

FOREST FOCUS

NO. 27 NOVEMBER 1982

Front Cover

Morning sunlight filters down through the karri to the valley of the Donnelly River. R. Burrows.

TOWARDS THE GREENING OF AUSTRALIA

Forest Focus No. 27,
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The titles "Year of the Tree" and the "Greening of Australia" are being freely used by the media, and are becoming familiar to the people of Western Australia. They have also caused confusion and the following descriptions may help to clarify their meanings.

YEAR OF THE TREE: Following suggestions by the United Nations Association of Australia, the Western Australian Government has adopted the concept of an Australian Year of the Tree (Y.O.T.T.) to promote an awareness of trees in the landscape and the need to plant them. Y.O.T.T. commenced on 5 June, 1982 and will end on 30 June 1983. At the direction of the Hon. Minister for Lands, Forests and Conservation and Environment, Mr. Ian Laurance, M.L.A., the State participation of Y.O.T.T. will be co-ordinated by the Forests Department and the Department of Conservation and Environment. A Co-ordinating Committee has been in action since April, 1982, its primary task being to collate information about the year's events and to prepare and distribute material for groups or individuals who wish to take part in Y.O.T.T.

GREENING OF AUSTRALIA: Australia will celebrate its bicentenary in 1988 and for this purpose the Australian Bicentenary Authority has been formed with councils in each State. The Authority has studied many proposals for major projects leading up to 1988, includ-

ing that of the Institute of Engineers of Australia for a many-faceted Greening of Australia programme. From this proposal, the Authority has elected to support a National Tree Planting Programme and has co-ordinated the appointment of a Steering Committee in each state, as well as a National Steering Committee.

In Western Australia the Conservator of Forests has accepted an invitation to be chairman of the State Steering Committee, the inaugural meeting in June 1982 having been opened by the Hon. Minister for Forests.

The W.A. Steering Committee has some 18 members representing relevant Government departments, Local Government, environmental groups, and primary industry. Projects will be studied by the Steering Committee and the public will be kept informed through media releases and a proposed newsletter.

Peter Hewett





C. Winfield.

FROM GERMINANTS TO GIANTS - The Manjimup Nursery

by Rick Sneeuwjagt

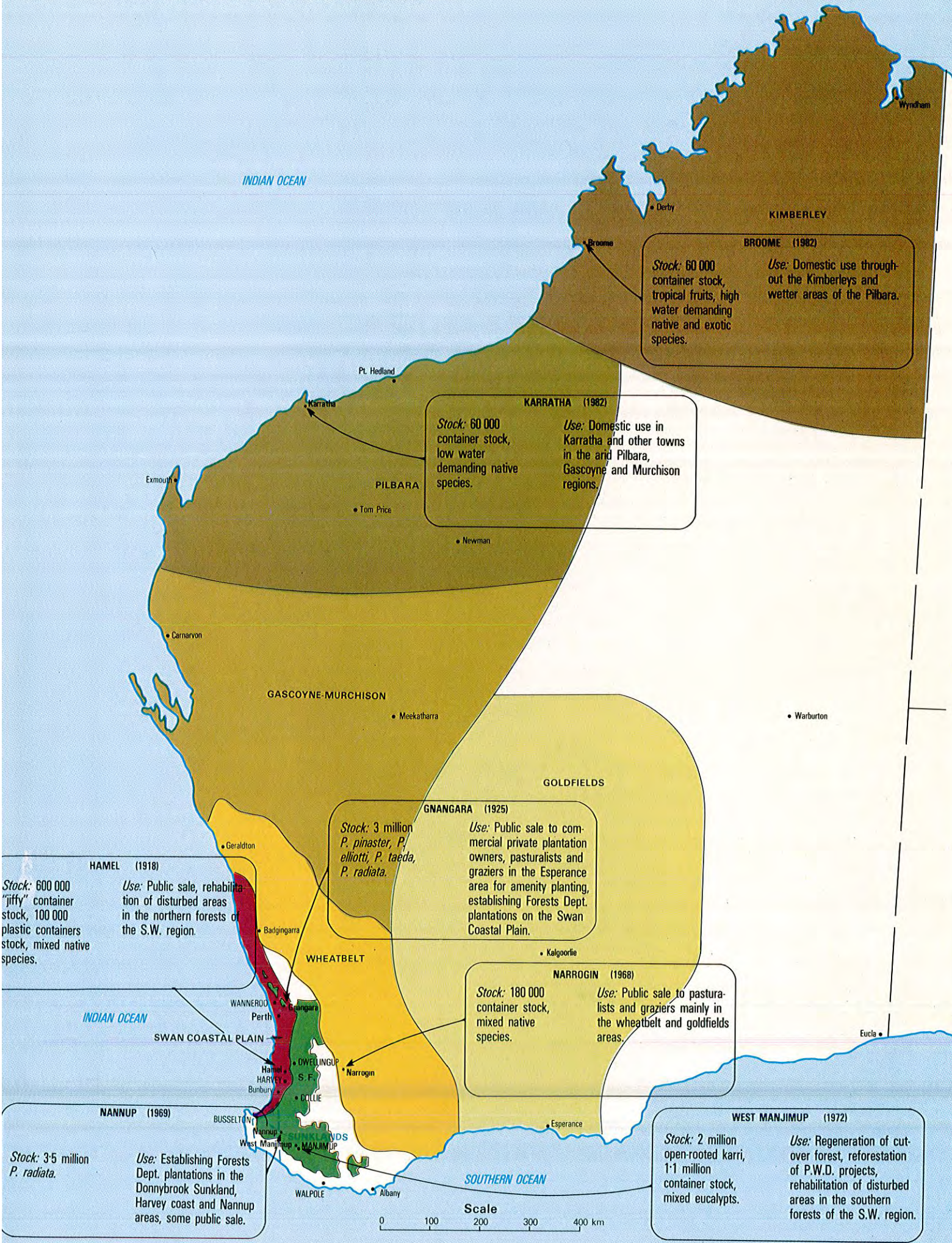
“Ask of the trees themselves how they should be treated, and they will teach you more than can be learned from books”. *

Basic skills in the growing of plants have been with us since ancient times. At least since the Roman Empire nurseries in one form or another have been established to enable the study of botany and the cultivation of all sorts of plants, including trees. The profession of forestry itself grew up around the art of tree growing, called silviculture. Silvicultural knowledge has been consistently passed

down through successive Western cultures through the Middle Ages and into the modern era, and with increasing population pressures has become vital in sustaining these cultures. Silviculture has become complex and even though much is known about European tree species, is still evolving. The transplanting during the 18th and 19th centuries of European culture to “the Antipodes” further broadened silvicultural know-

ledge and research with the discovery of a whole continent of different tree species and soil types. The pioneering of nursery practices in Western Australia, only 153 years settled, is very much a part of forestry today. Much research has been conducted in recent years developing appropriate nursery techniques for raising trees in our unique environment.

Fig. 1 Forests Department nurseries in Western Australia



EARLY STATE NURSERIES

The State Government's first nursery was established at Guildford in 1896 to provide tree seedlings for government reforestation projects. This site was found to be unsuitable and was superseded in 1897 with the establishment of a nursery on the old de Hamel Estate some three kilometres south of Waroona. The Hamel Nursery was developed primarily to supply commercial tree seedlings for State Government plantations, but gradually its functions expanded to include the provision of ornamental trees for the Education Department's school plantations, and for street and park plantings for Shires and other public bodies, as well as providing trees to farmers.

Then in 1925 the Forests Department's first pine nursery was established at Gnangara near Perth with the aim of establishing *Pinus pinaster* and *P. radiata* plantations in Western Australia. Several other pine nurseries were set up, including the one at Nannup established in the 1960s. Altogether, 3½ million pine seedlings are now raised annually for Departmental and private pine planting projects.

The increased demand for tree seedlings suitable for planting in low rainfall areas of the wheatbelt and goldfields lead to the establishment

of another nursery at Kalgoorlie in 1947. After functioning for seven years this nursery was transferred to the Dryandra Forest headquarters, and again in 1968 to its present location in Narrogin.

MANJIMUP NURSERY

In 1967, the Forests Department acquired the grounds and buildings of the Agricultural Tobacco Research station situated on a reserve of 160 ha, seven kilometres west of Manjimup, as a training centre for forestry field staff cadets. By 1972, a eucalypt nursery was also established at the centre, and during the next 10 years this has developed into one of the biggest and most sophisticated eucalypt nurseries in Australia.

The need for a karri nursery is based on the fact that karri will only seed well every three to six years. Regeneration of logged areas using seed trees can only be achieved at these times. In order that the cut over areas with poor karri seed crops are brought into production with a minimum delay, it is necessary to supplement the seed tree system by artificial regeneration means, such as broadcast seeding or planting. Broadcast seeding is not favoured because karri seed is scarce, and both difficult and expensive to collect. The raising of seedlings under the controlled conditions of a nursery represents the most efficient

use of the seed and provides the means of stocking all growing sites for optimum development.

The Nursery Process

Tree nursery practice is based on some universal principles. Seeds are sown into prepared soil beds or pots. After germination, the young plants are carefully nurtured until they are old enough to withstand the stress of transplanting out into the field and the forest.

There are two different types of seedlings produced: (i) open grown (or "bare-root") seedlings which are raised in beds and then uprooted for transplanting in the field, and (ii) container (or "potted") seedlings, raised individually in small pots.

Although nearly 100 different eucalypt species are raised at the Manjimup nursery, the principal species grown is karri. The bulk of the karri is raised as bare-root seedlings. These are used in the regeneration of our karri forests.

Bare-root karri seedlings are relatively easy to raise and transplant most successfully. On most sites, survival rates of 90 per cent can be expected, followed by rapid growth. However, on particularly harsh or arid sites, the bare-root seedlings are less successful. On these sites container grown plants must be used to ensure successful survival and growth.

Production at Manjimup Nursery

Research trials in the early 1970s lead to the first developments of low-cost techniques for raising open-grown, or bare-root karri seedlings. The first wide-scale operational production of bare-root karri seedlings was achieved in 1972. The modest total of 22 000 seedlings in that year increased to 120 000 in 1973, with further large increases in subsequent years. The annual production reached 2.5 million in 1978 and has been at that level since.

A programme of raising container seedlings commenced at Manjimup in 1976, mainly to provide karri seedlings for rehabilitation of log loading areas, snig tracks and gravel pits. Later, several other eucalypt species were included to meet expanding demands for fast growing, dieback-resistant, or salt-tolerant trees for reforestation projects

Forester Rick Sneeuwjagt has seen the Manjimup Nursery grow to its present capacity of over 3.5 million plants.



throughout the south-west of the State.

By 1978, the annual container stock production at Manjimup was about 200 000. In 1979 the Department accepted the responsibility for raising and establishing some 600 000 container tree seedlings annually for the Public Works Department project in the Wellington catchment. This involves the reforestation of re-purchased farms with the aim of reducing the salinity of streams within this catchment east of Collie.

Raising Bare-Root Karri Seedlings

In order to produce a successful bare-root tree seedling, the nurseryman must condition his stock to withstand desiccation during lifting, transport and transplanting. The plant must be capable of rapid shoot and root growth once established in the field. An ideal tree seedling must be robust, with a large fibrous root system. It must also feature a single, sturdy shoot about 35cm long, with 15 to 20 toughened leaves that do not readily dry out or become damaged by the effects of wind, sun, frost or defoliating insects.

To achieve the ideal plant a strict programme of conditioning treatments must be followed in each stage of the seedling's development in the nursery bed.

Seed and Sowing

The karri seed is collected in the forest during periods of peak seed production. Forests Department crews collect the seed from the crowns of trees felled during timber harvesting.

Because karri seed is very tiny - one kilogram contains up to 600 000 seeds - the operation is difficult and costly and requires careful planning and supervision.

Seed collected from the various river systems and zones within the karri forest are stored separately so that the nursery seedlings can be returned to locations close to their origin to maintain the genetic integrity of the new stands with the neighbouring forest.

Sprinklers that produce a mist spray are preferred for watering nursery stock, as these do not wash out the fine seed, nor damage the fragile germinant.



▲ Prior to the development of raising bare-root seedlings, karri wildlings like these one-year olds were transplanted from the wild into logged areas of forest.

R. Sneeuwjaagt.

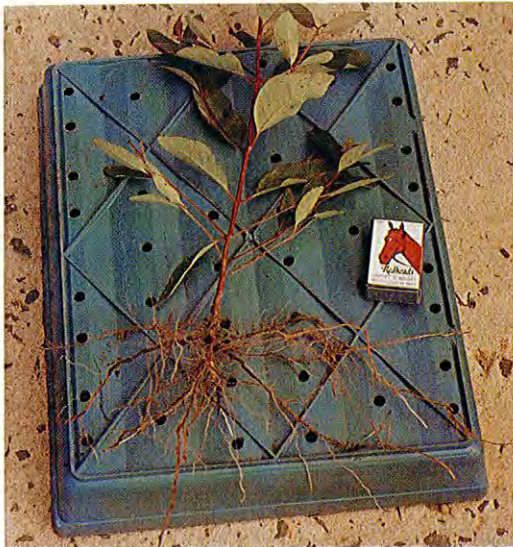


▲ *Eucalyptus globulus* and *camaldulensis* raised at Manjimup nursery are used for reforestation of cleared land in the salt-affected Wellington catchment.

G. Peard.



R. Sneeuwjaagt.



R. Smeeuwlaagt.

Before sowing in the nursery, the small karri seed is coated with a special clay powder containing a fungicide and an insecticide. This process, known as pelleting, makes the seed easier to handle and provides extra protection against disease and insect attack.

Six rows of seeds are mechanically sown into each bed in December. The newly sown beds must be kept moist by watering whilst the seeds are germinating and until the plants are about 10cm tall. Watering is gradually tapered off once the seedlings are well established. By the time the seedlings are 20 to 25cm tall, they are watered only when they begin to wilt. This is to encourage the development of hardy plants.

▲ Root pruning of the bare-root seedlings promotes a fibrous root system and a sturdy plant.



G. Peard.

Root Pruning

The practice of regular root pruning on a monthly basis of the bare-root planting stock has been found to be the most effective way of producing sturdy plants with a high capacity for survival in a variety of conditions. Root pruning undercuts the plant causing callousing of the tap root and the subsequent formation of a mat of fine lateral roots. At the same time, the shoot growth is arrested and leaves become toughened and leathery.

▲ A mechanical root-pruner undercuts karri seedlings to promote a fibrous root system necessary for growth of sturdy plants.



R. Smeeuwlaagt.

When the seedlings are approximately 15cm tall the tap roots are trimmed off with a thin, sharp blade on a high speed cutting mechanism mounted on the rear of the nursery tractor. It is essential that this operation be done carefully with minimal shock to the seedlings: the soil needs to be moist to reduce plant stress, and the tap root must be cut cleanly and accurately to avoid root distortion or damage.

Lifting of the bare-root seedlings can take place as soon as the forest soils are thoroughly wet. The plants are gently pulled from the ground and bundled, then loosely wrapped in wet hessian sacks for transit by truck to the planting areas.

Planting

Bare-root karri seedlings are used for the regeneration of cut over forest. The clear felled areas have previously been burned to reduce logging debris and competing understorey trees and scrub to a minimum. Burning the debris releases locked-up nutrients to the soil and the resulting ashbed provides excellent growing sites for the new transplants, and growth in height of two metres per year is common for the first five years or so.

Forests Department crews use planting spears making sure that the seedlings are correctly and firmly planted. The roots must not be distorted or exposed to the air. They then add fertilizer to each tree soon after planting enabling the young seedlings to compete successfully with the scrub regrowth that develops rapidly in the first year.

Raising Container Stock

The Forests Department has raised container-grown seedlings in its nurseries since the first days of their establishment. At Manjimup this was in 1976. The container system employed in these nurseries was to sow the seed in seed boxes and transfer the seedling at the two to four leaf stage into a range of pots. The first to be used were small earthenware pots, called Thumb Pots.

▲ Lifting six-month-old bare-rooted karri seedlings from the nursery for transport to reforestation areas.

After many years of research, current techniques involve the use of “Jiffy” pots. These are a Scandinavian product made from peat and wood fibre pressed into strips. This peat pot is inexpensive, moisture retentive and light and easy to handle. Because the seedling roots can penetrate the pot wall, the pot itself is planted. This avoids root disturbance during transplanting.

Potting the Plants

Trays of peat pots are filled with a specially prepared soil mix and carefully measured combinations of fertilizer. The light soil mix drains freely and holds nutrients well. This aids plant growth whilst reducing the opportunity for disease organisms that develop in wet soil conditions.

The process of soil mixing and filling has now been mechanized. The exact soil quantity is automatically fed into the trays of pots at a rate of up to 50 000 pots an hour. Hygiene is a prime consideration in every aspect of all nursery procedures and is something that must be carefully planned and implemented. This will ensure that the nursery stock is not lost through disease and that infected plants and soils are not distributed into the field where they may initiate infection on healthy sites.

All soil filled peat pots and trays are sterilized in a process called steam-air pasteurizing. The filled trays are stacked on racks in a steam chamber whilst aerated steam at 60°C is circulated between the trays for 30 minutes. This heat treatment eliminates all weeds and unwanted pathogens such as *Phytophthora cinnamomi* (dieback disease). However, some beneficial micro-organisms remain in the soil, as these are generally more heat tolerant than the pathogens.

After they are cooled, the sterilized soil filled trays are transferred to the propagating room where a special machine is used to sow one seed in each Jiffy pot.

After seeding, the trays are moved outdoors where seedlings are allowed

Here germinants are evenly spaced out by hand, one plant per Jiffy pot. Note the hygienic conditions in the nursery processing room. ▶



▲ Two-week old marri (*Eucalyptus Calophylla*) seedlings are raised in the Jiffy pots for out-planting in jarrah/marri logging areas.

G. Peard.



▲ Soil-filled trays stacked on racks are wheeled into the steam chamber for sterilization against infection.

G. Peard.

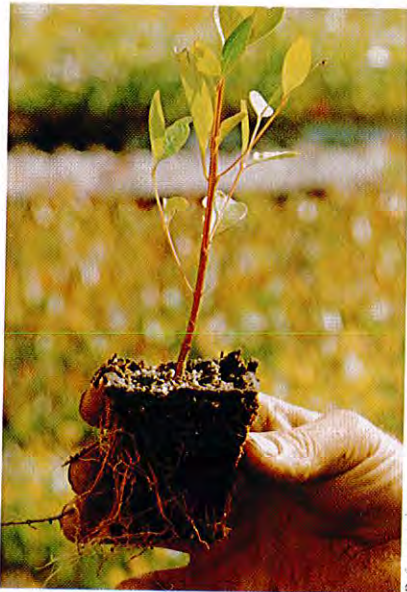


G. Peard.



G. Peard

▲ Nursery practices of soil-filling and seeding are now part of an automatic process.



R. Sneeuwijagt

◀ One of the major advantages of the Jiffy pot is that the roots eventually grow through the peat walls. This specimen is ready for outplanting.

▶ Planting Jiffy pot (or container-grown) seedlings on a former log loading site where the soil has been ripped and fertilized.



R. Sneeuwijagt

to germinate in warm, moist conditions. Shade protection has not been found necessary at Manjimup where the summer climate rarely stays very hot and dry for long periods. Frequent light watering during the early stages of germination and seedling development is essential to ensure a moist soil environment for the seed and seedling root system.

As the seedling develops, watering frequency is gradually reduced to let the soil surface dry between applications. This is done to harden the plants so that they are conditioned to successfully cope with the harsh environment of the planting sites.

The final phase of the nursery container stock programme involves the loading and delivery of the seedling trays to the planting sites. The system is designed to cope with the need to shift large numbers of seedlings easily and rapidly, and involves the use of tractor drawn trolleys, loading conveyors and large container trailers. Thus, the task of sorting and loading a full trailer consignment of up to 90 000 seedlings can be carried out in two hours by a team of four people.

In recent years the Forests Department has acquired nurseries at Karratha and Broome to provide suitable tree and shrub species for planting in the Pilbara and Kimberley regions in the north of the State. Nursery practices like those developed at Manjimup will continue to cater for the ever increasing demand for planting projects all over Western Australia.

*From Brown, J. and Nisbet, J., *The Forester*, William Blackwood and Sons, London, 1894.



TREES FOR BADGINGARRA



The approach to Badgingarra, 208km north of Perth, is notable for its silence, space, dryness and lack of trees. On both sides of the Brand Highway stretches the coastal heath country, hilly undulations covered with stunted species of Proteaceae and Myrtaceae competing in a continuous dense thicket for what little nutrients are there. The soils are mainly of lateritic origin and low fertility, and are sandy and dry. Trees are not a common feature of the natural environment here. However, along the sandy gullies and seasonal water courses such as the Hill River, York gums, river gums, powderbark wandoo and marri grow, providing some relief to the treeless heath.

The area's potential for cereal cropping and sheep farming was first realized in the late 1940s, and the Badgingarra district has gradually been cleared and settled since. Approximately 2300 square kilometres at present supports a farming population of four to five hundred

people. Despite the infertile soil agriculture is assured in this region by the annual winter rainfall of 500-600mm.

Because of the lack of trees it's not surprising that the people of Badgingarra are very tree conscious, realizing the benefit of shade trees to stock, and the district's potential for the top soil to erode once the scrub has been cleared. The small townsite is the focal point of the district and features a garage, tavern, general store, well developed community centre and primary school - all these facilities surrounded by hand-planted trees. Amid the low, shadeless heath, the township provides an oasis - trees are flourishing and enthusiasm growing, providing trees for Badgingarra.

Nursery

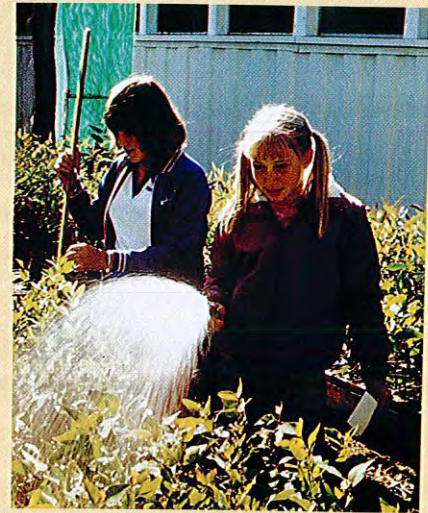
In November 1981 a project was commenced at the local primary school in co-operation with local

farmers, the Parents & Citizens' Association and the Forests Department to provide suitable trees for planting, not only in the townsite but throughout the area. A nursery was established at the school starting with over 3000 trees grown from seed. The children participated in the project and the arduous task of continued watering through the very hot summer school holidays was carried out by enthusiastic farmers in the district.

The fruits of the combined community labour have recently been realized, as six months later the first plants were sold to farmers in the area for amenity planting. Community projects like this not only create the awareness of the need for trees, but they actually provide good tree stock suited to the area. The 65 pupils at the school are becoming well educated on the botany and cultivation of our native trees as well as benefiting from the sales. All profits are used to improve



▲ When *Eucalyptus tottiana* is released from competing shrub in the heath country it grows into a well formed mallee, highly suitable for sheltering stock. It offers palatable leaves but is protected by a prickly bark that resists any ringbarking by grazing sheep.



▲ The nursery at the school provides seedlings for planting throughout the Badgingarra district. Proceeds from the sale of the seedlings are used by the community and the school.

▼ People in the Badgingarra district are very tree conscious. This property has been planted for some years with exotic tree species along the creek line and up on the slopes, providing shelter and wind breaks, and assisting in the prevention of erosion.



community life in Badgingarra, the first project being a paid tour of the Goldfields for children at the school. This spring will see the expansion of the nursery and improvements in nursery methods and techniques.

To realize the full benefit of the initial efforts in cultivation, maintenance and protection of the seedlings from stock when planted out on the farms is essential for successful maturation of the trees. But there's little doubt that Badgingarra has made a great start to being a green and pleasant place to live.

Helen Bradbury
Photography by Cliff Winfield

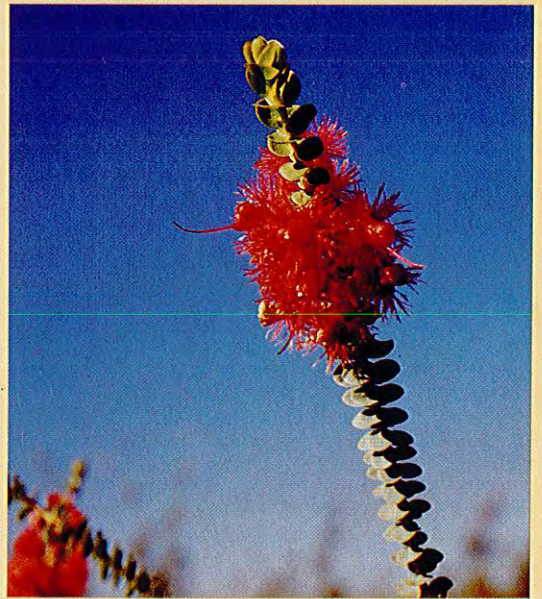


Local flora of Badgingarra -

TOP: *Banksia prionotes*

CENTRE: *Verticordia grandis*

BOTTOM: *Banksia menziesii*



Tree species currently grown at the Badgingarra School Nursery

- | | |
|---------------------------------|-----------------------|
| <i>Eucalyptus camaldulensis</i> | — river red gum |
| <i>E. todtiana</i> | — coastal blackbutt |
| <i>E. gomphocephala</i> | — tuart |
| <i>E. rudis</i> | — flooded gum |
| <i>E. platypus heterophylla</i> | — coastal moort |
| <i>E. lehmannii</i> | — bald island marlock |
| <i>E. sargentii</i> | — salt river gum |
| <i>E. caldocalyx nana</i> | — dwarf sugar gum |
| <i>E. wandoo</i> | — wandoo |
| <i>E. accedens</i> | — powderbark wandoo |
| <i>E. caesia</i> | — gungarru |
| <i>E. spathulata</i> | — swamp mallet |

Special vegetative features of the area include:

- | | |
|-------------------------------|---|
| <i>Eucalyptus johnsoniana</i> | — recently discovered and specific to the area. |
| <i>E. pendens</i> | — recently discovered and specific to the area. |
| <i>E. lane-poolei</i> | — recently discovered in this area. The only other known occurrence of this species is in the moister area at Pinjarra close to the Darling Escarpment. |

NEW LIGHT ON THE NUMBAT

by Karan Maisey & Helen Bradbury

Who knows what a numbat is?
How big is it? Where does it live?
Why? How many are there in
Western Australia?

The numbat may be Western Australia's State faunal emblem, but until recently very little was known about the characteristics of this native mammal, let alone its ecology and occurrence throughout the State. Over the past eighteen months the Forests Department Manjimup Research Station has been radio-tracking, observing and studying these endearing creatures to find answers to the many

questions relating to *Myrmecobius fasciatus* and its survival in State forests. But before we can even start to find out how forestry practices affect this species, we have to document the details of its physical characteristics and day-to-day existence.

It is perhaps surprising that there is little scientific knowledge of this unique and interesting animal. However, intensive studies of West-

ern Australia's native fauna have generally only recently been undertaken. Rarer animals are more difficult to study and the numbat in particular is not easily trapped or kept in captivity. Forests Department researchers have kept records of numbat sightings in the Perup Fauna Priority Area since 1972. These observations, added to increased research activity in recent years, have combined to cast new light on the numbat.



Landscape No. 4.

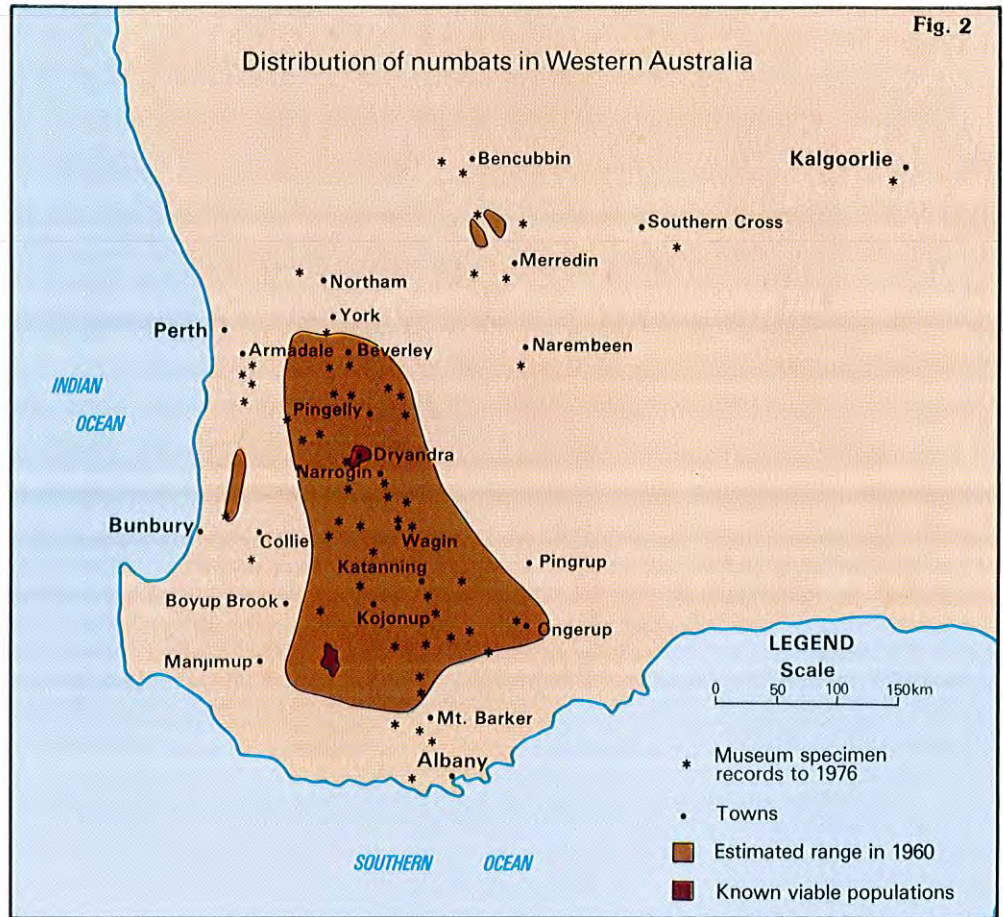
In the Year of the Tree, take time to really see the texture, character and life in the trees around you. Old man paperbark was photographed near Denmark by Cliff Winfield from the Forests Department, Como.



Gentle Creatures

The numbat is the only member of the family Myrmecobiidae. Its closest relatives are the Dasyurids (including animals such as the western native cat, the dunnart and the mardo), which share certain characteristics of behaviour and physiology. It is not surprising that the numbat was chosen as Western Australia's faunal emblem, for it is an extremely attractive animal both in appearance and temperament. Adult animals weigh a little more than half a kilogram and are easily held in one hand, especially as they do not scratch or struggle very persistently. The numbat has a very alert appearance with its small head, long nose and pointed ears, and if alarmed the long coarse hairs covering the tail bristle up, making this gentle creature appear far more hostile than is actually the case. Coloured for camouflage, the numbat's coat features black and white bands on the back, and reddish-brown forequarters flecked with white.

The numbat seems to be quite a curious animal and has been observed to sit on its hind legs and gaze curiously at cars that have stopped, rather ironically, to enable the people to gaze curiously at the



Wandoo forest, once covering the wheatbelt is a known habitat of the numbat.



Dunnart (*Sminthopsis murina*). The numbat is possibly of similar evolutionary stock as the dunnart but has diverged due to its specialization of diet.





N. Maloney.

▲ Numbats inhabit the jarrah/marri forest in the Perup Fauna Priority Area. Here a researcher radio-tracks a numbat. Note the red tape used to mark the route.

The numbat is also known as the banded ant-eater because of its diet of “white ants” and the distinctive markings across its back. This numbat is about to be released after being fitted with collar and small antenna.



T. Lettwich.

numbat! On one occasion a numbat stood behind a termite mound resting its paws on it, watching a person on foot.

Although the numbat is a marsupial the female does not have a pouch. The young, which are born between January and April are carried by the mother and are attached to the teats. When the young are too large to be carried they are sheltered in a burrow or log where the mother returns for feeding.

Declining Numbers

The numbat was once common in the open wandoo forests. Much current research relies on the only detailed biological study previously conducted on the numbat, by Dr. J. H. Calaby, who worked in Dryandra forest in 1960. The distribution map shown in figure 2 is taken from that study and shows the range of the numbat as estimated by Dr Calaby. As can be seen from this map, the open wandoo forests inhabited by the numbat are in the region known as the wheatbelt. Museum records also show that numbats were collected from various locations outside the wandoo forest region. Sightings from these areas were far less common than from the wheatbelt but indicate the original extent of the numbat's distribution.

In recent years the status of this species has dramatically changed. Most of the wheatbelt is now cleared for agriculture, leaving very little area as undisturbed bushland. The few remaining bush reserves, and uncleared private land are seldom of a size large enough to support a self-perpetuating population of numbats. Bushfires and other disturbances associated with settlement probably further reduce the value of these areas as numbat refuges.

Present day sightings are rare and restricted to areas of State forest such as Dryandra and Perup forests. It is not known how quickly the population declined, but it is certain that today there are fewer numbats in Dryandra forest than in 1960.

Records of numbat sightings in the Perup Fauna Priority Area show an encouraging increase in numbers in recent years. This follows an alarming decline between 1972 and 1976.

Tracking Programme

Early in 1981 while trapping for woylies and tamar wallabies (see *Forest Focus* Nos. 23-25) we had the great fortune to catch two numbats to commence the radio-tracking programme. Since then several other numbats have been caught and fitted with a collar and transmitter, so that we are gradually building up a picture of the daily lives of these animals. The great advantage that the numbat affords our research team is that it is a diurnal creature, that is, active during the day, whereas other animals being tracked, such as the brush-tailed possum (see *Forest Focus* 26) are nocturnal and more difficult to follow.

The transmitter emits a signal that is picked up on a hand-held directional antenna. When the numbat moves, the signal alters accordingly, so that we may follow the creatures as they are actually moving through the forest searching for food. Keeping a distance of 200 metres from the numbat affords enough room between the researcher and the subject to allow us to keep within range without disturbing or altering the numbat's behaviour.

Daily Routine

Each day the numbat is tracked to its home log where it sleeps overnight, and the tracking programme is resumed the next day from that log. During summer, these animals have an enviable routine. At about 7.15a.m. the numbat, perhaps curled up in its nest, wakes up in its log and starts to stir. The transmitted signal begins to fluctuate, indicating that it's on its way towards the entrance. Very sensitive to overhead predators, the numbat often will take two or three trips to the entrance of the log before satisfied that the coast is clear. Normally, it's well on its way before 8.00a.m., quickly at first as it heads eagerly to the first spot likely to provide a breakfast of termites. Foraging for termites under small logs or sticks

At the start of the day the numbat moves to the end of the log and has a good look about before leaving. ▶

takes up most of the morning's busy schedule. When the summer temperatures rise during the middle of the day the numbat, in classic Mediterranean style retires into a log for a three or four hour siesta, arising in the late afternoon to continue foraging often until 8.00p.m. The numbat is quite active towards the end of the day making its way as it forages, back to one of several preferred logs in its large home range, where it will spend the night.

The cold, wet conditions of winter see a change in routine for the numbat. During this period, particularly if it's raining, the tracker has waited for hours for the animal to wake in the morning. It likes very much to sleep in on cold days, the main period of activity at this time being in the middle and warmest part of the day.

Termites

These changes in behaviour between summer and winter are most probably related to termite activity. The numbat is more likely to be out and about when the termites are

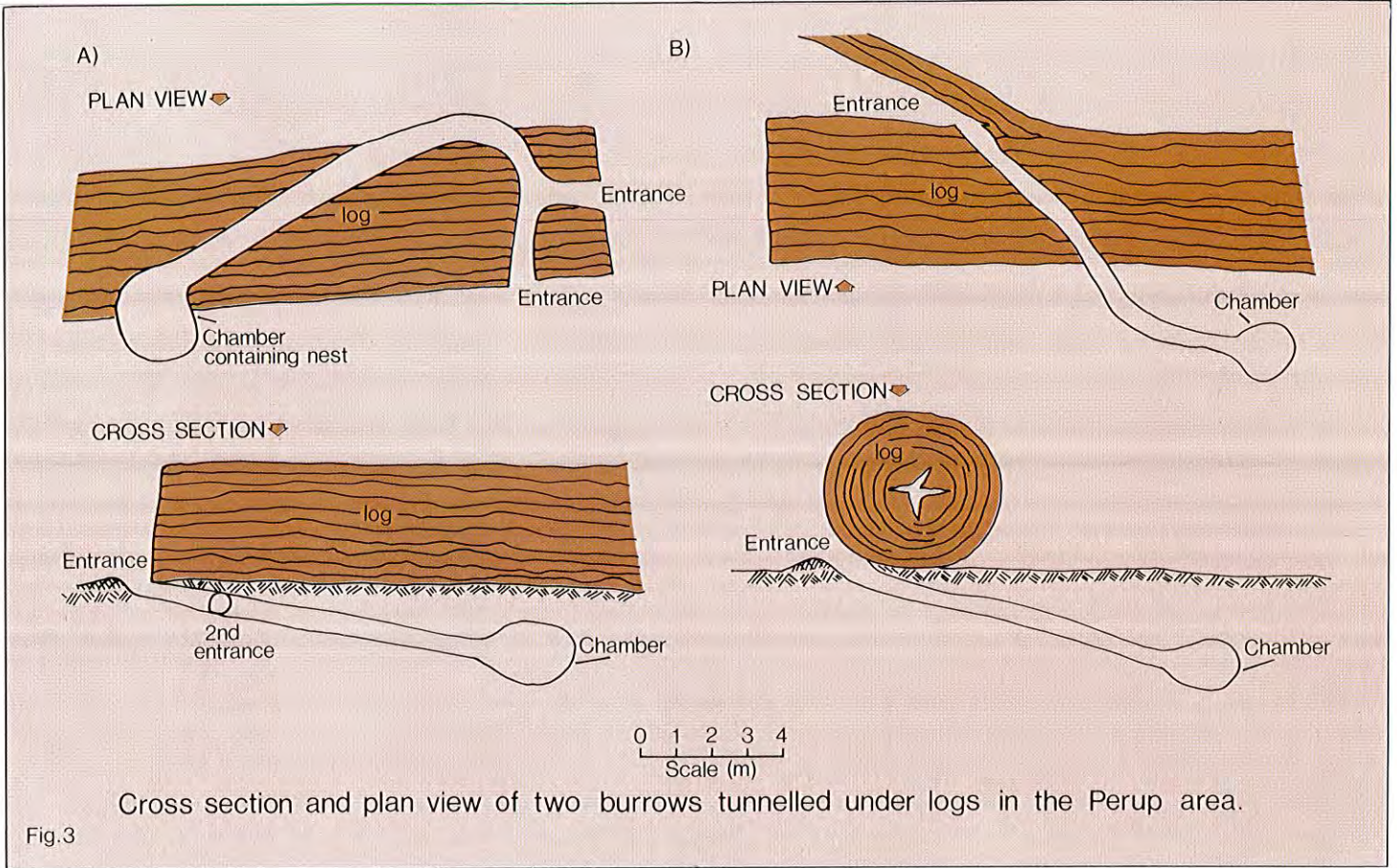


N Maissey.

▲ Female numbat with three young attached to the teats. Even though a marsupial, the numbat doesn't have a developed pouch.



T. Leitch.



Termites invade sticks and branchwood where they establish their working galleries. It is easier for the numbat to roll the sticks over than attempt to break into the mud walls of a termite mound.



G. Wardell-Johnson.

most abundant. In winter this is during the middle of the day when the termites are active in small sticks and branchwood laying on the forest floor. The numbat obtains the termites by turning over the sticks exposing the insects in the ground beneath and the termite galleries on the underside of the sticks. Large logs that are heavily infested with termites are broken into by scratching open the galleries just under the surface. Bark has been found scratched away from logs by the numbat searching for termites in the sapwood beneath.

During hot dry weather termites, being moisture-sensitive, tend to retreat from the small branchwood as it dries out. Activity then moves to the underside of larger logs or to pieces of wood partially buried in the ground. The numbat changes its method of searching and concentrates more on digging in the soil beside pieces of buried wood, at the base of trees, or at the base of termite mounds where the galleries are abundant just below the soil surface.

However, this small animal is not strong enough to actually break the hard surface of the mounds.

Logs and Burrows

Within its home range the numbat uses a number of logs created, in the case of the Perup forest, as logging debris from cutting operations conducted there in 1972. One animal used a total of 23 logs during the time that it was tracked. Some of these were simply refuge logs used when the animal was disturbed, others were regular "home" logs that the numbat returned to at night. The size of the hollow of the log seems to be very important. The numbat chooses those of approximately 7cm in diameter, although when startled will run into the nearest hollow for safety.

The numbat uses burrows in a similar way as the logs in its home range. The entrance to the burrows are always well concealed under logs or piles of branches and the tunnel invariably goes under the log for some distance making it very difficult for animals such as the introduced fox or the racehorse goanna to dig up. The tunnel section of the burrow is a consistent size for its entire length, and the entrance is of a characteristic shape, a shape that closely matches the hindquarters of the animal.

The tunnel opens out into a small nest area lined with shredded bark and dry leaves. This material is scratched from fallen logs and is similar to that used by other animals for lining their nests. It probably has a reasonable insulating effect and is used in both logs and burrows.

The burrows were once thought to be breeding burrows which the female excavated to house her litter. However, two of the numbats tracked were males and both had more than one burrow. It is more likely that these burrows are used in cold weather, as the ground may hold the heat generated by the numbat once inside its nest. Logs are less likely to remain warm once they are saturated. A numbat tracked in late autumn began using burrows when the temperature dropped and maximum temperatures of around 15°C were experienced. Another numbat tracked for a short period in winter used only burrows, whereas those tracked in summer used logs.



Termites are social insects, ordered into castes. The soldier caste defends the population with either ferocious looking mandibles on the head, or chemicals that are sprayed at intruders through a proboscis. Species are primarily identified by the shape of the mandibles or proboscis.

Top: *Heterotermes platycephalus*
Middle: *Nasutitermes exitiosus*
Bottom: *Termes occidentalis*.

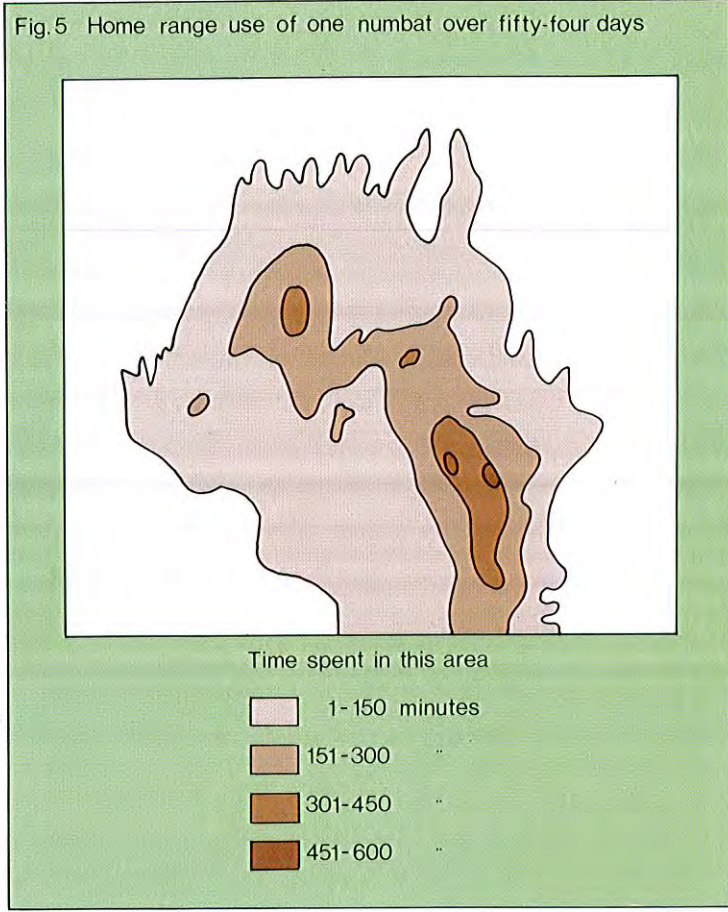
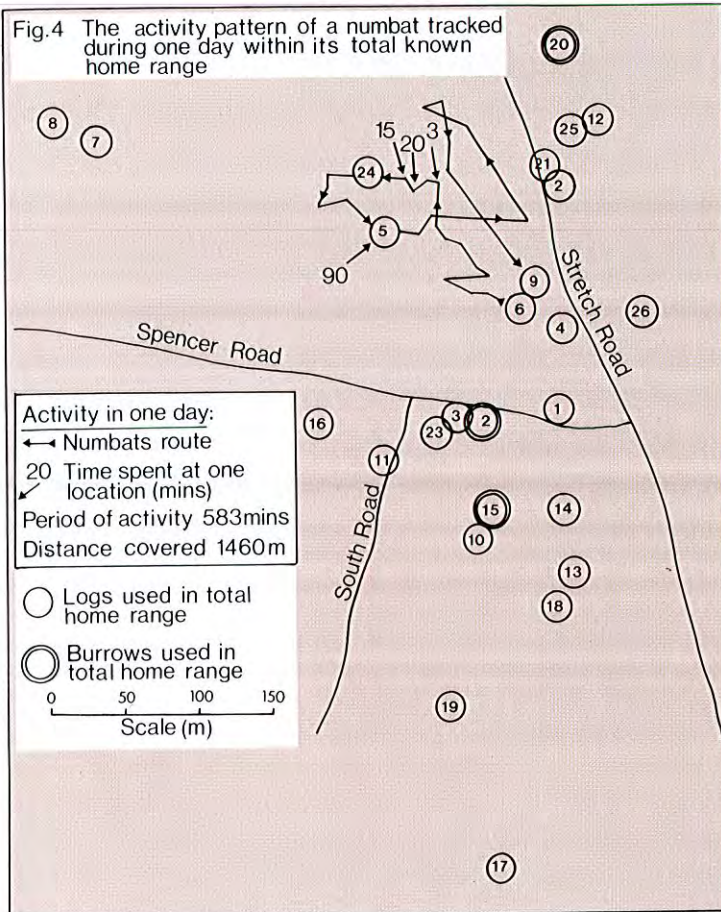
Results So Far

Once all the information about log-use, home range area, distance travelled and activity patterns was gathered, we could begin to piece together a story. The numbats' daily paths were plotted on maps, computer diagrams drawn up and vegetation grids of the whole study area composed. It appeared from these daily movement maps (see fig. 4) that a large proportion of a numbat's home range is not used while some particular locations are favoured. A pattern of rotational use began to emerge, suggesting that numbats spend certain amounts of time in one area in a home range then move to another allowing the first to recover its supply of termites. Once termite tunnels that connect a mound to pieces of wood are broken, it may take some time for repairs or new channels to be built.

Figure 5 presents the computer drawn maps of home range use. These show clearly the uneven pattern of utilization and the shift of the centres of activity.

The Future

What does the future hold for this unique species of fauna? Speculation is difficult at present as there is still much to learn about the numbat. Because of the extent of individual home ranges (in one case 128 hectares), we know that the numbat requires large areas of dry sclerophyll bushland to inhabit. The Perup forest is composed of wandoo and jarrah/marri forest, and the study area is significantly within the jarrah forest - an area not considered commonly inhabited by the numbat. But this area does



provide an enticing habitat for these creatures. There is an abundance of logging debris at least 10 years old that is readily infested with termites which to our knowledge are the numbat's only food source. Also the debris is old enough to have commenced rotting, making available safe shelter for the numbat in the log hollows. It appears that the Perup Fauna Priority Area may be one of the few strongholds for the numbat. Dryandra is another and these two areas have been set aside by the Forests Department for the conservation of our native fauna. But what is the numbat's specific habitat requirements? How do we manage the forests to provide this habitat? These and many more questions are still to be answered.



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SITES FOR SORE EYES

by Rae Burrows

When you are out in the bush barbecuing a juicy steak or photographing a little Rufous Treecreeper pecking at the crumbs on the picnic table, have you ever thought about how that forest recreation site was developed or is managed? If you are like most people you never have, nor are you likely to. It is enough that the weather is fine, the bush is great and the steak delicious.

Recreation areas don't just happen however. They are carefully planned, developed and maintained. In State forest the Forests Department is responsible for the recreation sites.

State forest is of major and growing importance to the State for recreational activities and provides one of the last large areas of relatively intact landscape available for recreation on an extensive scale. It is also close to most of the State's population and is easily accessible.

The Forests Department has been providing recreation facilities for the public for many years. It has

The giant Gloucester Tree has been a favourite recreation attraction in the karri forest for many years. Developments have taken place here to cater for the changing demands of visitors. ►



recently begun planning for recreation on a regional scale. This means that new sites will be located in areas best suited to a particular type of recreation and facility. Once the location for the site has been decided the work of effectively designing the individual facilities begins.

Changing Demand

Forest based recreation has always been popular. In the early days of settlement bush picnics, forest train rides and flower gathering were all common leisure activities. As the car began to dominate the forest scene, more vehicle-based forms of recreation like touring and sightseeing became important, but the forest picnic generally remained the main objective.

The Forests Department responded to the recreational demand by keeping special scenic routes open and in a reasonable condition - an example is the Rainbow Trail near Pemberton. Rustic tables, barbecues and bins were also provided in areas where it was obvious that people were congregating.

The advent of the 1970s and the increase in environmental and personal health awareness brought even more people into our forests for recreation and solace. In Western Australia they were encouraged by promotion of the appeal of the forests by such bodies as the Department for Youth, Sport and Recreation and the Education Department.

At about the time that the popularity of the forests was increasing, fuel prices were also escalating. Although no detailed studies were done in this State on the effects high petrol prices had on recreational patterns, it seemed apparent that Western Australians were reflecting the behaviour of people elsewhere. Indications were that petrol was saved for the leisure time but people would choose their recreation site carefully so that they could satisfy their range of recreation requirements without moving too far from the one place.

These economic developments, added to the fact that many unplanned picnic sites were becoming degraded and unattractive, prompted the Forests Department to begin the

process of redesigning old and planning new sites so that they could better serve the needs of the recreating public without causing unacceptable damage to the surrounding environment.

Redevelopment

Some existing sites had problems with their redevelopment and maintenance. These were generally the sites that had been developed by the Department in the wake of visitors. Some had been unwisely located on environmentally sensitive areas such as river banks which cannot withstand the constant pressure of large numbers of visitors. They become severely damaged.

Other facilities had been located actually on the feature that attracted visitors to the site. For example, at Boulder Rock near the Canning

Redeveloping recreation sites protects the natural environment itself, makes the sites functional for the user and produces a pleasant recreation environment. Here are site plans of Gloucester Tree before and after it was developed by the Forests Department.

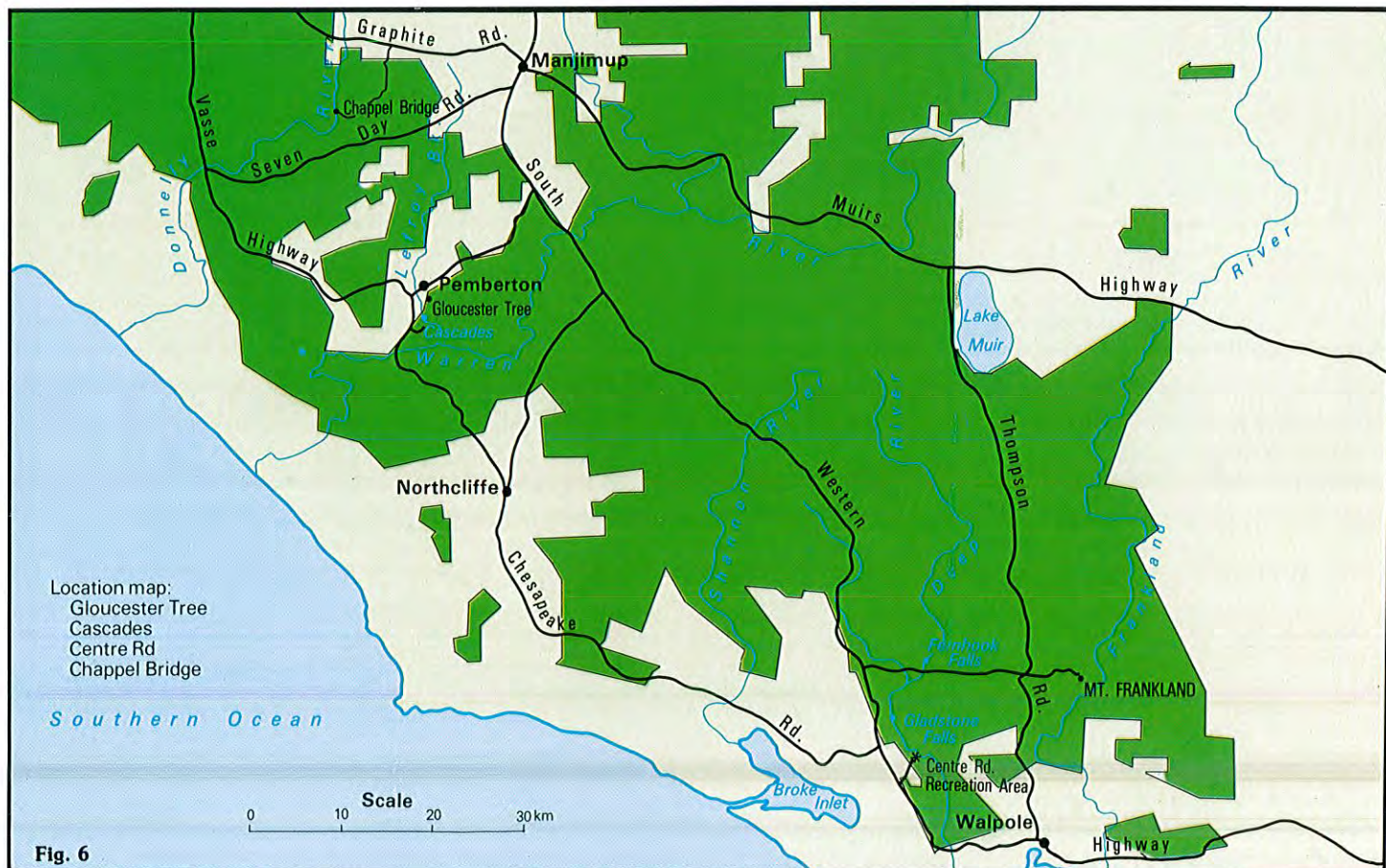


Fig. 6

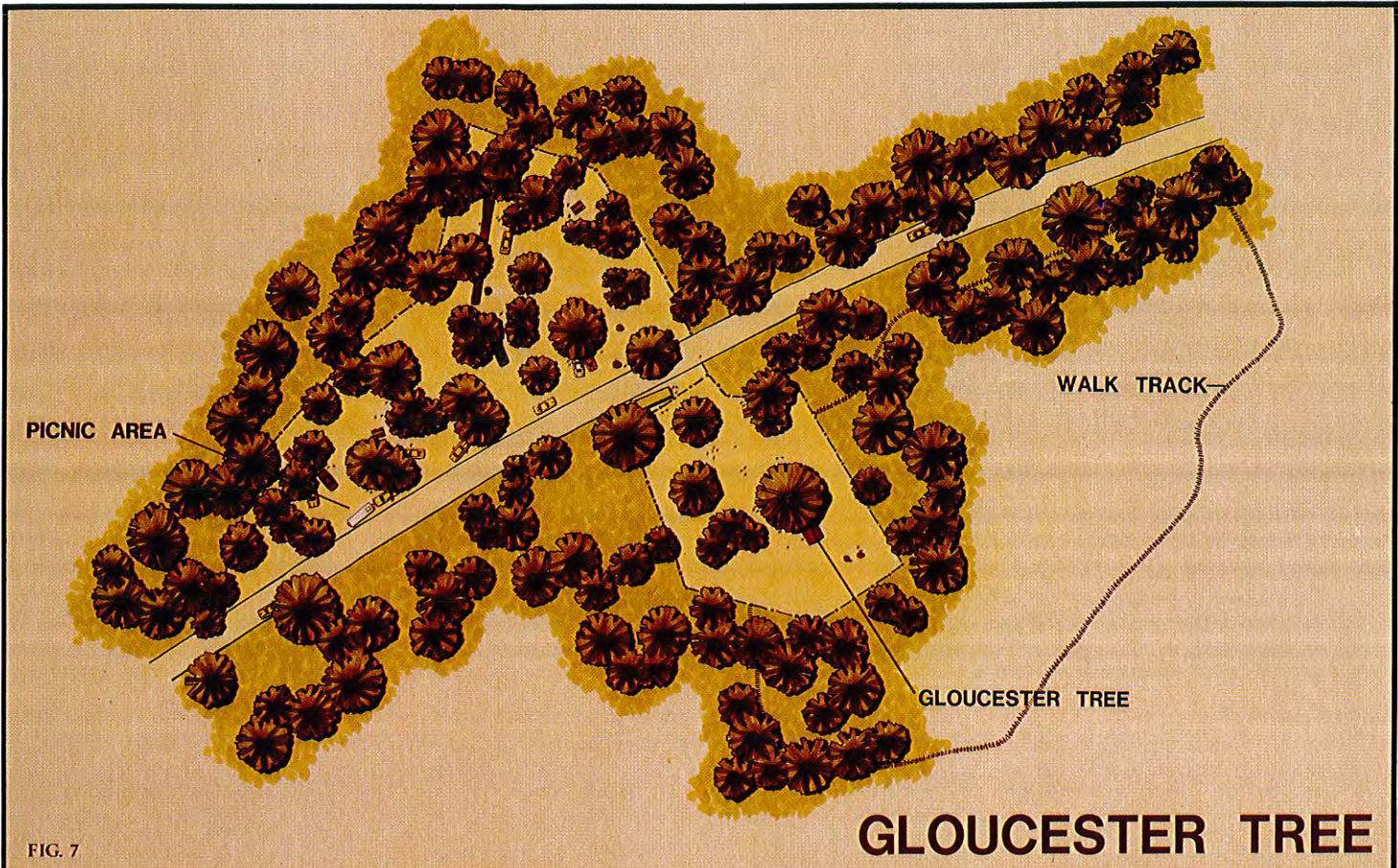


FIG. 7

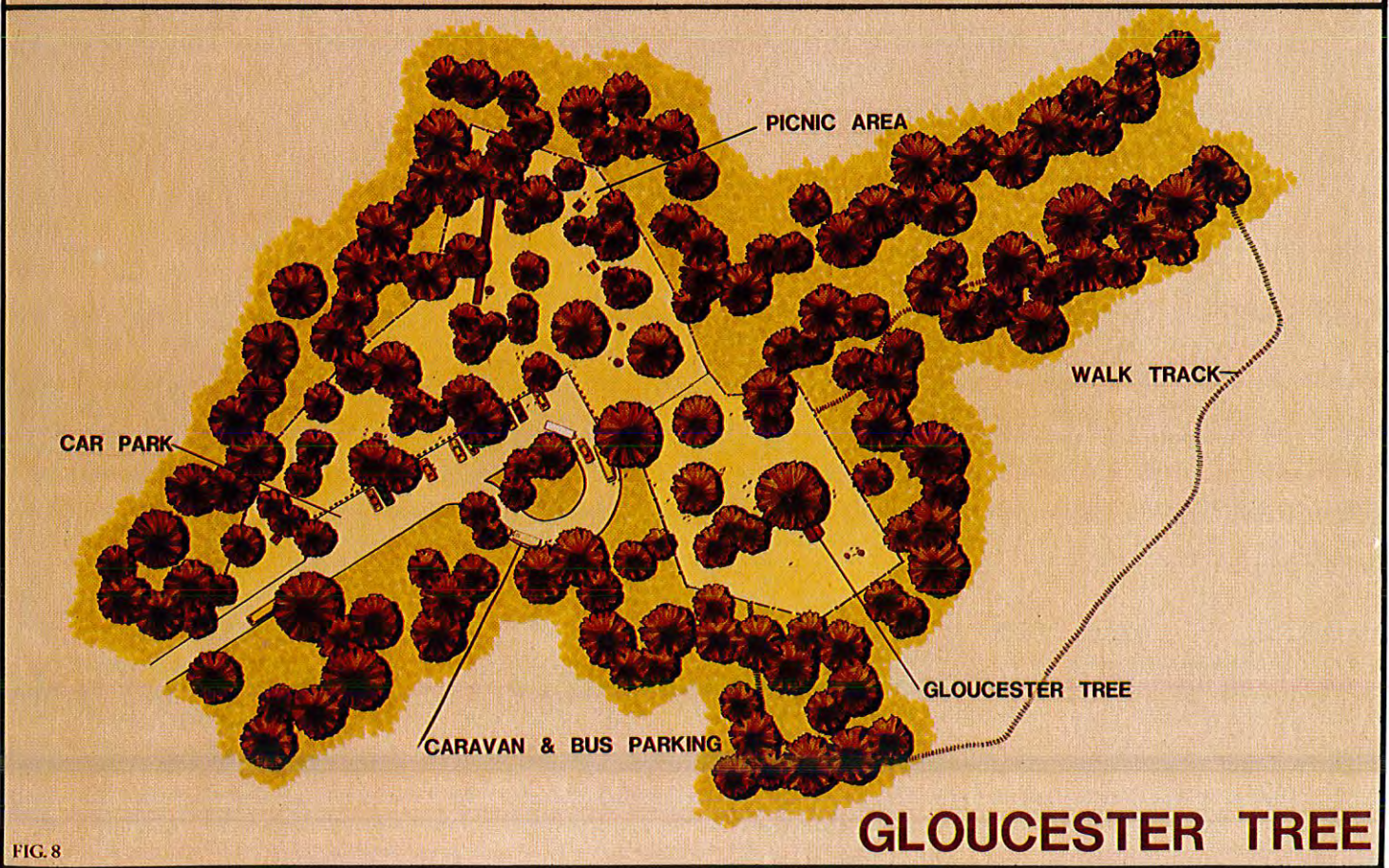


FIG. 8



C. Winfield

◀ Aerial view of the fire tower built on top of the towering Gloucester Tree. Although no longer used for fire surveillance, the tower provides a striking view of the surrounding karri forest.

Dam, picnic facilities were originally located on top of the Rock. This detracted considerably from the natural features of the site and its surrounds.

Still other sites had to be completely redeveloped to better meet the needs of the users and provide for a range of recreational activities without causing undue damage to the forest environment. Gloucester Tree is one such site.

Gloucester Tree

Gloucester Tree is an extremely popular and renowned fire lookout tree tower in Pemberton. Each year it is climbed by thousands of tourists from all over Australia.

The original recreation site below the tree was unsatisfactory, being centred around concrete barbecues and a 44 gallon drum that served as a rubbish bin. Cars could be driven right up to the base of the tree, creating a dust bowl in summer and a quagmire in winter. Compaction of the soil immediately around this huge karri also reduced the amount of oxygen reaching the surface roots, affecting the vitality of the tree.

These problems prompted the Department to draw up a detailed plan for the redevelopment of the

site in 1977. Rustic wooden picnic tables, stone barbecues and improved rubbish bins were provided in an area adjacent but not extending to the immediate vicinity of the Gloucester Tree. Vehicles were excluded from the whole recreation area by the use of vertical logs around a car park and bus turn-around area. The type of barrier was chosen to blend with the dominant lines of the environment - namely the stately karri trees.

Each picnicking unit, consisting of a table and barbecue, was separated from other units by distance and vegetation screens. This ensured a certain level of privacy for each recreating group while still keeping the area developed to a minimum. No units were located immediately under the popular fire tower so that it could never be perceived as belonging to any one group. It was and is a facility for everyone to use. Other facilities were provided to better cater for the needs of the public. Toilets were built and constructed in such a way that they didn't detract from the bush around them. The sturdy rough wooden structures are painted so that they merge into the surrounding forest.

A display shelter was also built. It houses information and photographs about the history of the Gloucester Tree and about the role of the Forests Department in managing forests like that around the site. The shelter is designed so that the displays can be easily changed or added to. It is also designed so that it is in keeping with the rustic appearance of the other facilities on the site.

Two walk loops were constructed through the forest around the tree. The trails are there to provide for those interested in becoming even more closely acquainted with the natural environment. The different length loops allow people with varying energy levels to appreciate the bush without needing to retrace their steps to get back to the picnic site. For those who are more energetic, an even longer walk trail

may be attempted. It is called the East Brook Circuit and is one of the circuit routes of the Bibbulmun Track - the marked bush walk trail that stretches from Northcliffe in the south of the State, to Kalamunda near Perth. The East Brook route is very scenic and takes about a day to complete.

People with other tastes can be catered for by the Pemberton Fitness Trail which was made within walking distance of the Gloucester Tree. It consists of a fairly gruelling signposted exercise circuit and a 1600 metre running track through a mature arboretum. Less energetic people can also enjoy themselves by driving down the Eastbrook Trail from Gloucester Tree. The one-way road passes through some magnificent karri forest and through some relatively rare pure marri (or red gum) forest. Glimpses of the pretty East Brook are also refreshing.

The new development based around Gloucester Tree has worked well to date. However it must be remembered that a recreation area, like everything else must change with changing demands, pressures and as better planning methods become apparent. Already some more work is required to further improve the area even in the immediate vicinity of the tree. Further trampling of the soil around the fire tower ladder is beginning to cause problems in winter by creating puddles in the trampled area. This of course is rather uncomfortable for climbers so a wooden ramp is planned to be constructed directly under the ladder.

Further improvements will no doubt be made in time, particularly if natural hazards like fire and strong winds cause damage to the site. To date, the Gloucester Tree area has been free of these problems. Some sites however, have been beset by problems caused by natural hazards. One such site is the Cascades.

The Cascades

The Cascades is a very attractive area adjacent to some splendid rapids on the Lefroy Brook south of Pemberton. Set in the karri forest, it was redeveloped in 1977 - at about the same time as Gloucester Tree. Soon after its transformation into a well designed recreation area, a fire burnt a great deal of the surrounding

bush. A few months later, further problems were encountered when a farmer's dam above the site burst. The resulting flood washed away part of the walk trail, scoured out the valley in front of a lookout area, destroyed two foot-bridges and deposited logs and other debris in one of the feature sets of rapids. The damage took three years to repair both by natural processes and a rebuilding and clearing programme organized by the Forests Department. Today, there is little or no evidence of these damaging phenomena.

Other minor problems have continued to occur in the area requiring prompt attention and repair. Trees have fallen over the walk trail, another foot-bridge has aged, requiring replacement, and some planting has been required in certain areas where machines and high water levels have exposed the soil.

This sort of work supplements the ongoing maintenance programme for the site. The latter is carried out for all recreation sites and includes grading and gravelling of access roads, emptying bins, providing firewood, raking walk trails and generally tidying up. The frequency of work is dependent upon the level of use of a particular site.

New Sites

The locations of new recreation areas have been chosen carefully so that the expected visitor pressure can be absorbed without damaging the very environment that attracts the visitors. Other factors such as vegetation and soil type, slope, drainage patterns and type of use that is to be catered for are all taken into account when choosing a site. People's preferences for views, forest types, areas close to bitumen roads and population centres, have been determined by recent surveys so that these factors may also be considered.

Two of the most recently developed sites are Centre Road near Walpole, and Chappel Bridge west of Manjimup.

Centre Road

Like most redeveloped and new sites, Centre Road recreation area has been planned so that it serves as a centre for recreational activity in the



▲ The Forests Department is responsible for repairing natural damage to recreation sites in State forest. Here part of the Cascades is blocked by flood debris.

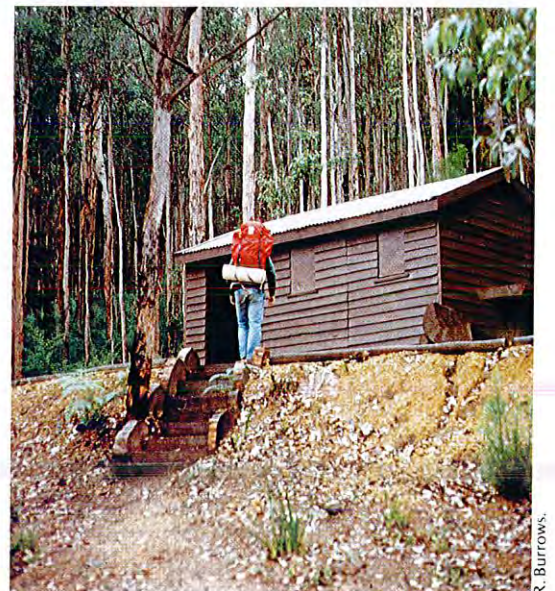
▼ The same area of the Cascades freed of the debris.



The recently constructed hut at Centre Road may be used by picnickers, hikers and canoeists for shelter in inclement weather. ▶

area. The site itself is located adjacent to the Deep River and has picnic and barbecue facilities and a hut for shelter from inclement weather. Centre Road can serve as a base for bushwalkers, canoeists and, in the near future, sightseers in vehicles, as it will be linked by scenic bush tracks to other beauty spots, like Gladstone Falls.

The hut is located on a hill overlooking the barbecue area and





R. Burrows.

the Deep River. It is one of three shelters in the Walpole region. The other two are located at Mt. Frankland and at Fernhook Falls and are used frequently. They are left open for the convenience of visitors and are well cared for by those who use them.

Chappel Bridge

Chappel Bridge is a newly developed recreation area about 25km west of Manjimup. It is named after the historic but unfortunately delapidated wooden bridge which spans the Donnelly River at this point. The river valley is steep and densely vegetated with magnificent karri forest.

Although the present development consists of only a barbecueing/picnicking area and walk trail, it is planned that the site will become the centre of a historic development. There is much evidence of the old methods of logging and hauling in the area and the old timber tramway is still easily seen.

Chappel Bridge is within an 800 metre scenic walk from an amazing curved wooden bridge called Palings Bridge. This old railway bridge was built three decades ago and does not cross the river but rather curves around a loop in it. The reason for building the bridge was apparently to avoid the exceedingly steep hills which the locos would otherwise have had to negotiate while hauling the logs.

The site of Chappel Bridge is also a handy resting place for the hardy walkers of the Bibbulmun Track.

Future Developments

Planned future developments are designed to explain the unique features of the forest to the visitors with the help of self-guiding car tours, information shelters and signs. We also plan to encourage people to try different types of forest based recreation such as orienteering, canoeing and horseriding. A horseriding trail is soon to be marked out from Manjimup to the south coast.

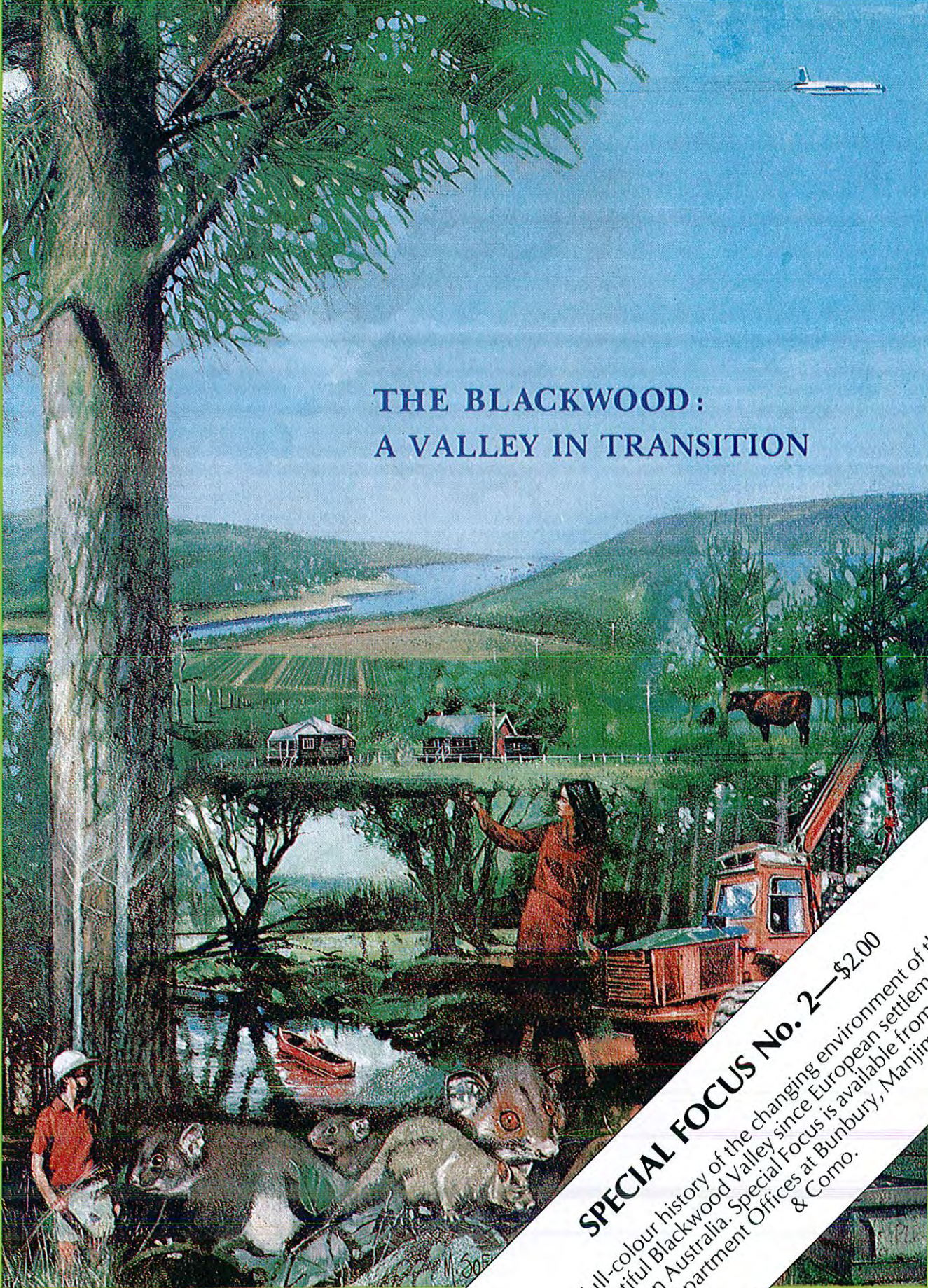


Built for bygone logging traffic, the old Chappel Bridge spans the Donnelly River near the newly developed recreation site. The site is also part of the scenic Bibbulmun Walk Track.

Loading and unloading areas and stabling facilities will be provided at points along the trail for the convenience of users.

In addition to these future developments and the existing facilities provided by the Forests Department, there will always be thousands of hectares of undeveloped State forest that you can discover and explore by yourself. Bring your friends, and enjoy yourself.





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