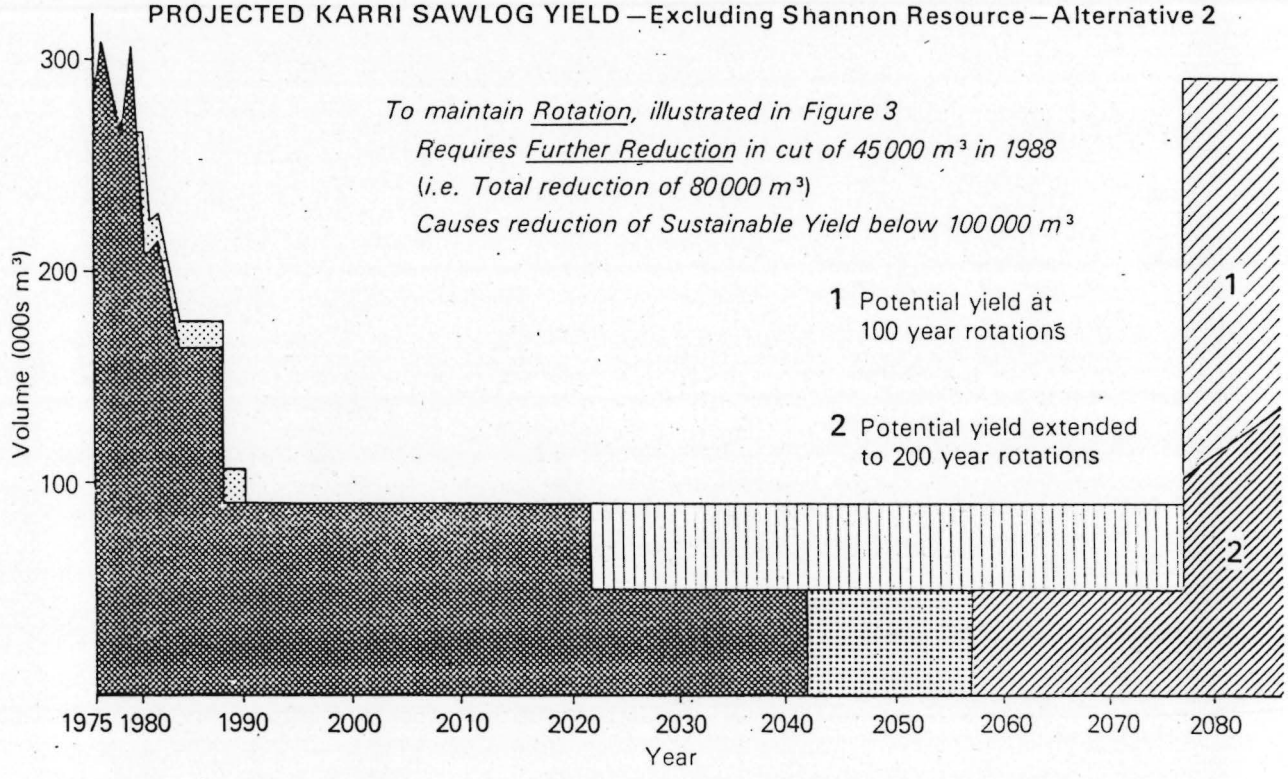
PRODUCTION FORESTS:

Production from Karri forests is carried out within the framework of long term yield predictions aiming at a minimum of 100 year rotation, and minimum yield of 100,000 m^3/annum. (Figure 1.) Because about $\frac{1}{3}$ of the Karri forest has been allocated uses other than production in recent times, severe reductions in permissible cut are required and we are in the process of implementing these. 45% between 1976 and 1982, 22% between 1982 and 1988.

Jarrah production is tied to production in the remainder of the State and to oncoming pine production to achieve overall State self sufficiency. Jarrah is not seen as a major long term production component in the future. Jarrah planning and silviculture have not reached the same degree of refinement as has Karri management.

FIGURE 1





Old Growth Clearfellings

Pre 1940 Regrowth Clearfellings

Pre 1940 Regrowth Thinnings

Post 1967 Regrowth Clearfellings

Post 1967 Regrowth Thinnings

Short term (4 year) rolling logging plans are prepared by the Department to take account of a whole variety of operational constraints - these include:

1. the need for integration of logging to produce the required amount of sawlog and chipwood from the same area each year.

2. dieback quarantine.

3. strategic fire protection (discussed later)

4. regeneration requirements.

5. coupe size and dispersal

and many others.

Detailed plans and prescriptions are prepared for the current year, actual performance and yield is monitored annually and used to make adjustments to future plans.

REGENERATION:

Karri - the silvicultural system used for Karri is:

1. clear felling with seed trees.

2. clear felling and planting.

3. clear felling and seeding.

Karri seeds on about a 5 year cycle. Holding seed trees for this period is not practiced because of:

- deterioration of seed trees.
- high fire risk of slash.
- inability to burn large areas in one year.
- imbalance of funds and work force required from year to year.
- inability to remove all seed trees within two years of the regeneration burn before suppression of regrowth occurs. For these reasons planting (with open-rooted stock) is employed between seed years. Seeding is used only to a limited extent because of excessive cost of seed. Specialised seed production areas are planned to overcome this problem.

TABLE 2 RELATIVE COSTS AND RETURNS OF SILVICULTURAL SYSTEMS

1981 ROYALTY V REGENERATION COSTS			
		WITH WOODCHIPPING	WITHOUT WOODCHIPPING
INCOME	ROYALTY (For Average Yield)	PER HA	PER HA
	SAWLOG - 78m^3/ha @ $9.60	$ 749	$ 749
	CHIPWOOD - 150m^3/ha @ $3.15	$ 472	-
	TOTAL	$1221	$ 749
COSTS	REGENERATION		
	Option 1. Seed Trees	$ 85	$ 173
	Return/ha	$1136	$ 576
	Option 2. Hand Planting	$ 225	$ 313
	Return/ha	$ 996	$ 436
	Option 3. Hand Seeding	$ 173	$ 225
	Return/ha	$1048	$ 524

Following germination assessments refilling is carried out in the following winter if required. Landings and snig tracks are ripped by the industry and planted with jiffy pot stock.

JARRAH

Jarrah silviculture has been in a state of change in recent times and a variety of systems have been used. Some areas are logged for sawlogs only, others for sawlogs and chipwood. A Group Selection System is now employed. In some cases this fits the pre-existing condition of the stand, in other cases it is an artificial imposition largely for aesthetic reasons. The primary concern is to ensure that gaps and groups are of a size which allows a subsequent cut to be carried out without damage to regrowth.

PROTECTION:

Regeneration is damaged by even a mild fire for the first 15 - 20 years for Karri and about 10 years for jarrah.

Our primary fire protection strategy is based on fuel reduction by burning and is only economically feasible on a large scale if carried out by aircraft. This requires relatively large areas available for burning. Regional protection is achieved by the establishment of strategic burning strips large enough for aerial burning. No cutting (and therefore regeneration) takes place in these strips. Logging and regeneration is carried out outside these strips in such a way as to create alternative strips which when 15 - 20 years old can replace the present strategic strips and make them available for cutting.

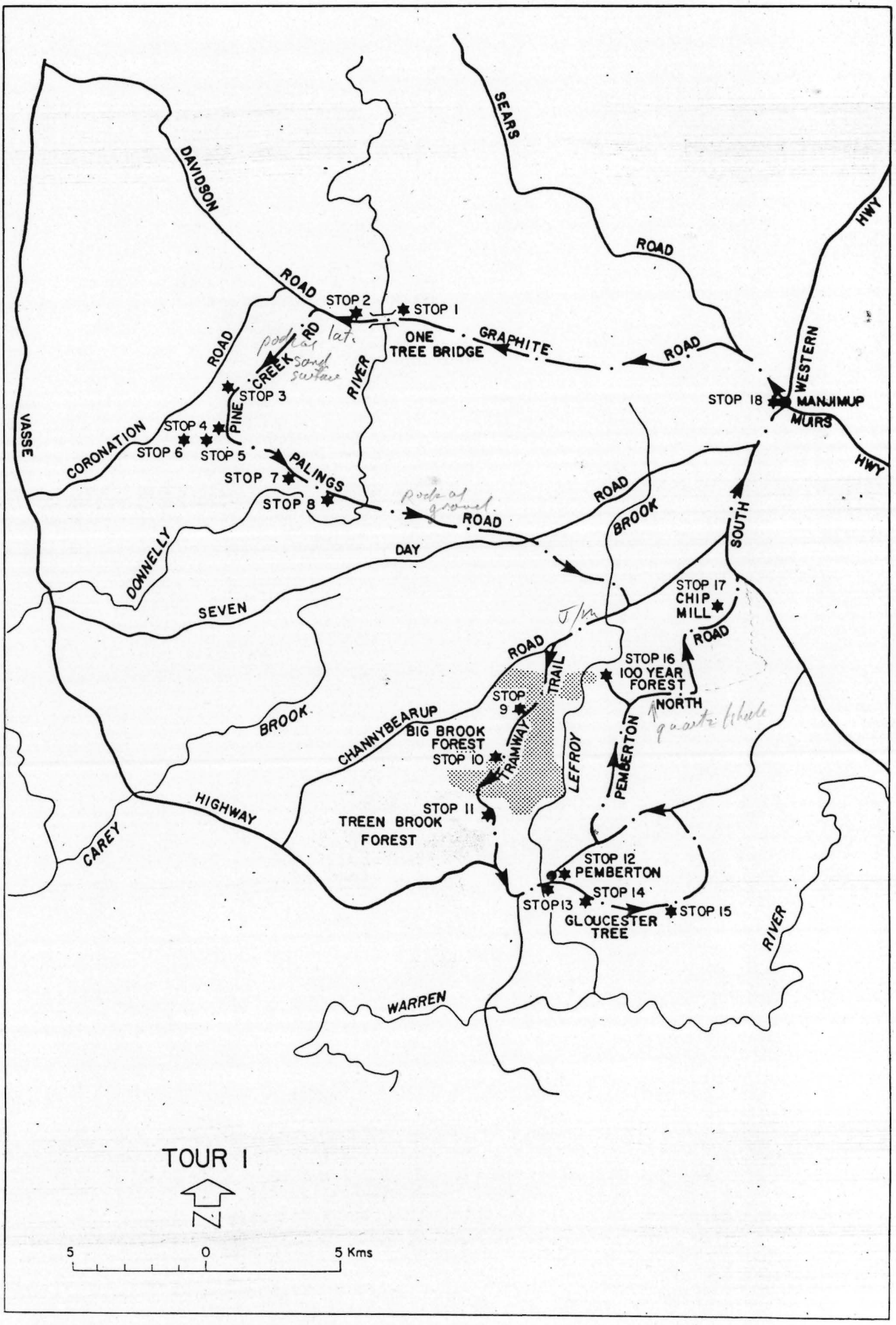
INTEGRATION:

The key to the success of the operation is integration of the various policies and practices. This requires relatively detailed planning over a 20 year time span within a longer term outline plan. Such planning is critical to provide sufficient forewarning of policy changes which may be required to prevent irreconcilable conflicts. This has been made more critical in recent times due to changes in the available resource base.

While this integration has been carried out with considerable success in Karri management, a good deal more work is required to bring jarrah management to the same level.

The complexity of these factors and the planning involved led to the development in this region of the Forest Management Information System. A data base incorporating some 45 attributes for the entire region has now been completed and the system is in constant use for planning purposes.

TOUR NOTES


SEARS
ROAD
HWY
DAVIDSON
ROAD
STOP 2
STOP 1
ONE TREE BRIDGE
GRAPHITE
ROAD
WESTERN
ROAD
PINE
CREEK
RIVER
STOP 3
STOP 18
MANJIMUP
VASSE
CORONATION
STOP 4
STOP 6
STOP 5
MURRS
HWY
PALINGS
STOP 7
STOP 8
ROAD
ROAD
BROOK
SOUTH
DONNELLY
DAY
SEVEN
STOP 17
CHIP MILL
ROAD
ROAD
TRAIL
STOP 16
100 YEAR FOREST
STOP 9
NORTH
BROOK
CHANNYBEARUP
BIG BROOK FOREST
STOP 10
TRAMWAY
LEFROY
PEMBERTON
HIGHWAY
STOP 11
TREEN BROOK FOREST
CAREY
STOP 12
PEMBERTON
STOP 14
STOP 13
GLOUCESTER TREE
STOP 15
RIVER
WARREN
TOUR 1
N
5
0
5 Kms

1. MANJIMUP FORESTRY NURSERY (NOT VISITED)

The Manjimup Nursery raises eucalypt seedlings for a number of requirements. Each year, upto 2.5 million open-rooted seedlings are raised for the reforestation of cutover karri and karri-marri coupes within the Southern Region.

Container grown seedlings are raised for difficult sites such as compacted landings, snig tracks and gravel pits. Some 500,000 containerised seedlings are provided for the Department's rehabilitation work on these sites. Another 600,000 plants are raised for the PWD project in the Wellington Catchment which involves the reforestation of re-purchased farms with the aim of reducing the salination of soils and streams within the Catchment.

The Nursery has been designed to allow for further expansion should this be necessary in future. It is envisaged that a large increase in demand will occur from farmers wishing to replant their farms for shade, shelter, soil protection and wood-production purposes.

OPEN-ROOTED SEEDLINGS

Open rooted seedlings are raised in long narrow beds within plots that cover some 3 to 4 hectares. The beds are specially prepared and treated to provide a disease-free and weed free environment for rapid early growth. Following seeding in December, young germinants are kept constantly moist by regular watering with a fine mist spray. The seedlings are gradually hardened to ensure maximum survival after outplanting, by reducing the watering, and by a regime of regular root pruning. The latter results in a fibrous root system and toughened shoot development which are necessary for successful transplanting from the nursery to the field. By the start of June, the plants average 20 to 25 cm in height. They are then progressively lifted and transported to the planting sites where they are hand planted by Forests Department Crews during the wet winter months.

The success of this method of raising plants can be gauged from their high field survival rates (better than 90 percent) and their low production costs (2 cents each).

CONTAINERISED STOCK

Approximately 1.1 million seedlings consisting of 70 different eucalypt species are being raised in peat (jiffy) pots for outplanting on harsh and difficult sites each year. The species being raised include fast growing eucalypts for wood production, salt tolerant trees for saline areas, and shade and shelter trees as well as ornamentals for landscape and aesthetic purposes.

The soil mix used consists of medium coarse sand, mature sawdust and some peat plus calibrated additions of fertilizer components. The soil is mechanically mixed and poured into the peat pots, and then steam sterilized to eliminate pathogens and weeds. Sowing is also done mechanically using a vacuum plate process which allows upto 10,000 pots to be sown in an hour. Trays of sown pots are transported to the growing areas where they are regularly watered and, if necessary, treated for fungal infections. The water is chlorinated and strict hygiene precautions are observed in all facets of the operation to ensure disease-free plants throughout the nursery.

Containerized plants are delivered to their various destinations (as far as Narrogin) by a large Forests Department pantechnicon trailer capable of carrying 55,000 plants at a time.

OTHER DEVELOPMENTS

Besides the Nursery, the West Manjimup complex contains a number of other Forests Department developments. These include the Forest Cadet Training and Accommodation centre, the *P. radiata* seed orchard, karri seed orchards and seed production areas, jarrah provenance trial plot and an *Eucalypt globulus* (Blue Gum) provenance trial plot. A seed extraction plant for both eucalypt and pine seed is planned to be built later this year.

STOP 1 RECREATION MANAGEMENT - ONE TREE BRIDGE

A Management Priority Area for recreation 670ha adjacent to the Donnelly River includes an interesting historic feature, a series of picnic sites, walk trails, scenic drives, access to several kilometres of prime river and notable stands of Karri. It is one of several areas designated as Recreation priority in the Karri Region, totalling 3,000ha, to which can be added over 50,000ha of roadside Amenity Reserve.

One Tree Bridge was originally constructed in 1904 by felling of a Karri tree across the river to provide access to graphite deposits in the area. It served as the only crossing for vehicles for over 50 years. Later washed away by floods it lay on the bank of the river for many years, until pulled out by the Forests Department to its present position, as the focal point for day visitors to the picnic area.

Downstream Glenoran Pool is a popular swimming hole in summer. Trout and Marron (fresh water crayfish) fishing are popular in the water-ways of the Karri forest.

The Bibbulmun Track, a long distance walking trail passes through this area. One of the most popular sections of this track is the route south of One Tree Bridge which crosses seven historic timber bridges - relics of the tramway log hauling days.

STOP 2 THE FOUR ACES

This site is still within the One Tree Bridge Recreation M.P.A. and it features four magnificant Karri trees perfectly aligned. The theory of how this phenomenon occurred is that when an old log burns away the subsequent ashbed provides a perfect site for new seedlings to germinate and develop. Probably hundreds of seedlings from the same parent tree germinated together along such an ashbed at this site about 300 years ago. The best four have grown side by side to maturity. Today only 10m separates the tallest from the shortest of the four. In sequence from the road the height of the trees is No. 1 69m, No. 2 70m, No. 3 79m, No. 4 77m.

The tallest existing Karri tree is in the Deep River area and measures 88m (290 feet).

STOP 3 PINE CREEK ROAD - SELECTION CUTTING

This site demonstrates a Karri forest cut under the Group Selection System. This silvicultural method was used in Karri forests from 1940 to 1967. Prior to that between 1925 and 1940 clear felling was used in Karri forests. Results were very successful but selection cutting was introduced for the following reasons:

(a) Inability to sell small size karri material.

(b) Need to increase the area of activity to open up fire control access and to salvage fire damage material.

(c) Previous association of clear felling with subsequent alienation of agriculture - a very real political pressure

Reasons for abandoning selection felling, include:-

(a) Difficulty of managing the second felling cycle into established regeneration, including felling and subsequent regeneration burning.

(b) Difficulties with initial regeneration burn, protection of retained crop trees.

(c) Difficulties experienced with the broadscale nature of activities associated with selection felling operations, viz. approx. twice the area is covered per annum.

(d) Deterioration of retained stems and suppression of regrowth. Veteran trees affect the regrowth in an area 4 times their own crown area. For every 5% veteran crown cover there is a 10% reduction in regrowth volume. At 20% veteran crown cover the influence becomes overlapping with even greater effects.

The Forests Department returned to a Clear Felling System in 1967. Woodchipping started in 1975.

STOP 4 PINE CREEK ROAD - CLEARFELLING

At this site two ages of clearfelling are observed. To the North 1970 Karri regeneration and to the South 1976 regeneration. Both areas were regenerated using the Seed Tree System.

Approximately 40,000 seedlings per hectare would have germinated on these sites. Competition and natural selection reduced this number to about 2,000 at age 10 and 600 per ha at age 15.

Karri is a species which expresses dominance from an early age and the dominant trees in the seven year old stand are now 15m tall.

STOP 5 PINE CREEK ROAD - SEED TREE SYSTEM

This demonstration plot shows a Karri/Marri area which has had the first stage of clearfelling completed prior to regeneration burning.

The initial logging removed approximately 300m3 of Karri sawlogs and Marri and Karri chipwood (see volumes on Information Sign). Once utilisation was completed the scrub was rolled flat with a bulldozer to enhance fuel removal, and an intense fire was prescribed and implemented. Following regeneration burning the Seed Trees were removed within 2 years to allow seedlings to develop and a further 80m3/ha was yielded (mostly sawlogs)

STOP 6 QUARTZ ROAD CLEARFELLING 1967 REGROWTH

This area was regenerated under the seed tree method in 1967, prior to woodchipping. A walk into the regrowth will reveal the large log material which was wasted before woodchipping and which will put crop trees at risk in subsequent fires.

This stand is now at an age where fuel reduction burning can be considered. This first burn is critical in terms of protecting the regrowth from damage from wildfire. The dominance classes in Karri (dominant, co-dominant and sub-dominant) are closely expressed at this site.

The "bird boxes" evident at this stop are part of an intensive research programme on the ecology of hole-nesting birds.

STOP 7 GRAPHITE 8 1978 REGROWTH

This area was regenerated under the seed tree method in 1978. Some infill planting was necessary because of poor seed availability.

Some problems with erosion control on steep slopes were experienced when this area was logged. Today, following consideration and research by both Forests Department and the Timber Industry slopes up to 20^{o} can be logged with relative safety.

The Forests Department supervises both the implementation of logging plans and the control of utilization and environmental controls during the logging operation.

STOP 8 GRAPHITE 10 1979 REGROWTH

This area was regenerated by hand planting in 1979.

Planting of open rooted Karri takes place in June and July. Approx. 1200 seedlings per hectare are planted by Forests Department workers on a piecework scheme. Later each tree receives approx. 80gm of fertiliser to assist establishment and early growth.

Here Eucalyptus muellerana (Yellow Stringybark) from the eastern states has been planted in alternate rows with Karri to provide a source of naturally durable transmission poles. It is planned to harvest the stringybark poles at age 25 - 30 and allow the Karri to grow on to maturity.

STOP 9 TRAMWAY TRAIL 1930 KARRI REGROWTH AND KARRI THINNING OPERATIONS

Cutting for the Pemberton Mill began in 1913. Up until the mid 1920's areas cut over were alienated to private property. With the advent of the Forests Act and dedication of State Forest, clear felling in Big Brook and Treen Brook Forests in the 1920's and 30's was regenerated to evenaged Karri regrowth. These stands are no 45 - 55 years old and the regrowth is being thinned commercially for the first time. This is considered to be a good example of the compatibility of production and recreation and

conservation.

THINNING PRESCRIPTION

The current commercial thinning is later than the optimum age for a first thinning in Karri. The lack of residue market and a suitable logging technique has prevented commercial thinning until the 1980's. Ideally pure Karri stands should be thinned at age 30 - 35.

The thinning prescription is based on co-dominant height and stand basal area and is selected from the table below:-

CO-DOMINANT HEIGHT (M)	BA RETAINED (M^2)
Up to 31 m	8
32 - 34	10
35 - 37	12
38 - 41	14
42 - 45	16
Over 45	18

It can be expected that the regrowth produced today on a similar site will be up to 40% more productive. This is because of assured full stocking and the removal of the veteran trees which suppress regrowth.

PRODUCTION

The range of produce includes Chipwood (to W.A.C.A.P.); Sawlogs for tile battens (to Monier, Busselton) and Peeler logs (to Wesply, Perth).

The contract is based on a production of 175m3 of logs per day (40,000m3 per year). To date the products have averaged 70% Chipwood, 28% Tile batten sawlogs, 2% Peeler logs.

Approximately 350ha per year (120m3/ha) will be thinned, and sufficient regrowth for 10 years thinning is available.

Approximately $1,000 per ha is generated for the State from this operation.

STOP 10 BIG BROOK ARBORETUM AND RAINBOW TRAIL

The arboretum in Big Brook was established between 1925 and 1930 and features many exotic conifers and eucalypts. Two of the most interesting species are the Californian Redwood (Sequoia) and Yellow Stringybark (E. muellerana). The Rainbow Trail and Tramway Trail are two popular routes through Big Brook regrowth forest. Thousands of visitors each year drive these routes and many admire the arboretum.

West of Rainbow Trail past the arboretum in an area of regrowth which has not been burnt since it was regenerated over 50 years ago. You may notice the difference in vegetation - more small woody trees such as Casuarina and a dearth of ground flora.

STOP 11 TREEN BROOK 1935 REGROWTH

This area was thinned commercially in 1980 and the following Spring a mild burn was prescribed to remove the logging tops and debris. Subsequently, the green scrub has regrown and this forest is now fulfilling a use for water production and recreation until a second thinning is programmed possibly 20 years from now.

STOP 12 OR 13 BUNNINGS PEMBERTON MILL

Pemberton Mill and town site was first constructed by State Sawmills in 1913 for the express purpose of supplying railway sleepers for the trans-Australia Line. On completion of the line it performed as a general purpose mill, until being replaced by the current operation in 1968.

This mill was designed to cut karri (Eucalyptus Diversicolor) which is Western Australia's largest hardwood, and is grown in the lower south west corner of the State. The town of Pemberton would be the most central town in the Karri belt. The mill and Company houses form the larger part of the town site which is served by normal facilities, ie. Senior High School, Hospital, Hotel, Motels, Social Club, shopping complex and extensive sporting venues.

The mill operates on a two shift basis and produces a complete range of timber for local and export markets. Karri is a durable hardwood that is mainly used for structural purposes, and has the advantage of being supplied in large sections and long lengths.

Wastewood from the mill is chipped and screened and delivered to W.A. Chip and Pulp Co. where it is exported to Japan for processing into paper. Sawdust produced is sold to a brick manufacturer where it is mixed with the clay to make a lighter but stronger brick.

EMPLOYMENT STATISTICS

Supervision	10
Mill Floor	40
Saw Shop	6
Yard	35
Maintenance	12
Pressure Treatment	2
Chip Production	2

The current permissible intake is 75,000m3 of log per year which is obtained under licence from State Forest and hauled by road by Bunnings Logging Operations over distances ranging from 15km to 125km.

From the log is produced 30,000m3 of sawn timber at an average recovery of 40%. 31,000 tonnes of screened chips and 10,000 tonnes of sawdust are produced.

MILL PRODUCTION AREA

Breaking Down

Item 1 Heavy Chain Log Haul Trough.

Item 2 Log Deck.

Item 3 Log Carriage - Eilbeck Four Knee, 2.1m opening.

Item 4 Band Mill - Salem 3.0m diameter wheels - saw 18.6m x 400mm x 8 gge x 75mm pitch.

Multi-Rip Saw (Edger)

Item 5 Isles Forge - Bottom Arbour Edger - opening 1,500mm x 200mm, 7 saws 700mm diameter.

Band Resaw

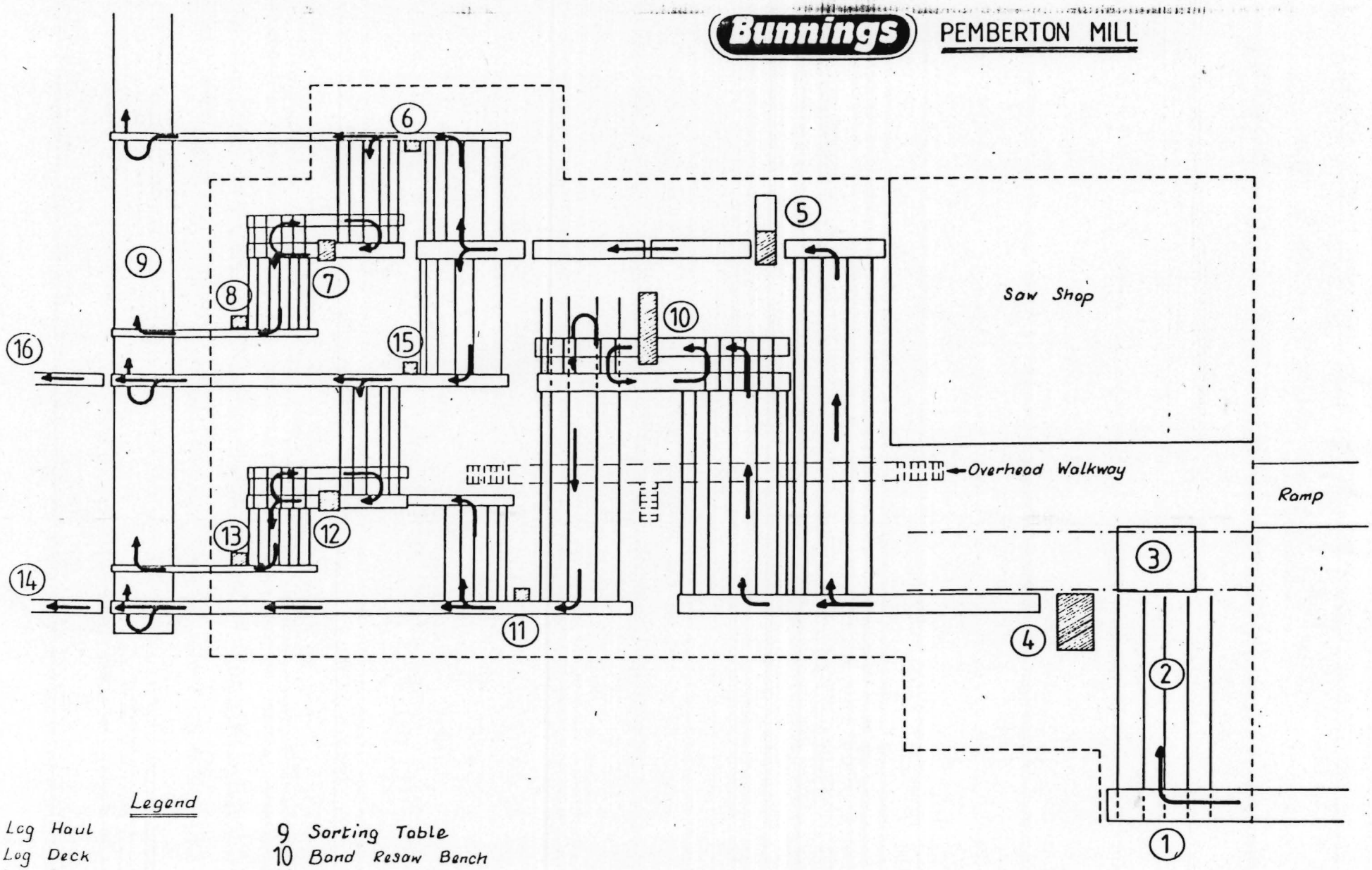
Item 10 McKee/McDonough 1.6m diameter wheels - saw 260mm x 16 gge, with fully mechanised roundabout.

Recovery Benches

Items 7 & 12 Gibson Power Feed Benches - 900mm diameter saws with mechanised outfeed and return rollerways.

The timber is transferred to two straight sorting tables where it is sorted to length and bundled. The heavy section is transported to holding areas and taken to the yard where it is bundled and sorted. Timber is then transported to Manjimup Production Centre where it is seasoned and is subject to further processing, or despatched by rail or road direct to the customer or to our Company retail outlets.

Bunnings PEMBERTON MILL



Legend

1 Log Haul
2 Log Deck
3 Log Carriage
4 Breaking down bandsaw
5 Edger
6 Docker
7 Circular Resaw Bench
8 Docker
9 Sorting Table
10 Band Resaw Bench
11 Docker
12 Circular Resaw Bench
13 Docker
14 To Heavy Sections
15 Docker
16 To Heavy Sections

STOP 12 OR 13 PEMBERTON SWIMMING POOL (LUNCH)

Pemberton townsite was first settled in the early 1900's. The first State owned sawmill was built in 1912 and was known then as Big Brook.

Pemberton can truly be described as being located in the heart of the Karri forest. The oldest National Parks in the area at Warren and Beedelup were set aside as Reserves in the early 1900's before any State Forest was dedicated.

The magnificent Karri forest around the Pemberton swimming pool is also a National Park (gazetted later).

The Caravan Park adjacent, and the swimming pool are maintained by National Parks Authority rangers.

The pool was constructed in 1929.

The trolley on rails on the far bank of the pool has not been used for about 20 years following a bad accident.

Trout ponds for breeding purposes are located on the Lefroy Brook near the Caravan Park.

All of the streams around Pemberton are stocked with trout, and fishing in these streams is a popular recreation pursuit.

STOP 14 GLOUCESTER TREE

This tree was built in 1947 as a fire lookout tower. A system of tree towers and man made wooden towers were placed strategically throughout the forest until the late 1970's when spotter aircraft assumed this role. This lookout tree is now a focal point for visitors to Pemberton and tourists may climb the tree if they wish. The tree was named after the Duke of Gloucester who visited the site during construction.

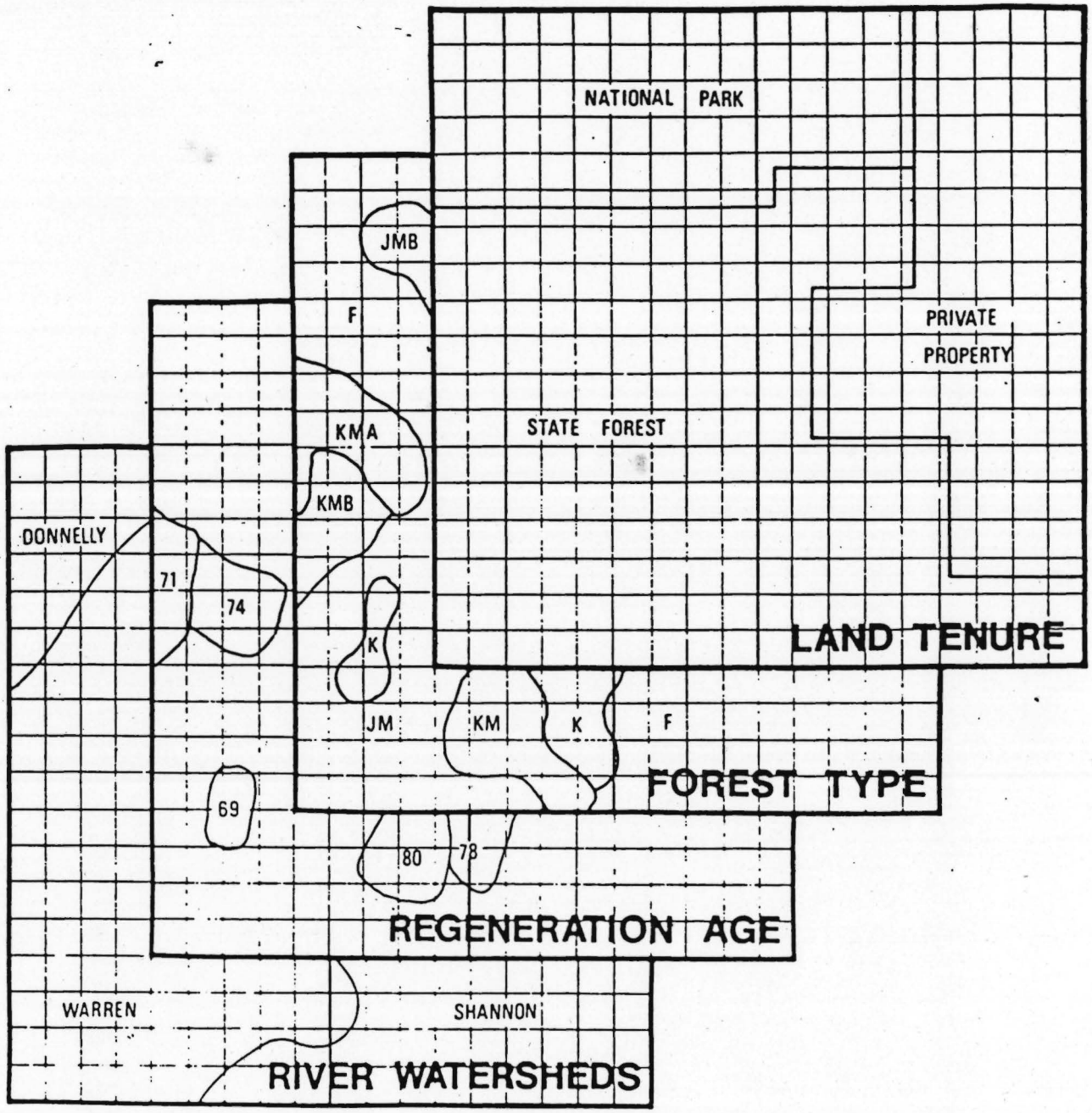
Gloucester Tree is only one of a number of attractions within the Eastbrook Recreation M.P.A. which includes the Cascades, Burma Road Flora Reserve and Eastbrook Trail.

STOP 15 BUNNINGS SOUTHERN AREA LOGGING OPERATIONS

With the commencement of the chipwood industry in Manjmup finally becoming a reality, our Company set about the task in 1974 of putting together a team of people with two aims. The first was to build the network of strategic arterial roads necessary to link up the sawmill permit areas to the Chipmill site at Diamond Tree. The second aim was to recruit and train the people and provide the equipment to extract and deliver the log quotas to W.A.C.A.P. Chipmill, and to our Sawmills.

FMIS

FOREST MANAGEMENT INFORMATION SYSTEM



FORESTS DEPARTMENT
WESTERN AUSTRALIA

THE FOREST MANAGEMENT INFORMATION SYSTEM

- A SUMMARY -

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The Forest Management Information System (F.M.I.S.) is a computer based system for overlaying maps which describe the various characteristics of the forest, management activities and constraints on management. It locates areas which satisfy particular combinations of characteristics on several resource map overlays, determines areas and prints or plots the resulting composite maps. It is also capable of comparing and calculating certain timber volume information. F.M.I.S. is a grid cell system with the basic data being recorded separately for each overlay or attribute.

The system was developed by the Forests Department to cater for the constantly changing planning constraints in the Southern Region, brought about by the introduction of multiple-use management, a general intensification of management and a growing need for readily available information. The forest in this region is characterised by a mosaic of two major forest types, each of which requires a different management practice influenced by a large and growing number of constraints. Co-ordinated operational planning is required in considerable detail over a large area, as well as long range resource planning for a variety of forest uses.

Manual techniques of manipulation and summarisation of the data required for this type of planning were inadequate - they were inconsistent, tedious and incapable of responding to rapid change and the demands of present day forest management. The sheer bulk of the work sometimes prevented all the relevant information being taken into account.

The Forest Management Information System not only provides this data more rapidly but makes it possible to carry out tasks which previously could not be contemplated.

F.M.I.S. is an extension and modification of the earlier Map Display System (MDS) which is extremely versatile in its manipulation capacity, but was primarily designed for small projects. The central core of the programme has been retained but peripheral programmes have been added to provide broad area coverage on a recognised grid system, simplified input, extended output including volume calculations, and scale map plotting facilities.

The system is based on a Cyber computer at the W.A. Regional Computing Centre at the University of W.A. At the present time there is no direct communication facility with the Cyber computer from field stations. For this reason the forest manager in the field must communicate his requirements to the Systems Analysis Section at the Forests Department State Headquarters in Como, which carries out all the computer functions.

STRUCTURE OF THE DATA BANK

F.M.I.S. Square

The whole of the southwest area of the state covering State Forest and its surrounds has been divided into grid squares, 8000m x 8000m in size, based on the Australian Map Grid, each square having a unique identification number.

The AMG grid is based on the Universal Transverse Mercator projection, while many of the older source plans used by the Forests Department were based on the Bonds projection. Because of this,an exact match with imperial maps is not possible and the F.M.I.S. squares have been adjusted to best fit. The error, however, is within acceptable levels.

The F.M.I.S. square is the basis for data input and storage.

F.M.I.S. Cell

Each F.M.I.S. square is divided into 57 x 57 (3249) cells, giving each cell an approximate area of 2ha. This is the smallest unit of data recording. This size was chosen as a compromise between the resolution required for management and the limitations of storage and manipulation. Given the precision of the basic information and the purpose for which it is used, this resolution is considered adequate.

Resource Attributes

Each resource attribute or overlay (eg. Land Tenure, Species Type, Management Priority), is input, stored and updated independently of the others. Attributes chosen must cover a single resource description only. Any number of attributes may be input and those which contribute towards the solution of a particular problem are chosen for interrogation. Temporary attributes may be input to create a "window" if this cannot be created by existing attributes. At present, some 43 attributes have been input, each covering an area of about 2 million hectares.

Characteristics (Codes)

For each attribute, each cell is coded for its resource characteristic (eg. Land Tenure is an attribute and within it State Forest, National Parks, Private Property, together with 16 other tenures, are characteristics). Each characteristic must be mutually exclusive of any other within the same attribute. Characteristics should be precise in definition and of as low an order as possible - they can be combined with ease but they cannot be subdivided without complete reinput. There is a limit of 50 characteristics per attribute. Where more are required, the attribute must be subdivided (eg. regeneration date has been subdivided into DREG (decade) and REGY (year), the combination of the two providing the year of regeneration.

Data Input

Data may be input by either manual coding, computer coding or digitising, whichever is most appropriate to the data. In all cases the data is transformed as required to a cell basis, for storage, manipulation and plotting.

Data Output

A variety of tabular outputs and listings are available as well as schematic line printer maps and high quality plots at any reasonable scale.

Development

The system was developed on a limited budget against severe time limits. The majority of the data base for the Southern Region was input over a period of 18 months, mainly by manual methods. The cost of development to its present form and the creation of the data base is estimated to have been paid for in its first 6 months of its operation and the system is now used routinely to provide data for management planning. The creation of a similar data base for the Central and Northern region is now under way.

The present system is seen as a stage in the development of a more sophisticated system and a consultant has been appointed to recommend on future development. The requirements for an upgraded system will include:

- access to the data base from regional stations to improve the capacity for interrogation, editing and updating, and the rapid input of new data.

- a simplified method of interrogation.

- a much increased capacity to draw on non map data bases as would be required for gradient modelling.

- a capacity for dynamic simulation for planning and for use in problems such as fire suppression tactics.

The present system can continue to be used during this development programme.

RESEARCH ACTIVITIES

FOREST FIRE MANAGEMENT RESEARCH

DFO Neil Burrows
Manjimup Research

Summary of Research Work - July 1980 to August 1983

Shea (1975) suggested that moderate intensity fire could be used on certain sites to manage the understorey to disfavour jarrah dieback disease.

Existing fire prediction tables (Sneeuwjagt & Peet, 1976) were designed for fuel reduction burning and wildfire suppression and there is some uncertainty about their applicability outside these areas.

Project Narrik, a study to validate (and improve if necessary) the existing fire behaviour model and the entire fire management system including weather forecasts, fuel moisture predictions and fire descriptors for other than fuel management, has occupied the time covered by this report. Twenty four plots were prepared, assessed and burnt and then re-assessed and surveyed. The study was in conjunction with C.S.I.R.O.'s Project Aquarius, an evaluation of water bombers in fire suppression, and excellent fire behaviour data were collected for single, free burning and mass ignition fires burning under conditions of high S.D.I. and between F.D.I.'s of 40-100.

Principle Results

Mass ignition fires starting from a point source, did not reach a steady state even after burning for 3 hours. Instead fires accelerated, slowly at first, but faster as the fires grew. Acceleration rate was a function of surface burning conditions (fuels, topography and weather) and fire interaction. There was no fire interaction in the early stages of fire development, but it became increasingly influential as fire increased in size and as the energy release rate per area, increased. Surface burning conditions pre-empted the timing and magnitude of the effect of interaction on fire acceleration. Where fuel moisture control was 4-6%, fires interacted 20-30 minutes after ignition and showed erratic and often severe behaviour. Where surface burning conditions were less severe (i.e. lower F.D.I.) the subdivided fires burnt along an

acceleration curve for a longer time and only displayed erratic fire behaviour immediately prior to junctioning. Although I am still analysing data, I am confident that the behaviour and mis-behaviour of these fires can be predicted within limits.

Existing behaviour tables are not sufficiently refined to enable the prediction of fire acceleration, hence fire spread rate at any time after ignition. Another feature of these fires was the range of fire behaviour exhibited between fires burning in the same plot and at the same time. Slight variations in fuel load, slope, vegetation type, wind ratios etc. have little effect on a fires behaviour under cool, moist conditions, but not so under these conditions (S.D.I. >1000 & S.M.C. $\leq 10\%$). These variations need to be measured and fire behaviour re-calculated with time and space - a dynamic fire model is necessary to predict the ranges of fire behaviour. The tables under predicted terminal spread rates by a factor of up to 10, but mostly by a factor of 2-3. Major weaknesses appear to be with wind, slope interactions and the static nature of the existing model.

Reports

- Progress report No. 1 Project Narrik
- Progress report No. 2 Project Narrik
- Fuel Assessment Report Project Narrik
- The reduction of basal area by moderate intensity fire
- Integrating fire and Land Management Planning (a report on future fire research).

Further Action

- Continuation of data analysis and verification procedures Project Narrik.
- Re-define a dynamic fire behaviour model for fires burning under dry fuel and high S.D.I. conditions. This to include biotic descriptors of fire such as intensity, heat release rate, reaction intensity, soil heat penetration, defoliation and scorch heights and further effects (tree damage etc.) as data become available.

FOREST MANAGEMENT ECOLOGY

o P. Christensen
G. Wardell-Johnson

(2) SELECTED SPECIES MANAGEMENT

Re-establishment of populations of Bettongia penicillata

Following successful re-introduction of *B. penicillata* into an area of the Perup M.P.A. a programme to extend the range of the species was begun. Areas of suitable habitat were selected, and re-introduction has taken place at two locations. 1. Collie - 30 animals were released July 1982. Trapping and radio-tracking in March 1983 indicated that some of the individuals had established successfully. Further trapping sessions will monitor the populations progress. 2. St. Johns Block, Sunklands - 30 animals released March 1983.

Habitat management for Macropus eugenii

The use of fire as a management tool for the manipulation of habitat is being investigated. A heartleaf *(Gastrolobium bilobum)* thicket regenerated by an experimental burn, autumn 1981 is being monitored to determine the factors influencing the successful establishment of a thicket suitable for *M. eugenii* habitation. The main factors influencing thicket formation seems to be fire intensity and the grazing pressure present in the early stages of growth.

Ecology of Myrmecobius fasciatus

Information has been gathered, through radio-tracking, on the activity patterns and habitat requirements of *M. fasciatus*. Further investigation into the effect of prescribed burning on *M. fasciatus'* food source is continuing. Long term and seasonal changes in termite activity are being monitored within three burn rotations. The information gained from these studies will be used to formulate a specific strategy for *M. fasciatus* which will be incorporated into the overall management plan for the Perup M.P.A.

Ecology field course

Participation of outside institutions is encouraged in fauna ecological work within the forest areas. Emphasis has been placed on the establishment of field ecology teaching courses at the field station within the Perup M.P.A. The Perup Forest Ecology Study Centre is now operational and is now handled through Extensions.

FOREST MANAGEMENT ECOLOGY

P. Christensen
G. Wardell-Johnson

(1) BIOLOGICAL SURVEYS AND EFFECTS OF FOREST OPERATIONS ON SPECIES AND COMMUNITIES

Biological surveys are conducted to establish, fauna/habitat relations and serve as benchmarks for changes in land use. Emphasis is currently placed on distribution and abundance of vertebrates within the northern forest areas.

Forest operations effects are studied to demonstrate any areas of concern and so if necessary ameliorate any undesirable or enhance any desirable effects. A long term community bird study (W.P. 22/82) has been established within the karri forest of the Donnelly system to determine the effects of four forestry operations. Fixed point census procedures and mist netting have shown that the avian communities have strong similarities between the four sites prior to the implementation of four forestry operations (clear felling, selection cutting, control burning and control). Additional aspects are studied to determine the reasons for the favouring or displacement of particular species at each stage of the succession following these operations.

Artificial nest boxes (W.P. 21/82) are being used within the karri forest to examine the effects of various forest operations on hollow nesting species. The use of boxes by mardos *(Antechinus flavipes)* was examined in the first year of the study. Boxes erected within four sites within the karri forest of different management history showed differential use by mardos. A more detailed study (likely a post graduate research project) is now required to determine the factors governing the timing of successful general colonization by mardos in regenerating karri forest. Work has begun on a detailed study of the phascogale in the Perup M.P.A. using nest boxes in conjunction with radio-tracking.

A long term study of the effects of a single summer fire on small mammal populations in the karri forest has been terminated. Eleven years data demonstrates a succession of small mammals within the karri forest and shows that the fire does not affect long term population changes in the bush rat.

Field work begun in 1981 will conclude this summer on the determination of factors affecting the distribution of abundance of three species of *Geocrinia* (W.P. 1/83). Taxonomic and morphometric analysis of these species is being completed at the University of Western Australia and Macquarie University.

(YOUNG) KARRI FIRE RESEARCH

Keith Low
Manjimup

The last year has seen the continuation of work on fuel reduction burning in young karri, and commencement of research into tree damage caused by wood-boring insect larvae.

Three sets of plots were established in 10 year old karri regrowth. Following establishment, stand and fuel characteristics were measured. This included the use of a new method (Brown's Planar Intersect) of fuel measurement which, in addition to providing an estimate of fuel weight, also gives information on the physical structure and spacial distribution of the fuel array. Computer analysis of this data is underway.

Two plots at each site were burnt in March 1983. Of the six burns, three were regarded as successful, two as marginally successful and one as a failure in terms of fuel reduction. The latter was in *Acacia pentadenia* fuels which have proved difficult to burn in the past. It will obviously be 2-4 years before fuel at this site will burn readily due to an increased component of eucalypt litter.

Since the trees were still only 10 years old it was felt damage to the crop could become a problem, especially after burning treatment so late in the season. Damage assessment six months after treatment was inconclusive. At one site scorch was greater than expected but recovery is good. There were few signs of butt damage to crop trees but since this can take two years to show up more may appear in later assessments.

Following the discovery of wood-boring insect larvae in significant numbers work has started in this area. Occurrence covers the karri range but heavy infestations appear isolated at this stage. A study has begun in an attempt to discover the cause(s) of infestation. Initially the effects of fire, site, drought stress and large monocultural populations are being investigated.

The coming year will see the continuation of the above projects. As part of the work on fuel reduction burns in karri regrowth a detailed study will be undertaken this summer into the response of moisture contents of litter fuels in young karri stands to ambient weather conditions.

JARRAH SILVICULTURE

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During the first part of 1983 time was devoted to familiarisation and literature review of the Jarrah Silviculture portfolio.

Also in this period there was much concern regarding outbreaks of the Gum Leaf Skeletoniser, *Uraba lugens*, on which some time was spent in monitoring and mapping. The insect showed a preference for jarrah but also attacked marri and was found on karri, *rudis* and *patens*. There was some association between the older burn ages and severe attacks. The insect extended far beyond the areas of obvious attack. The winter generation numbers have declined dramatically and a decision on further work is waiting to see the impact of this summers attack.

Basic silviculture trials were also initiated for establishment, seeding, fertilising, spacing and leaf miner control.

In the ensuing period of autumn and early winter concentration was on the main project of Site Classification. This was initially an evaluation of what work had been done already in the south and comparison with the northern jarrah classification.

This initial work gave some good indications and evaluation of the method of site analysis. However it was found to be restricted in the sample base and too tightly defined into classes to be applied in the field and used for mapping. A more subjective use of indicators was required rather than classes, and the sampling had to be extended to consider only relevant management categories.

A new site survey strategy was prepared and sampling commenced mid winter and is progressing. This is designed to cover regeneration, dieback and silviculture etc. At the completion of each stage, indicator species will be evaluated and management guidelines defined for the various site characteristics identified.