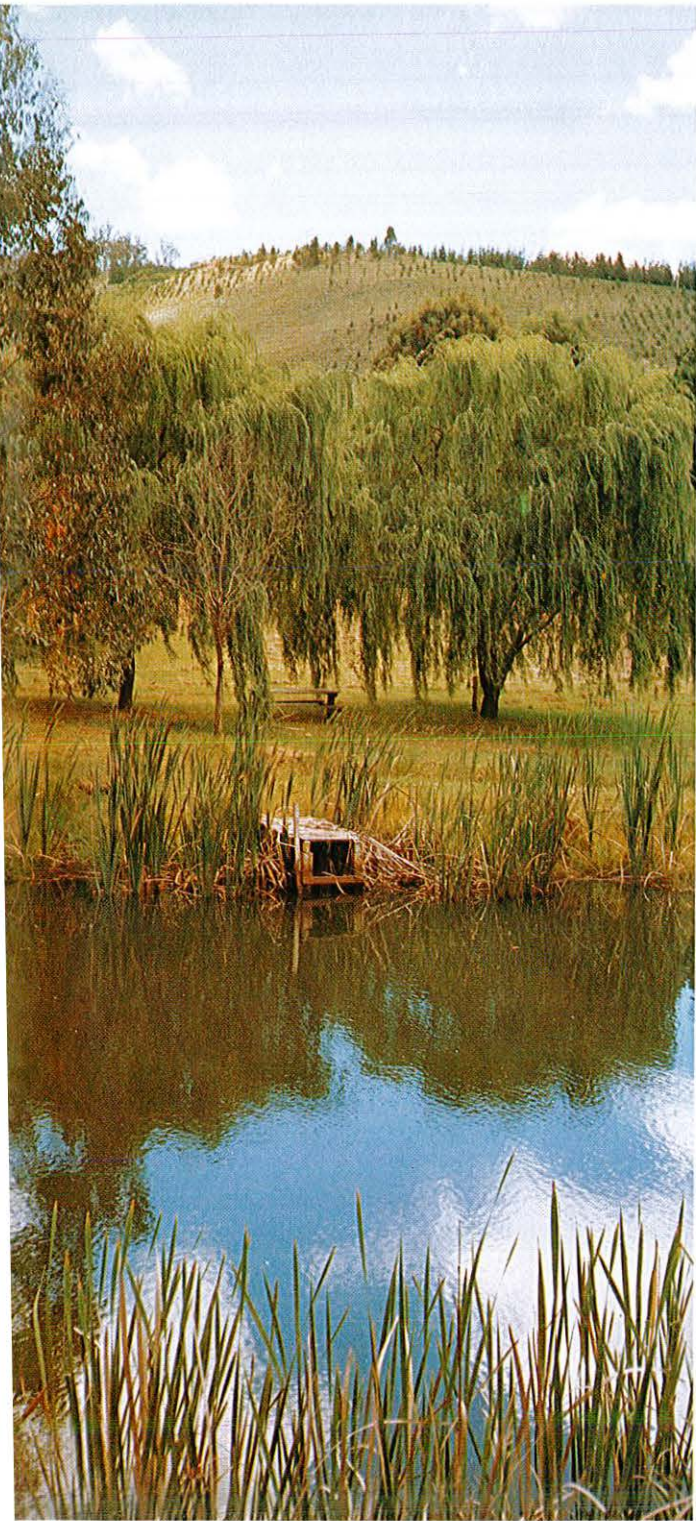




FOREST FOCUS

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Front Cover

Left: One of the many picturesque scenes at the Lewana settlement. (Courtesy of the Department of Youth, Sport and Recreation)

Top, right: The Britten-Norman Islander ("Aircraft of the Forest"). (R. A. Selkirk)

Bottom, right: Mueller's snake (*Rhinoplocephalus bicolor*), a species whose centre of distribution lies within the marri Woodchip Licence Area. (T. Leftwich)

▲ Taken from the Piper Super Cub, this picture shows a panoramic view of the South Dandalup Dam and surrounding jarrah forest. (Les Harman)

Inset, top: The Super Cub was built in the U.S.A. Its 150 h.p. engine, smaller body and cheap running costs make this craft ideal for the job of fire detection. It is pictured here taxiing on the 900 m long airstrip at Dwellingup. (Les Harman)

Inset, bottom: The British designed Britten-Norman Islander is the latest aircraft used for prescribed burning and aerial photography programmes. The twin-engine BN-2A features the high-wing design affording greater visibility during flight operations. (R. A. Selkirk)



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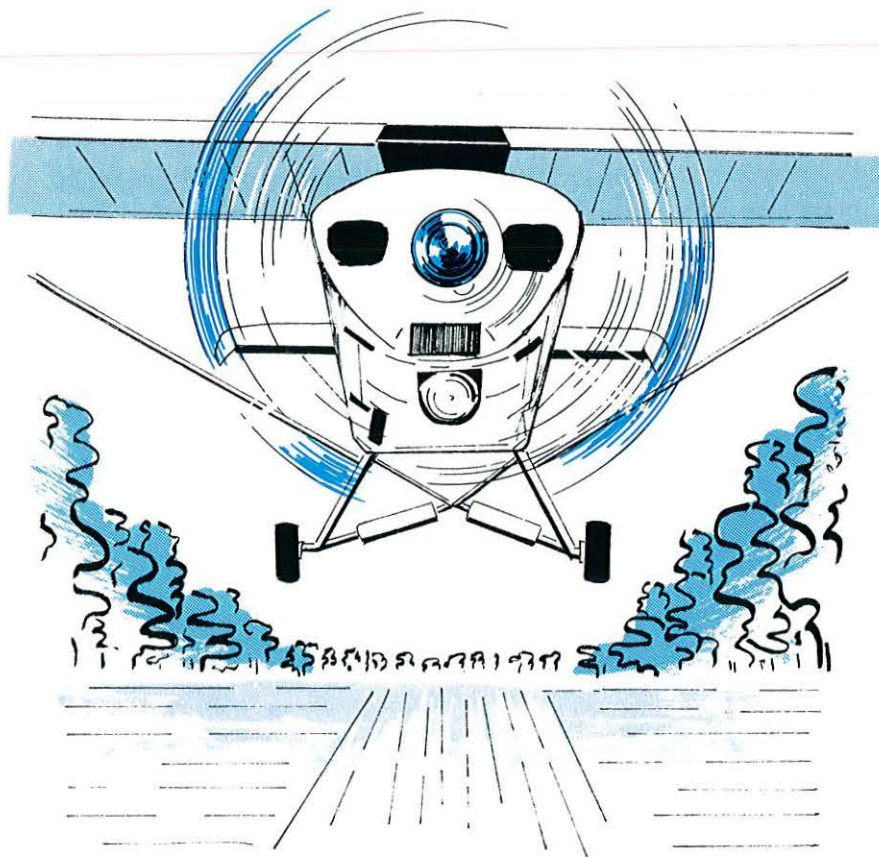
Written, photographed and illustrated by Forests Department officers.

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Compiled by H. K. Bradbury.

AIRCRAFT OF THE FORESTS

H. K. BRADBURY



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“Necessity is the mother of Invention”, so the proverb says, and the development of forest management techniques is no exception to the rule. The south-west of Australia is endowed with unique eucalypt forests which have evolved under a set of specific conditions. Here we have the combination of hardy forests, flat, accessible terrain and harsh climatic variations in rainfall and temperature. Because of the climate most of Australia’s open forests are subject to frequent wildfire, and have evolved with fire. In Western Australia the annual fire risk is acute. It is not surprising, therefore, that in the area of fire protection and research the Western Australian Forests Department is among the world leaders. Fire surveillance commenced locally with the well-known tree lookout system for fire spotting (see *Forest Focus* No. 23). Now with the advancement of technology, an even better system has been developed for fire management and forest protection. In 1966 aircraft were introduced into the Department to meet the need for fire management. Since then, aircraft have been integrated further into forestry and are now used not only for protection, but also for fauna, fire and dieback research, crop dusting of plantations and arboreta, broadcasting of scrub seed for revegetation of damaged forest sites, and management projects requiring aerial photography. However, the major impact of aircraft in Western Australian forestry has been in the long-term broad-scale projects of the Protection, and Inventory and Planning branches of the Department.



▲ The current model Cub is directly developed from a similar high-wing monoplane used in World War II for reconnaissance after bombing raids. It is shown here over the jarrah forest. (G. van Didden)

Three types of aircraft are used at different times of the year for different reasons. The Britten-Norman Islanders are used for burning and photography in spring and autumn operating all over the south-west. These are twin-engined aircraft, capable of carrying ten persons. They are re-fitted for forestry operations. The single-engined Cessna and Piper Super Cubs are used primarily for fire spotting in the summer months and operate from Dwellingup, Nannup, Collie and Manjimup. They can carry two persons.

Fire Detection

The concept of fire spotting from aircraft is not new. The Forests Commission of Victoria for example, used airborne spotters as early as the 1930s, commencing an occasional usage of aircraft in eastern states forestry ever since. In Georgia, in the United States of America, the Piper Cub is now used for the same job, but on a smaller scale than that used in Western Australia. Many countries of the world use aircraft for forestry operations, but again the need for fire surveillance is not so great as it is here, and not so highly developed. It was not until 1972 that the concept was tested for Western Australian forest conditions, and found to be particularly

successful. The comparatively flat terrain of the south-west is very suitable for light aircraft flight operations, compared with that of New South Wales, for example, where the mountainous terrain is too treacherous for comprehensive surveillance by aeroplane. Overall, the aerial spotting system costs less than manned tree and tower lookouts, and the efficiency of accurate and immediate aerial interpretation of a blaze far outstrips methods used in the past by foresters on the ground.

Originally the Cessna 150 was used for fire detection but has now been superseded by the more powerful Super Cubs which are lighter and provide greater visibility, with the turned-down nose and tandem seating arrangement. Nineteen pilots are contracted for six or seven months of the year, working throughout the fire season from November to April. Unlike other pilots employed seasonally, John Woodward of Dwellingup returns each summer for the spotting. The exacting job of continued surveillance would seem tedious to some, but to John, now in his fourth season, the summer spotting is very much a way of life. Boredom is out of the question he says, because of the arrangement of the shifts and flight circuits. Pilots are on a rotating roster working mornings or afternoons, for only about two to



▲ Inside the Super Cub. The tandem seating arrangement is especially suited to surveillance work, as 180° viewing is available without tilting the aircraft. (Les Harman)

three hours at a time, and for a maximum of 30 hours per week in compliance with air safety regulations. There's no room for lapses in concentration. The aircraft must be in top condition and thoroughly checked before each take-off. Like the other centres in the south-west, the Dwellingup-Jarrahdale system is divided into circuits, which are surveyed in accordance with the fire hazard rating of the day. The circuits are flown more often as the hazard increases. John can therefore be flying as far south as Harvey and as far north as the Avon Valley, or east and west for the whole breadth of the Darling Scarp. At the height of the fire season, when the likelihood of wildfire is at its highest, the integrated surveillance from all the spotting centres covers the whole of the south-west forests every day.

Many Western Australians recall the huge wildfire which devastated the town of Dwellingup in January of 1961. The fires were caused by a heavy build-up of fuel on the forest floor and extreme weather conditions. In those days the tower system was the only method for fire-spotting, and it proved too cumbersome a method for the 19 wildfires which sprang up from lightning strikes within days of each other. Not having the benefit of the aerial over-view, sightings in the past had



▲ Made from stressed metal and fabric coated with a plastic Dacron finish, the Super Cub is strong, but light enough for one person to wheel in and out of the hangar. Here John Woodward wheels the aircraft out on to the taxi-way. (Les Harman)



▲ As well as fire spotting, pilots patrol quarantine areas and check oil spillages from vehicles at the Alcoa bauxite mines pictured below. (Les Harman)

to be confirmed by at least one other tower. A forestry officer then had to be sent in to assess and exactly locate the blaze, and finally the suppression crews sent in. Even initial sightings could have been slow using the old method, as the tell-tale smoke often needed to rise a considerable distance to be seen by the lookouts in the towers. John Woodward was the pilot flying the circuit in January 1978 when a replica of the 1961 lightning pattern occurred. Then the full value of the spotting system was realised, as John quickly located seven smokes, two of which weren't even seen by the towers. By radio he communicated the size, intensity and direction of the fires and the available access roads for the suppression crews, guiding them away from blocked roads and down free access points to the heart of the burns. Even for the spotters the visibility of the fires at times of big burns is restricted by smoke, but the advantage of the airborne spotter is manoeuvrability around the smoke, and the ability to approach from altitudes varying from 500-10 000 ft.

The keen-eyed pilots naturally become more adept at spotting fires as their experience increases. Under optimum visibility a single smouldering log can be detected. The bird's

eye view is also used for spotting violators of the Forests Department dieback quarantine areas. In the Dwellingup area, oil spillages from single vehicles in bauxite mining operations can be spotted. In either instances John can determine the colour and type of vehicle, whether it be a car lost in the forest, or a haul-pac¹ operating a mine site.

Over the past eight years the network of aerial spotting in Western Australia has increased by leaps and bounds from one hired Cessna 150 in 1973 to eight Cubs in 1980-81. In 1979 the Department purchased four of those eight Piper Super Cubs at a cost of \$31 000 each which represented a large saving over the hiring method. Obviously the use of aircraft is an important part of the Forests Department's protection operations. No other country in the world can boast the inventive, efficient surveillance system which has developed in Western Australia. The special nature of our forested environment has been at the heart of the innovation.

The "Bombers"

The other major way of protecting the forest from the damage of wildfire is to reduce the build-up of inflammable litter on the forest

floor by burning off in the mild seasons of the year. These so called "cool" burns are done on a rotating basis, depending on the characteristics of vegetation and weather. Prior to 1965-66 this enormous task was attempted by hand, which not only proved expensive, but also inefficient. Then in 1965 tests were conducted to determine the feasibility of aerial ignition of prescribed burn areas using a Cessna 337. Even from the trial stage it was obvious that this method was far more efficient than ground burning, as the area covered within a single day increased dramatically. It now takes only one hour to light up an area of 2000 hectares. Rapid lighting enables the Department to take advantage of optimum conditions at shorter notice. Aerial burning proved to be four times cheaper than hand burning, including the labour costs of ground crew used in each operation.

Two Britten-Norman Islanders and their pilots are hired each season for the prescribed burning programmes in autumn and spring. An aerial ignition (bombing) operation requires team work and accurate flying. The pilot, navigator and bombardier are trained on-flight for five to ten days for the special requirements of the job, learning

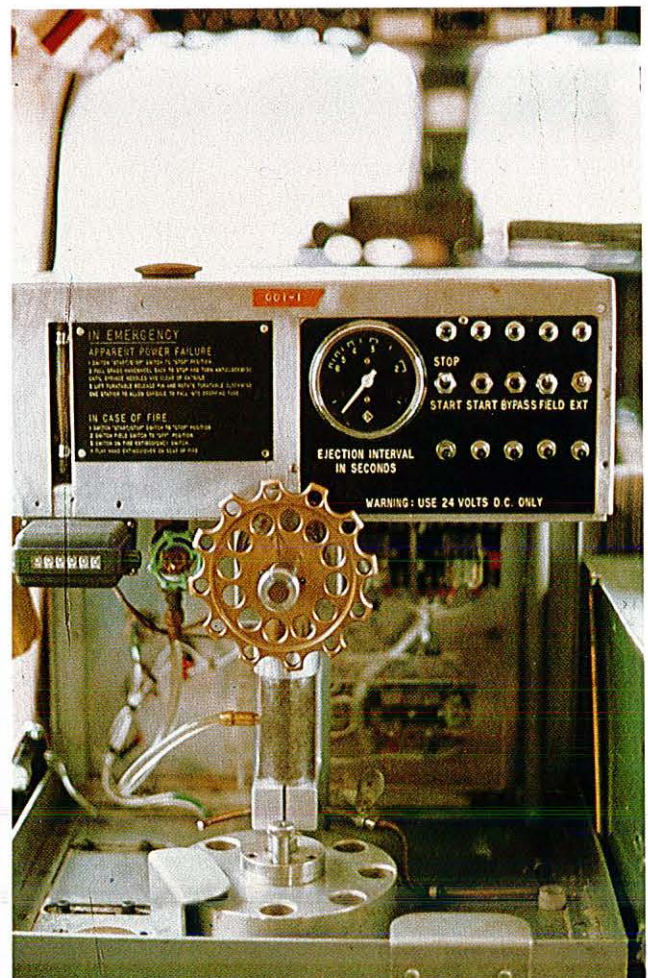


▲ The ignition capsule, an incendiary "bomb", has gone through many stages of development, including the current one of potassium permanganate crystals held in a plastic cylinder. It is shown here igniting 30 seconds after having been injected or "primed" with a catalyst. (G. van Didden)



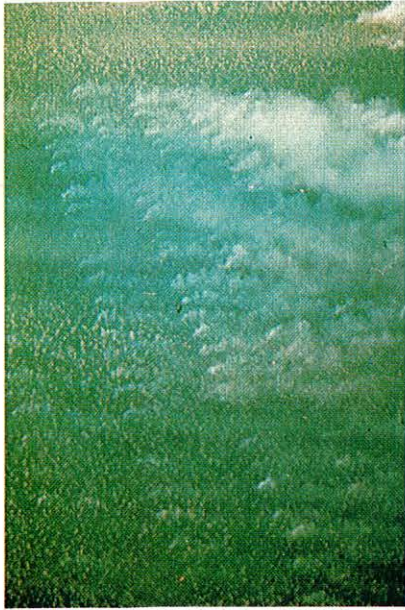
▲ This picture shows the relative size of the capsules. (G. van Didden)

The current incendiary machine is based on an original C.S.I.R.O. design and was built by the National Instrument Company in 1968. The machine primes the capsules and drops them through a chute in the floor of the aircraft. (G. van Didden)



▼ The incendiary capsules are made and mounted in a factory in Perth. (G. van Didden)





how to co-ordinate flight lines, drop rates and air speed. They fly very low, between 150 and 700 feet and at present can drop a maximum of 37 "bombs" per minute with the current incendiary machine. The calculated rate of spread and the required intensity burn determines the rate of drop. The latest incendiary machine being designed at the Western Australian Institute of Technology will be able to drop between 20 and 120 "bombs" per minute.

In the 1979-80 season a total of 309 597 hectares were lit, over 250 000 of these being done by aerial ignition. Safe protection operations on this large scale have been made possible by the constant refinement and development of technical equipment. The possibility of accidents has always been a major concern. Over the years the aircraft have been changed, the incendiary and radar equipment refined, and the "bombs" perfected.

Aerial Photography

The prescribed burning programmes end in January in the most southerly part of the karri forest. One of the Britten-Norman Islanders is then re-fitted for the autumn



▲ On board the BN-2A Islander during burning operations. Pictured are pilot, navigator and "bombardier". (G. van Didden)

◀ Typical cross-wind lighting pattern viewed from 3 000 feet. (P. Cheney)



▲ Deliberate intense burn conducted for research.

(G. van Didden)

▼ Ground view of a "hot" burn in the northern jarrah forest conducted for dieback research, late summer, 1980. This was lit using aerial ignition, and regeneration patterns are now being monitored. (Les Harman)



project of aerial photography required by the Aerial Photography and Interpretation Section based in Manjimup. Once more the major impact of aircraft has been to open the way for sophisticated technological innovation. In this way previously impossible management and research tasks are made accessible and economical.

The "bombing", spotting and aerial photography techniques have been directly evolved from military activities of the two world wars. Stemming from the light-aircraft reconnaissance tradition, aerial photography was first used in the 1914-18 war. Later, in World War II, photography was widely used for planning and recording specific occurrences such as direct hits after bombing raids. This same type of aerial photography of specific locations is used in the Forests Department for logging operations, management and research projects. The other major task for the Aerial Photography and Interpretation group is mapping the spread of the dieback disease fungus *Phytophthora cinnamomi*. This particular type of aerial photography had no predecessors and has been developed in Western Australia for accurate broad-scale mapping of vegetation deaths. It is a constant photographic survey. Once the spread of the fungus is located, quarantine areas can be mapped and declared in order to isolate and monitor diseased pockets of the forest.

▼ Ground crew install a radar transponder to act as the ground reference station for the airborne Motorola navigation system at Mt. Roe, south of Manjimup.

(Neil Hamilton)

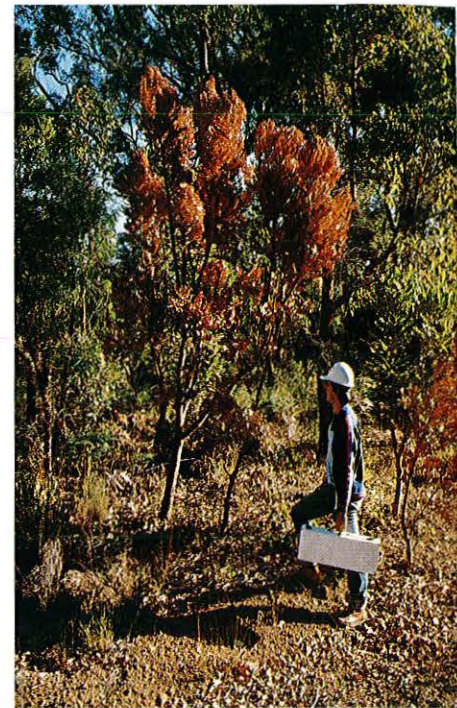


Flying Computer

On board the Britten-Norman Islander is an imposing set of equipment, including a Motorola computerised navigation system, two Vinten reconnaissance cameras and an intervalometer. The cameras take large negatives, 70 mm wide, which show a lot of detail. The intervalometer determines the time between each photograph, automatically operates the cameras and links them with the data processor.

Two crews comprising three members each are trained for dieback photography. The pilot must familiarise himself to fly by observing the Motorola track indicator (see photograph) and be capable of making fine track adjustments in order to fly at a constant accuracy of ± 20 metres. The navigator operates the airborne navigation system, feeding in all initial positioning data through a data terminal and then monitoring the print-out to ensure accuracy of direction and correct operation of the equipment. The cameraman is responsible for photograph acquisition and sets up the cameras by the remotely controlled intervalometer. The rest is done by the data processor which:

- Navigates by radar, sending and receiving signals *via* two ground-based transponders.
- Stores mapping co-ordinates on a magnetic tape along with the specific location of each photograph taken.



A ground view of the "dieback" death of *Banksia grandis*. (R. Chandler) ▲

- Co-ordinates the intervalometer which operates the cameras. As one camera runs out of film the second camera takes over to provide continuous coverage. Every single tree, its health and position, is thus recorded. A piece of ecological history is frozen.

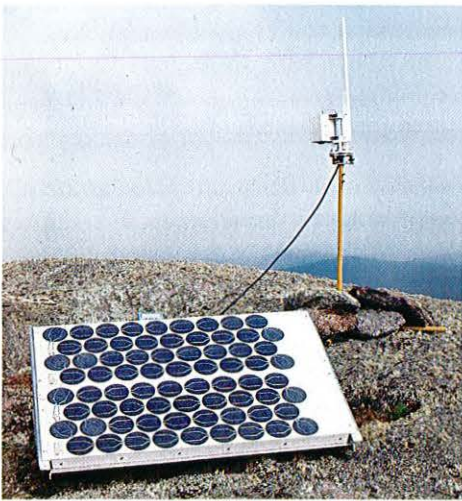
The flight operation, conducted in low light conditions for four months of the year, is just the beginning of the dieback mapping procedure. Once an area has been photographed and the information correlated with individual film frames, the dieback mapping interpreters take over. It is their job to read the photographs for vegetation deaths, go out in the field and physically record the cause of death, then on maps, record the progress of the dieback fungus through the forest.

Technology and Forestry

Something happens to human awareness when we get lifted out of our environment on the ground, to a position in the air where we can view the activities of the people on the earth as if they are ants. Those towering, mighty eucalypts which dwarf the forester become themselves dwarfed from the air. So as well as the ground view of individual

In 1980 Forests Department officers R. Chandler, A. Egerton-Green, M. Hamilton and K. Vear won an Award of the Productivity Promotion Council of Australia for developing the navigation system required for the photographic survey of dieback. The components of the system are pictured below.

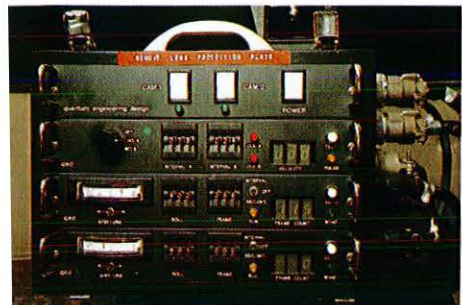
Photographs by Neil Hamilton.



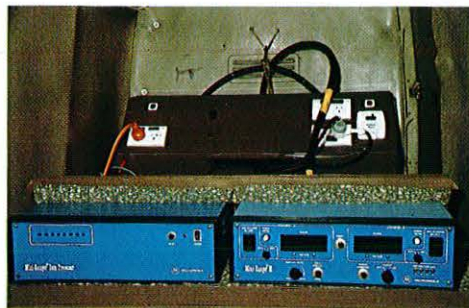
▲ A solar bank (front) provides 24-volt power to batteries which operate the transponder (rear) on top of Mt. Roe.



▲ The terminal interface (left) is operated by the navigator who types in co-ordinates of the desired flight line. The tape-deck records plotting co-ordinates for later mapping and matching with photographs.



▲ Also on board is this intervalometer which operates cameras, times exposures and interfaces with the processor. It was designed by Forests Department staff and made in New South Wales, and is believed to be the only one like it in the world.



▲ The range-finder (right) and micro-processor co-ordinate all the other parts of the navigation and photographic system. They are pictured here installed in the back of the aircraft.



▲ The Motorola Track Indicator (centre).



▲ Just touching down at the completion of a day's work near Manjimup.

trees, our perception of the forest has become balanced with the overall perspective of the whole forest spread like a carpet across the land. Man has learnt much about himself and his environment with the aid of technology. He has learnt that forests for instance, are finite, that those "unending" forests of

the south-west are tiny compared with the land surface of Western Australia.

Radio, aircraft, radar, cameras, data processors—who would normally associate them with forestry? Yet advanced technology is a familiar part of modern life and it has enabled us to "get the job done". Technology = information = power. The growth of technology, it can be claimed, has made the forests vulnerable. Yet it has also given us the power to monitor the progressive health of the forests, and to observe and record broad ecological changes as they are happening. Societies need to use the double-edged sword of technology with care.

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K. Vear, N. Hamilton, R. Selkirk from the Forests Department, Manjimup.

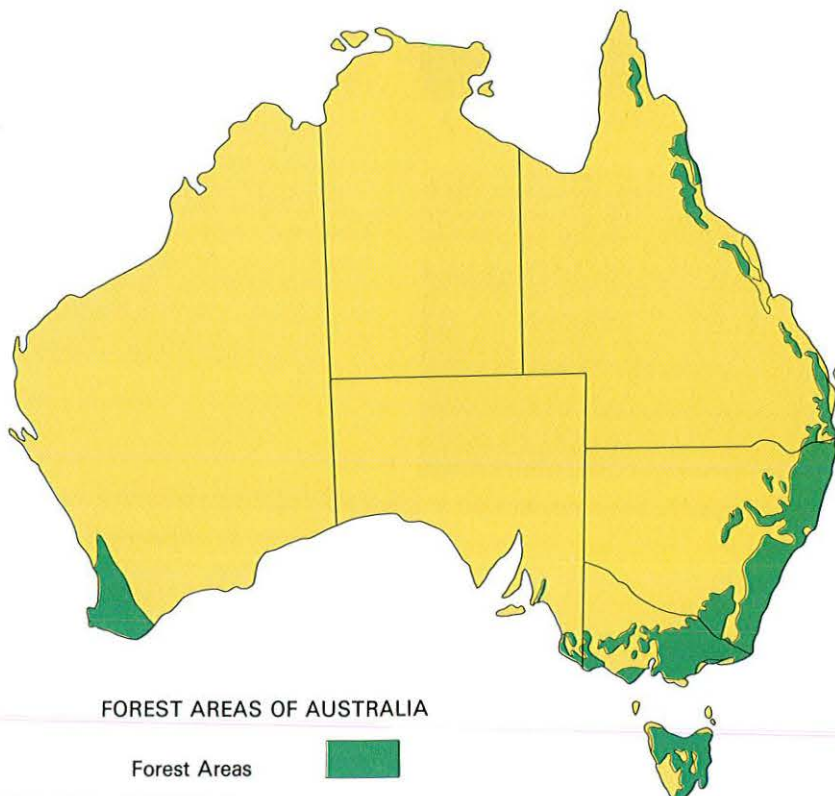


Clear Felling and Native Fauna in South-West Forests

P. E. S. CHRISTENSEN

The eucalypt forests of south-eastern and south-western Australia and Tasmania probably form the single most important wildlife refuge in Australia. Some 35 per cent of native mammal species, for example, are confined to sclerophyll forest. This is in spite of the fact that less than five per cent of the continent is covered by sclerophyll forest. The forested area of Western Australia covers less than one per cent of the total area of the state.

Clear felling is a long established forestry practice for the utilisation and regeneration of certain tree species in many parts of the world. In recent years this practice has come under criticism from conservationists and others who are concerned, among other things, about the effects of clear felling on wildlife. What are the effects of this method of forest regeneration on the wildlife of our forests? Is the welfare of animal populations being taken into account in the planning of clear felling operations? To answer these and other questions clear felling needs to be viewed in perspective, as one of a range of forest activities which may disturb wildlife.



▲ Map 1. The relatively small area occupied by sclerophyll forest is home to 35 per cent of Australian native mammals.

Because of their close proximity to major population centres, forests are important for a variety of purposes, for example, timber production, water catchment protection, recreation and as a wildlife habitat. The demand for these resources is continually increasing and there is a need for management to be directed at multi-purpose objectives. Obviously then, the entire forest estate cannot be set aside solely for the purpose of fauna conservation.

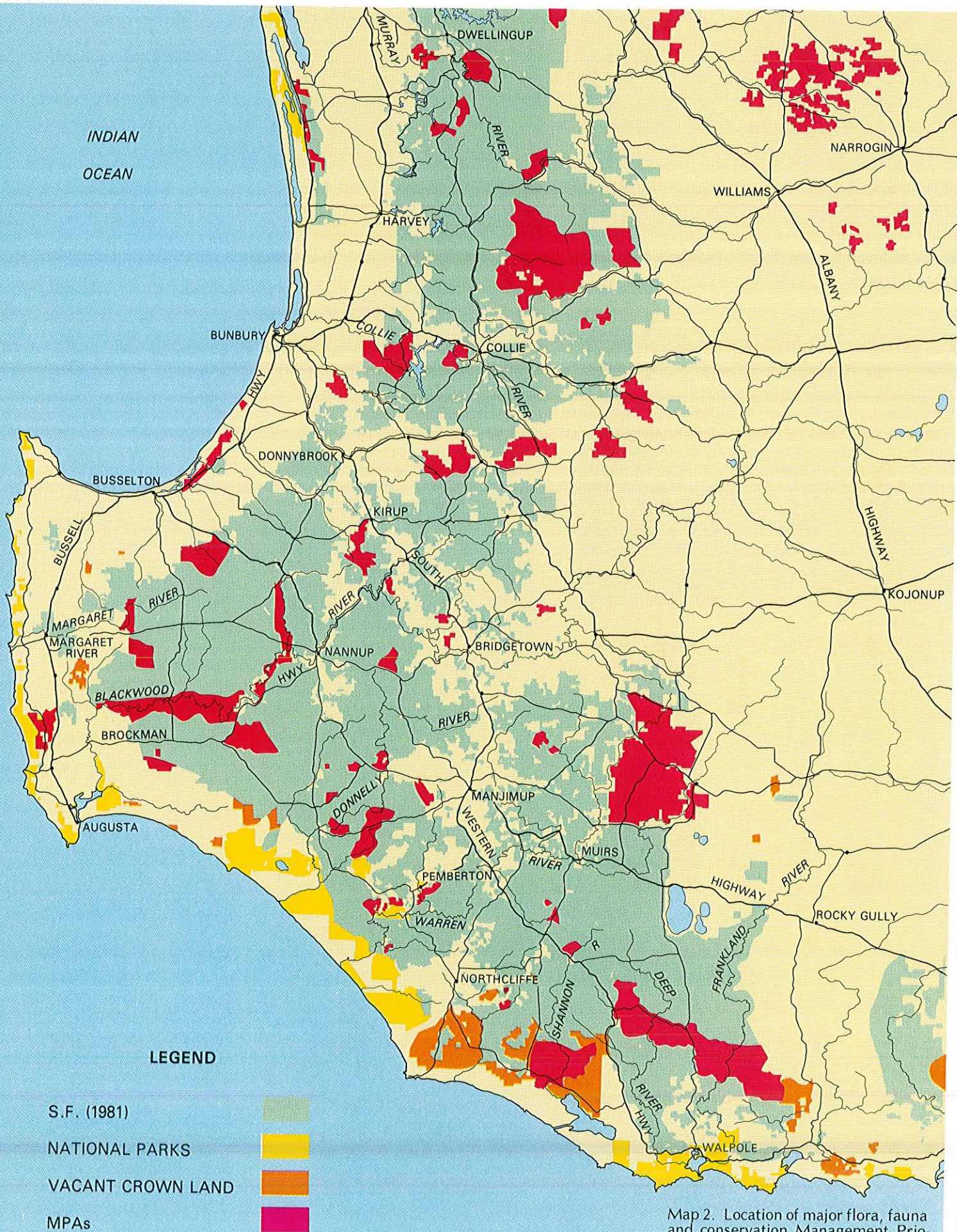
In Western Australia, two basic strategies have therefore been employed with regard to the welfare of forest wildlife.

1. The setting aside of flora, fauna and landscape management priority areas (M.P.A.s). To date, 71 areas have been set aside (map 2), Dryandra and the Perup forest are examples (see *Forest Focus* Nos. 10, 18).
2. Research and monitoring aimed at a better understanding of the effects of the various forest uses on forest fauna.

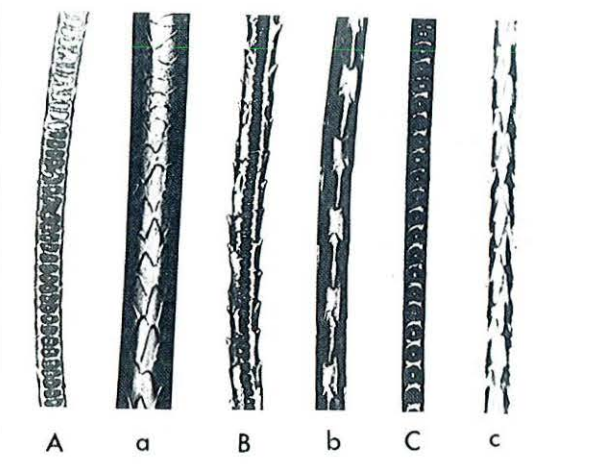
Biological Surveys

A necessary requirement before these two strategies can be put into practice is a knowledge of the occurrence and distribution of forest fauna. In 1970, when this work started, such basic information was fragmentary. Museum records were inadequate because no biological surveys had ever been carried out in any areas of state forests except Dryandra. The only information available was from specimens, mostly of mammals, sent to the museum by private individuals. Some bird lists did exist for certain areas where naturalists, as individuals or groups, had assembled them.

With this dearth of knowledge, the first task was to make up species lists for the vertebrate fauna of the forest. To accomplish this a continuing programme of biological surveys in



Map 2. Location of major flora, fauna and conservation Management Priority Areas in the southern forests. These Management Priority Areas contain examples of most of the main vegetation formations in the area.



▲ Top: Forests Department biological survey team camped near Dombakup State Forest. (P. Skinner)

Centre: Collecting fish specimens in the southern flats. (T. Leftwich)

Bottom: Foxes often catch and eat some of the smaller, rarer species which are difficult to trap. It is possible to identify an animal from a single hair, and microscopic examination of hairs from foxes' scats collected on surveys yields valuable information. (T. Leftwich)



Bat trap. Bats fly into two sets of closely spaced nylon fishing lines strung on an aluminium frame. They fall into the sack below, crawl up underneath an overhang and settle down to sleep awaiting the arrival of the trapper in the morning. (T. Leftwich)

selected areas of state forest was initiated. Initially for the first few surveys the Forests Department contracted naturalist Harry Butler. He helped make up the first lists and, working in co-operation with departmental personnel, helped to establish the basic framework for future biological surveys.

Some 17 biological surveys have now been carried out in various parts of state forest. Teams of five to ten men camp in the area to be surveyed for a period of one to two weeks, working sometimes almost around the clock.

Areas to be surveyed are chosen on a priority basis, for example, areas where it is believed that forest operations may pose a threat to the fauna, fauna rich areas, or other places of interest being chosen first. Having selected an area, aerial photographs, maps, museum data and information from previous surveys, are all used in planning the survey. Specific forest communities most deserving of attention are selected and preliminary trips to the area are made to establish trap lines and to familiarise the survey team with the area.

The main object of the surveys is to collect and record all species of vertebrate fauna in the area but at

the same time a collection of plants is also made. To collect fauna, a variety of traps is used to catch animals, mist nets are used for birds and bats, spotlights are used at night and shooting is also used occasionally to collect specimens. Frogs, lizards and small mammals are also collected by turning over rocks and logs and inspecting other likely hiding places. Fish are caught using a small hand net. A few more exotic methods, such as hair identification in fox scats, are also employed.

To date some 30 species of native mammals including 9 bats; 166 birds; 42 reptiles; 11 frogs; and 15 fish have been recorded as occurring in forest areas in recent years.

The surveys provide some of the basic data on which decisions to set aside flora and fauna management priority areas are based. Thus species which have a restricted distribution may receive special attention, for example, the decision to reserve the Perup Fauna Priority Area was based to a large extent on the occurrence of the woylie and the numbat in the area.

Fauna Research

In addition to the collection of basic information on occurrence and distribution of species, detailed



LANDSCAPE No. 1

Paperbarks lining the Murray River form beautiful scenes like this one, photographed by Les Harman, Forest Department, Dwellingup.



research projects are undertaken to gather data on the effects of forest activities on wildlife species.

Many of these projects are long term ones and mammals are most frequently chosen as the study species. This is because in general, mammals are more highly developed and may often be more sensitive to change than the lower forms. There are other requirements also in choosing study species, forest dependant species for example receive priority, likewise animals which live in areas in immediate danger of disturbance may be chosen. Not least of the requirements is "catchability", if an animal is difficult to capture or to observe it is often not possible to study it in detail.

Detailed studies have been carried out on the effect of fire on the woylie (*Bettongia penicillata*) and the tammar wallaby (*Macropus eugenii*). Information obtained from this study has been used to develop a special fire management plan for the Perup M.P.A. Known in certain areas as "featured species management", this concept of selecting groups or individual species as the specific objectives of management is also being developed by the U.S. Forest Service.

Studies have also been done on the effects of fire on small mammals, in particular the southern bush rat (*Rattus fuscipes*) and the yellow footed marsupial mouse (*Antechinus flavipes*). There are also research projects in progress involving the effect of clear felling on the quokka (*Setonix brachyurus*) and the mud minnow (*Lepidogalaxias salamandroides*). Studies on the effects of fire and clear felling operations on bird populations are also in progress.

Information from such studies, the biological surveys and other less intensive studies on other species, is all being used in relation to the clear



▲ This fearsome looking creature is a long-eared bat (*Nyctophilus geoffroyii*). The sharp teeth are used to kill insect prey, and the large ears to detect ultrasonic waves emitted by the bat itself for orientation purposes. (A. G. Wells)



▲ A biological survey team searches an area of coastal dunes and lakes for animals. (P. Skinner)

▼ The quokka (*Setonix brachyurus*) trapping and radio tracking study is in progress near Pemberton to determine the effect of clear felling on this species.

(A. G. Wells)





▲ Powderbark wandoo (*E. accedens*) forest in the Dryandra fauna, flora and landscape management area. (T. Leftwich)

Aerial view of uncut stream and roadside strips in clear felled experimental forest coupe. The bulge in the foreground is part of a road reserve which includes some uncommercial forest. (Neil Hamilton)



▼ Granite rock habitat in the southern forests, Mt. Lindesay. (T. Leftwich)



felling which is taking place, particularly within the Woodchip Licence Area.

The biological surveys using fauna information indicate that the tall open forests of karri and marri, which are best for timber production, are the poorest habitat in terms of numbers of vertebrate species. Only 76 of the 141 species of birds listed within the Woodchip Licence Area were recorded in the karri forest. Likewise the karri forest *per se* is comparatively poor in species of mammals, frogs and fish and only a limited range of reptiles occur there. The highest diversity of species within the licence area is associated with the coastal strip of consolidated sand dune country, and the low open woodland and sedgeland communities of the south, and the jarrah and wandoo areas of the north-east Perup area.

All these communities are excluded from clear felling operations either by reason of there being no timber species or, as in the case of the Perup, through having been declared a flora and fauna M.P.A. In addition representative areas of all other major forest and non-forest communities have also been set aside for management as flora, fauna and landscape conservation M.P.A.s.

To complement these areas, strips of forest have been left along all major rivers and some minor rivers, and on selected roads within the Woodchip Licence Area. These strips to be left uncut are allocated prior to felling and mapped on a block by block basis (4000 ha at a time), in such a way as to create a network of uncut corridors of stream and road reserves which connect with the conservation M.P.A.s. Approximately 37 per cent of the area of state forest within the Woodchip Licence Area, where the clear felling technique is used most extensively has now been withdrawn from cutting on this system.

As a further safeguard, cutting proceeds in several different areas at any one time, and the longest possible lapse of time is allowed before felling occurs in adjacent cutting coupes. This allows re-invasion of fauna from uncut areas on to the regenerating coupes.

These measures are not all entirely for the benefit of the fauna, for example, stream-side strips also act as erosion and silt barriers and they have a recreation potential also.

Restricted Species

In terms of their dependence on forests, animals may be classified as transients, marginal, non-dependent residents and dependent residents. Transients are those species which only occasionally use the forest for food or shelter, for example, some species of bats and birds. Marginal species may use the forest edges for shelter while feeding elsewhere—kangaroo for example. Non-dependent residents are those species which live in the forest but also occur in other areas, for example coastal shrub or savannah woodland. Dependent residents are those species for which the forest is essential.

True forest dependent species are those which occur only within the forest and include aboreal species such as the gliders and the mountain possum (*Trichosurus caninus*) of the eastern states. With the possible exception of the native squirrel (*Phascogale tapoatafa*) there are no true forest dependent mammals in south-western Australia.

However, several species, among them the numbat (*Myrmecobius fasciatus*) and the woylie have become forest dependent species as a result of agricultural clearing of their woodland areas of habitat. There are also species of birds, reptiles, amphibians and fish which occur only in forest areas.

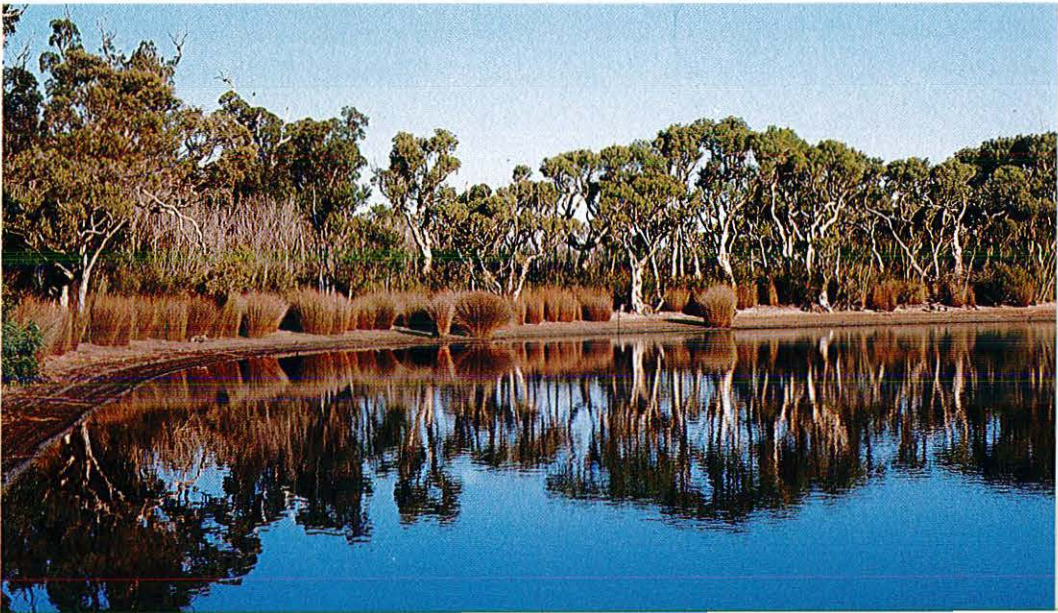


▲ The "native squirrel" (*Phascogale tapoatafa*) probably the only true forest dependent mammal in south-western Australia. (T. Leftwich)



▲ The numbat (*Myrmecobius fasciatus*), a species which has become forest dependent as a result of agricultural clearing of much of its former habitat. (L. Schick)

▼ Small lake within the Frankland M.P.A. (T. Leftwich)



When the Manjimup woodchip agreement was drawn up, fauna lists were examined for possible forest dependent species and further survey work was done to check the area for species which might previously have been missed. Two mammal species, the numbat and the woylie, were nominated as forest dependent species in addition to being considered sensitive to clear felling. For this reason clear felling was excluded from the already established Perup Fauna Management Priority Area.

A search for vertebrate species restricted entirely to within the Woodchip Licence Area came up with three possible species, the little brown snake (*Elapognathus minor*) and two small frogs (*Crinea rosea* and *C. lutea*). There are three other species whose centres of occurrence are believed to lie within the licence area. But they occur outside the area as well. These are: Mueller's snake (*Rhino-plocephalus bicolor*), the small frog (*Metacrinea nicholsii*) and the Shannon mud minnow.

Very few specimens of the little brown snake have ever been collected. The three collected by the Forests Department in recent years have all come from a restricted woodland ecotype on grey sands near the south coast. Mueller's snake occurs in a similar ecotype. These forest types, although within the licence area are not affected by any logging activity. The Shannon mud minnow occurs primarily in the "brown water" streams, high in organic content, of the southern non-forested flats. These areas are not affected by clear felling operations and a number of the streams in which the minnow occurs are to the east of the Frankland River, outside the licence area.

Both frog species, *C. rosea* and *M. nicholsii* have been collected or recorded recently in karri sapling stands regenerated following clear felling and burning during the last ten years. This demonstrates their



▲ Virgin karri (*E. diversicolor*) forest areas such as this have been reserved from clear felling in M.P.A.s within the marri Chipwood Licence Area.

(Jack Bradshaw)

ability to cope with clear felling. The other small frog, *C. lutea*, is known only from nine specimens from Deep River within the Nornalup National Park.

Direct Effects

Having covered the various safeguards which have been initiated before clear felling operations, we may now turn to examine the direct effects of clear felling on fauna actually living within the coupes.

Before attempting to understand the direct effects of clear felling on fauna, it is necessary first, to appreciate certain basic characteris-

tics of animal populations. Most animals are extremely adaptable and have evolved characteristics and behaviour patterns which allow them to cope with most situations.

Cruel and heartless as it may seem, in nature the welfare of the individual is not important in itself. The survival of individual birds or animals is only important when it affects the survival of the population. Thus, in most populations under natural conditions, only a very small proportion of the total number of young survive to adulthood. For example, approximately 15 of every 100 joeys born in woylie populations survive to live for more

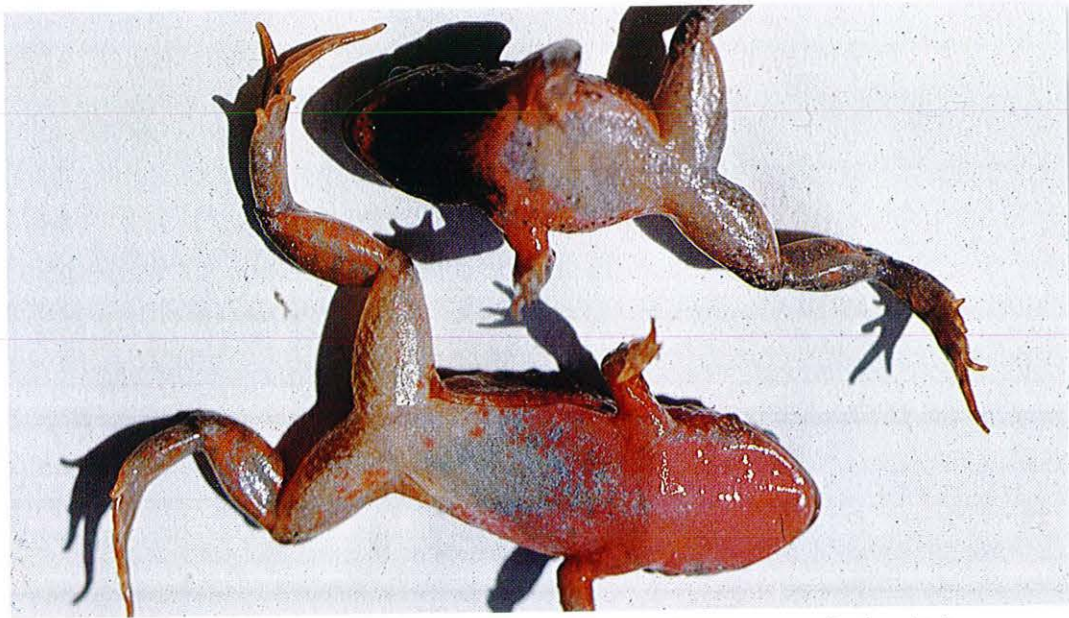
than a few months after leaving their mothers. There simply is not room for them.

Nature produces enormous numbers of excess young as an insurance policy in order that these may be available to re-populate areas where natural disaster has reduced the population. Thus following fire, as the vegetation regenerates, the survival of young woylies in areas surrounding the burn may increase to 40 out of 100 joeys. This is because many of the young which would otherwise die, find a home on the regenerating area, from where the adults disappeared following the fire.

This pattern is typical of many animals, and what may be a disaster to the present population—a wildfire or clear felling—is a boon for later populations, provided the habitat is allowed to regenerate. It is the re-population of the regenerating habitat which is important, not the immediate disturbance, disastrous as it may appear to be to the individual. If these facts are appreciated, the apparent devastation of clear felling may be seen as a transitory phenomenon. The studies which have been done so far indicate that these characteristics of animal populations are allowing them to cope successfully with the clear felling system.

In a two-year study the flora and fauna of regenerated karri forests ranging in age from one to over 100 years, was compared to that of uncut virgin stands. The study showed that although the immediate effect on the individual animals living in an area which is clear felled is devastating, this effect is transitory. Further studies are in progress to confirm these findings.

At no stage, even directly following felling and regeneration burning, is there no fauna present. Individual small frogs and lizards survive and continue to live on the burnt area. Regeneration of plants and young

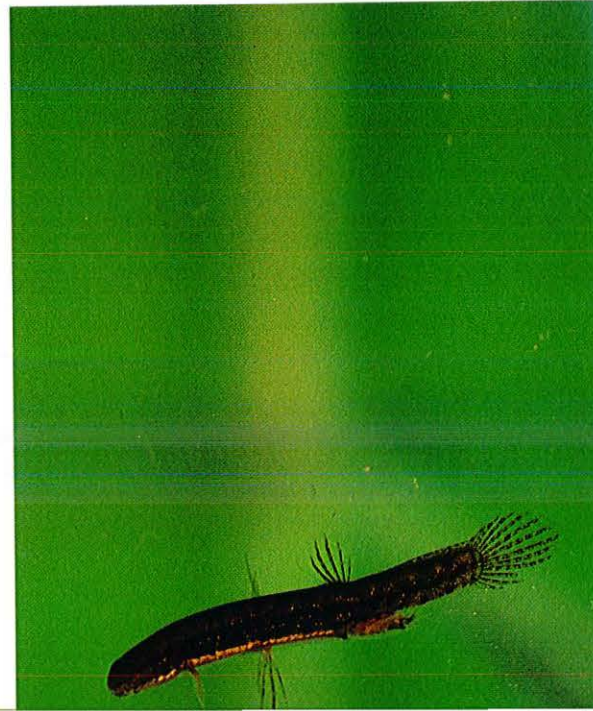


▲ *Crinea rosea*, male and female. This species lives in the dense reedbeds which are a feature of many water-courses in the karri forest. (T. Leftwich)



Winter floods on the Frankland River. ▲ (K. Pentony)

The mud minnow (*Lepidogalaxias salamandroides*), a species of great scientific interest. It is the only known southern hemisphere species of an otherwise northern hemisphere group of fishes. (T. Leftwich)





▲ Low open woodland and sedgeland, an area rich in fauna including the diminutive honey possum (*Tarsipes spenceri*). (T. Leftwich)



▲ The honey possum (*Tarsipes spenceri*). (T. Leftwich)

Dusky wood swallow (*Artamus cyanopterus*) nesting in a broken and splintered tree on a recently burnt clear felled area. (T. Leftwich)



A clear felled area recently burned for regeneration and still hazy with smoke. Even areas such as this still harbour a few species of animals which will live to reproduce as the forest regenerates. (Government photographer)



seedlings occurs rapidly and animals return and start to increase in numbers again.

The relative abundance of mammals, and to a certain extent also the insects, follows a pattern of change almost identical to that following fire in uncut forest. Thus species return to the area as suitable habitat regenerates, the greater proportion returning within the first few years following the regeneration burn.

Bird populations likewise, depend on the stage of succession or development of the new forest. As a particular niche or habitat develops it is occupied by species favouring that habitat. For example, wrens,

which favour dense low habitat, are early colonisers of the regenerated stands.

Birds are found in greatest numbers in virgin or mature karri forest. However, numbers of different bird species are highest in forest recently logged to seed trees, and in young regeneration. Lowest numbers of bird species were recorded in the pole stands, 30 to 50 years after regeneration.

For mammals and birds results appear to be fairly conclusive. The insect work is preliminary only and further work needs to be done to confirm and extend the results. However, indirect evidence in the form of the return of vertebrate

fauna to the area, many species of which feed on insects, suggest that the insects also return quickly.

Hole nesters form a group of special concern. Among the mammals, the bats are affected and several species of birds need hollow trees for nests. The numbers of hole nesting birds were not seriously affected, but it is presumed that they nested in surrounding uncut forest and only used the regenerated areas for feeding. The value for conservation of flora and fauna of M.P.A.s and the uncut strips is obvious in this regard.

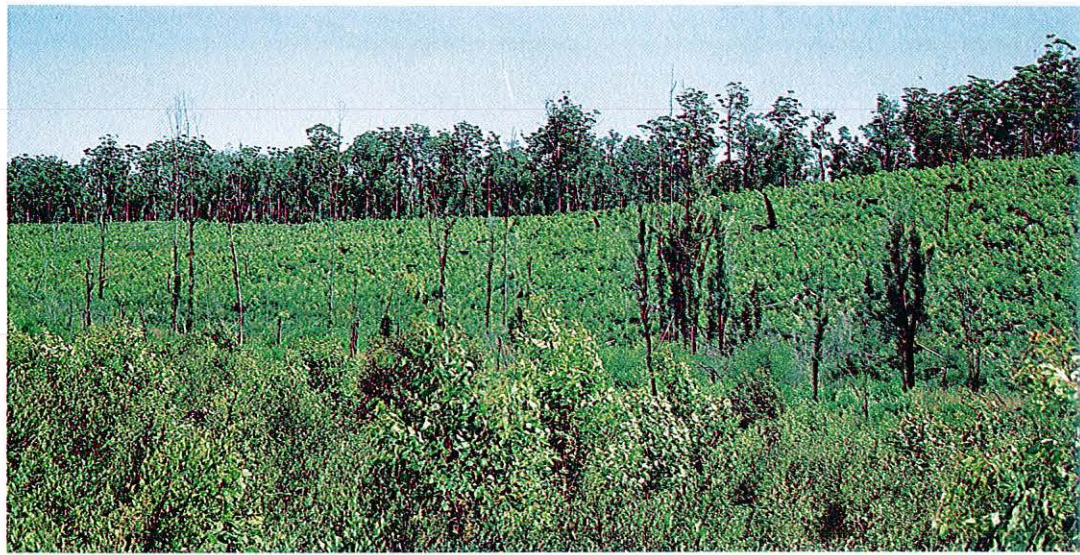
Reptiles, amphibia and fish were not covered to any great extent in

this study but survey data indicates that the fish are unaffected by clear felling and that the other two groups follow a succession similar to that observed of mammals.

The effect of clear felling on fauna, like those of a wildfire are therefore temporary in nature. Areas of regenerated forest of different ages favour different species and groups of fauna. The mosaic or mixture of different aged forest created is capable of supporting the full range of species present in the virgin stand, providing a percentage of uncut forest is left in all areas. This is necessary in order to supply the full range of habitat and to provide nest sites for the hole nesters and other species requiring mature trees.

An important reason for having the uncut area left in a pattern of interconnecting strips and blocks is to provide mature trees in close proximity to all regenerated coupes. This is particularly important for the hole nesters. If the total area of uncut forest were to be left as one or two very large blocks, hole nesting species would only be able to live in those coupes close to the uncut areas. The rest of the regenerated forest would be too far away from their nesting sites to be of use to them.

The present system is based on the best available information and fulfils current needs. However, nothing is static and as needs change and the results of further research come to hand changes may be made to accommodate the new needs as they arise. A continued process of monitoring allows for the identification of problem areas which may develop in future.



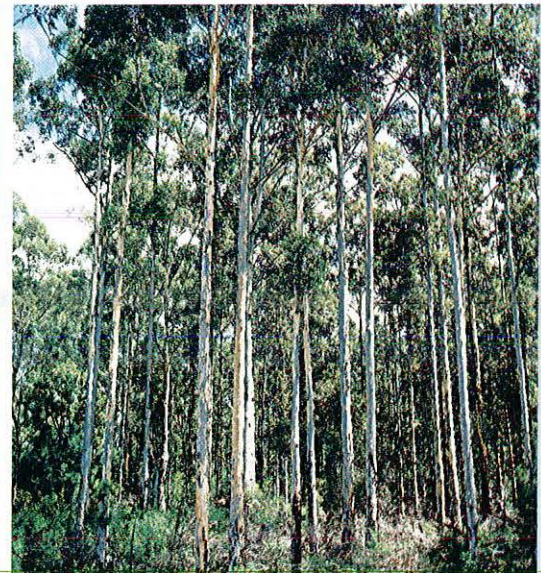
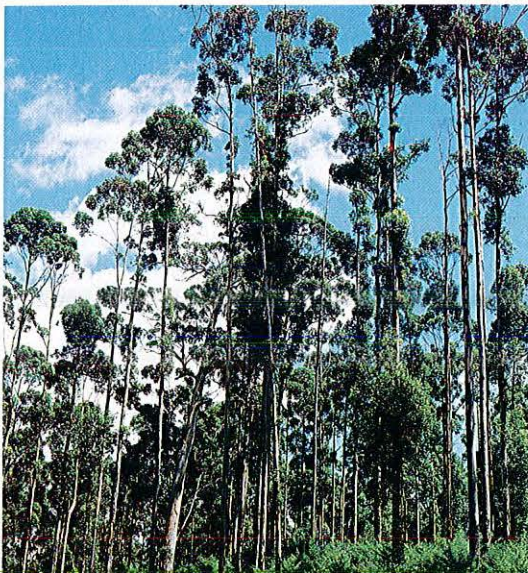
▲ Vigorous young karri regrowth two years after regeneration. At this stage many species of animals and birds are already returning. (T. Leftwich)

▼ Five-year-old karri regeneration. Note the young trees starting to dominate the dense understorey. (T. Leftwich)



▼ Karri pole stand 50 years old. Such forests have a full complement of karri fauna, but some species are not yet as plentiful as in the mature virgin forest. (T. Leftwich)

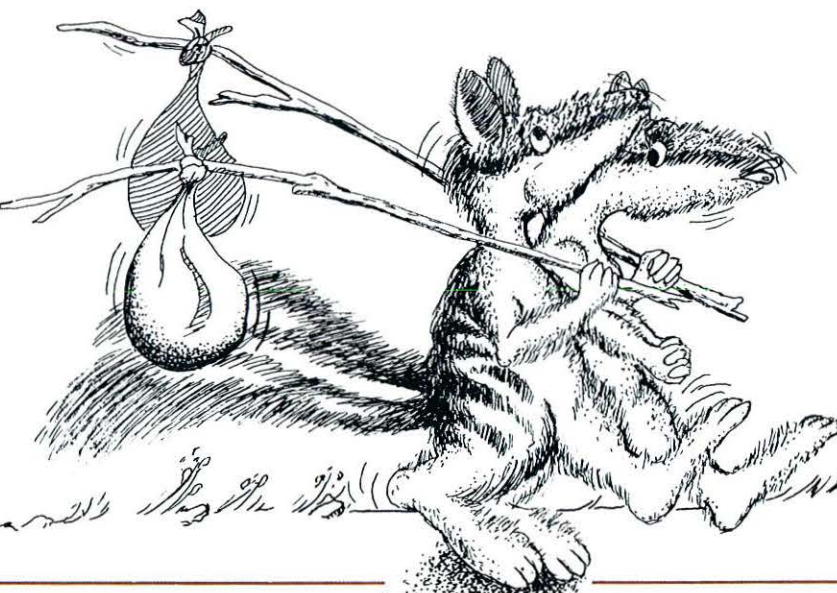
▼ Karri forest at Boranup near Margaret River, clear felled and regenerated in the 1860s. Not yet as large as their fully mature predecessors, these trees nevertheless form a magnificent forest. (T. Leftwich)





Recreation in State Forests

W. SCHMIDT



As in many other countries of the world, Australia's forest lands are a valuable recreational resource. Not only do forests provide a wide array of opportunities for people to engage in leisure time pursuits, but they also offer types of recreational opportunities which can be found under no other circumstances and which can satisfy human needs in no other way. Such is the case in Western Australia where, despite the attraction and availability of beach, estuary and other coastal resources, State Forest areas are used by a growing number of residents and visitors alike for a range of leisure activities.

By world standards, the forest areas of the south-west are not extensive, nor do they possess the rugged relief and spectacular scenery often characteristic of other forested regions. However, their location on the edge of a large arid continent and within easy reach of the majority of the State's population ensures their value for recreation.

This value is perhaps best demonstrated by the apparent rapid growth in forest-based recreational activity that is presently occurring. Areas of forest which were, as recently as ten years ago, virtually unknown to the recreating public are today attracting tens of thousands of visitors annually. Any inquiries for further recreation information can be made through the Extensions branches of the Forests Department at Como, Bunbury or Manjimup.

RE-CYCLED TOWNS

P. N. HEWETT

The concept of re-cycling applies not only to community consumer goods but to "communities" themselves. The Western Australian Forests Department has been involved in re-cycling five small townships from forestry settlements to recreation settlements. Over the past 20 years or so the Department has ceased using several former outstations because of problems with staffing and servicing remote centres, and because of difficulties with education of the settlement children. The weather board and iron buildings, however, have been in good condition, so it was decided in the early 1970s to commence the lease of old outstations to interested groups for use as holiday and recreation camps. The first of these was Dryandra which was leased to the Lions Clubs of Western Australia in 1972.

Dryandra

Situated 20 kilometres north-west of Narrogin (164 kilometres from Perth) the Dryandra settlement was established in the late 1920s, primarily to carry out the sowing of seed of brown mallet (*Eucalyptus astringens*). The seed was spot sown by relief labour during the 1930 depression and produced 8300 hectares of mallet plantation. The area of State Forest in the Dryandra district is 16000 hectares, the non-mallet areas being natural forest of wandoo (*E. wandoo*), powder bark wandoo (*E. occidentalis*) and marri (*E. calophylla*).

The original objective was to grow mallet for commercial production of its bark, a valuable source of high quality tan products. The objective was never realised, although many tonnes of bark were chipped. Exported production declined progressively until it ceased in 1970. The Dryandra tree nursery, moved there from Kalgoorlie in 1955, was experiencing difficulties with an inadequate water supply. It was then decided to move the district headquarters and the nursery site to nearby Narrogin, a move that was completed in 1970.

The creation and protection of an ecological oasis in the wheatlands of

the Great Southern district has been widely recognised for its importance as a managed reserve for a wide range of endemic plant and animal species that are poorly represented in other reserves or in national parks. Originally envisaged and designed as a camp for the disabled, it is now possible for any members of the general public to stay in the old forestry settlement and experience the unique environment of Dryandra. Six cottages and two Nissan huts can accommodate up to 144 people. A dam for swimming and a recreation hall are included in the facilities available. Inquiries should be directed to

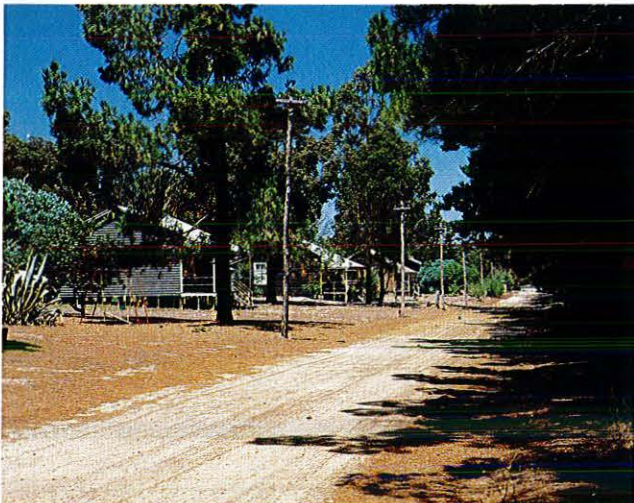
Lions Dryandra Forest Village,
P.O. Cuballing, 6311
Tel. (098) 83 6020.
After Hours (098) 83 6065.

Pimelea

This small settlement was established at the time of planting the small Pimelea pine plantation. It is about 6 kilometres west of Pemberton and 348 kilometres south of Perth, situated among plantation, farmland and karri forest.

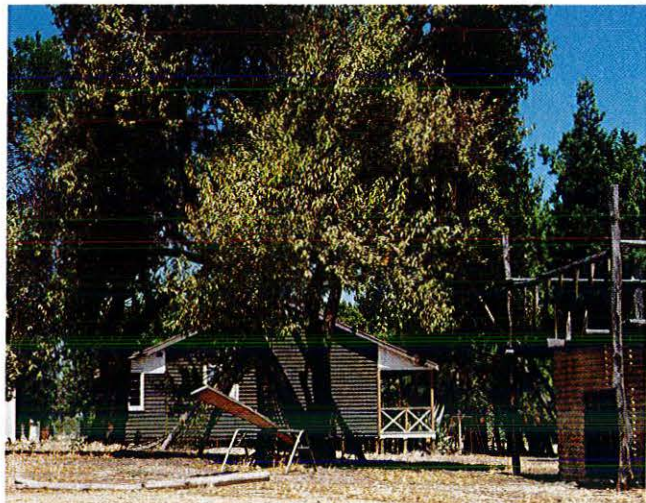
▼ The Lions Club settlement at Dryandra, near Narrogin.

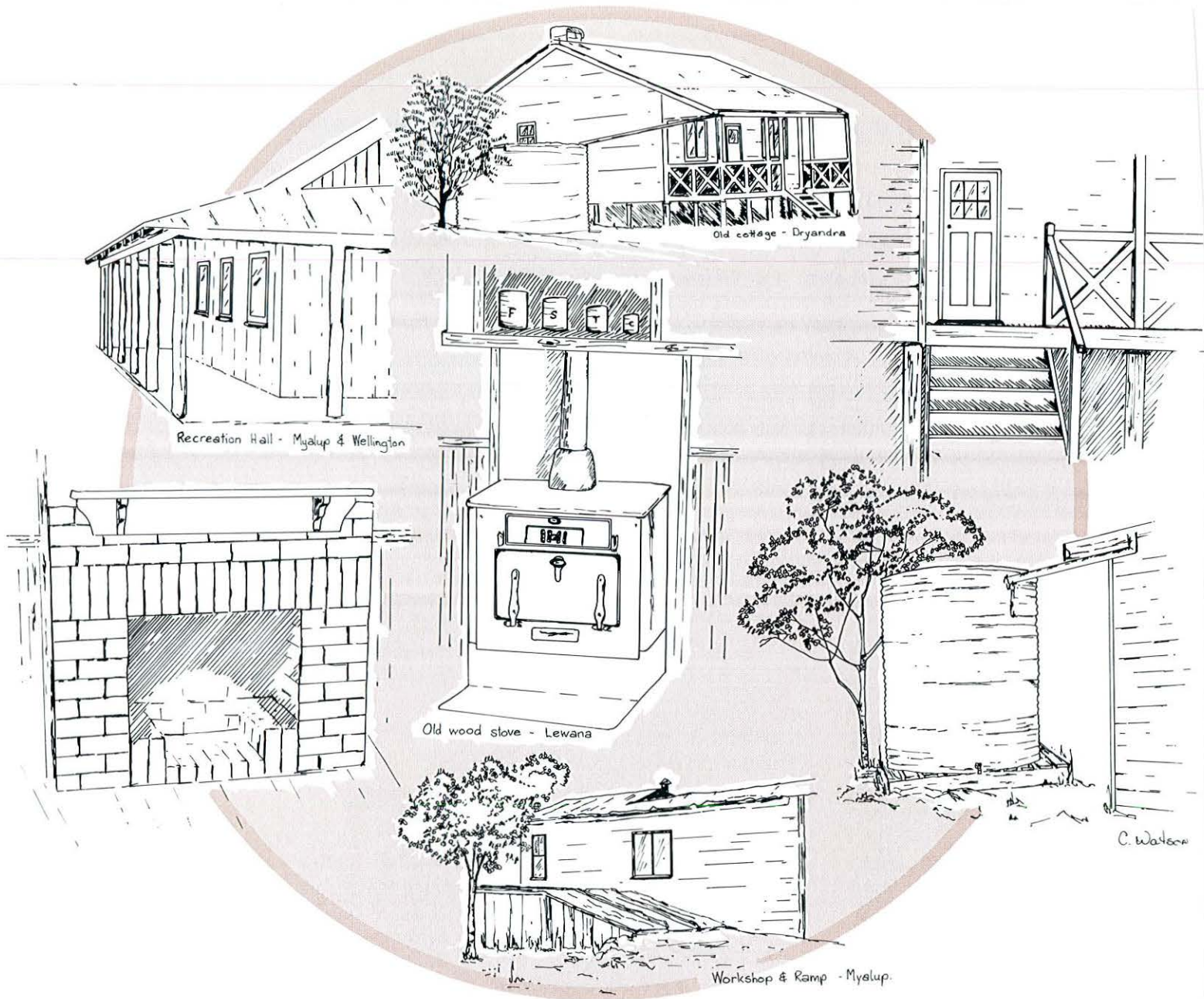
(Cliff Winfield)



▼ A typical ex-Forests Department house at Dryandra. Note the playground facilities in the foreground.

(Cliff Winfield)





It was initially leased in three ways, one house to a farmer neighbour, one to the Guide Association of Western Australia, and the remaining three houses to the Department of Youth, Sport and Recreation (formerly the Community Recreation Council). Because of the small number of houses they, in turn, leased the area to the Youth Hostels Association in 1975. The centre is currently available only to members of that association.

Inquiries can be made at the Department of Youth, Sport and Recreation, or the Youth Hostels Association of Western Australia.

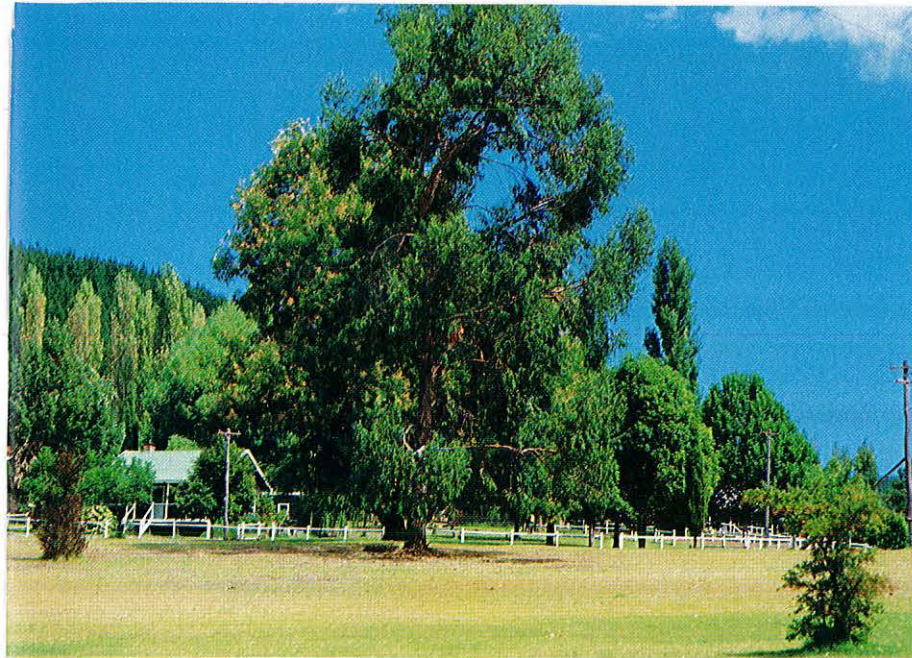
Wellington

The five cottages at Wellington Mills are situated near Wellington Dam, 192 kilometres south of Perth. Access by vehicle is usually *via* South-West Highway and Dardanup or by foot *via* the Bibbulmun Walk Track which stretches from Kalamunda to Northcliffe. Set in the jarrah forest near Collie, this camp provides opportunities for walking, fishing, canoeing, swimming and orienteering as well as recreational activities on the premises. It is also a favourite spot for bird watching, as forest borders three sides of the camp.

This settlement dates from the early 1920s when the nearby Wellington timber mill, now a farm, was in operation. In its hey-day the forestry settlement was part of a 1 100-strong community, and local people tell of a lively history of community events, shows, races.

The Wellington forestry settlement became unnecessary when access to Collie improved, the mill closed and logging operations moved further east.

A lease was negotiated with the Community Recreation Council (now the Department of Youth, Sport and Recreation) in 1971 for



▲ A view of the grounds at Lewana. (Cliff Winfield)



▲ Part of the settlement at Myalup, near Harvey. (Cliff Winfield)

use of five houses and retention of a retired officer as the first warden/caretaker.

Since then a recreation hut of vertical jarrah slabs has been added, and the cottages are frequently booked 12 months in advance.

Myalup

Myalup can be reached from the South Coast Highway or *via* Harvey and is 142 kilometres south of Perth. It is sited in a small area of tuart (*E. gomphocephala*) forest, but generally is surrounded by the Myalup plantation of maritime pine (*Pinus pinaster*). As the plantation establishment programme was completed and rapid access for fire protection became available from

Harvey, the six cottages were leased to the Department of Youth, Sport and Recreation in late 1975. Later a recreation hut, similar in design to the one at Wellington, was added.

The Myalup area has had an interesting history dating back to the first 20 years of the colony of Western Australia. It was included in the plans of the Utopian city of Australind as one of the outer suburbs of this envisaged paradise of the Southern Hemisphere. Historical documents of the development of the Myalup forestry settlement unfortunately were lost in the Dwellingup fire of 1961. However *via* word-of-mouth and other historical evidence, the history of Myalup is gradually being pieced back together. Near the present community are the remains of the old forestry operations station, including a blacksmith's shed and the old Forests Department offices.

Myalup's capacity is 60 people in six cottages and facilities at the camp include volley-ball and table-tennis equipment, a pool table and barbecue area. It differs from the other camps in that it is situated close to the coast and offers opportunities for sea fishing and swimming at Myalup and Binningup beaches.

Lewana

Access to the picturesque camp at Lewana is from the Balingup to Nannup road 256 kilometres from Perth.

This settlement has five houses available for hire and is situated deep in the valley adjacent to the Blackwood River. Lewana was established as a working settlement for the softwood pine plantations which abut the valley on three sides. In 1977 the site was leased to the Department of Youth, Sport and Recreation because the plantation programme was completed and work could be handled just as effectively from Nannup and Kirup.

Because of the high fire risk in summer the camp is closed from late October to April each year. Winter activities centre around canoeing in the river and walking in the valley area, or just relaxing in front of an open fire. This camp is very popular and bookings have to be made well in advance.

Bookings for all of these Department of Youth, Sport and Recreation holiday camps can be made by telephone or letter to:

Camps Booking Officer,
Department of Youth, Sport and Recreation,
Perry Lakes Stadium,
P.O. Box 66,
Wembley, W.A. 6014.
Tel. (09) 387 4400.



Back Cover

The Wellington settlement, set in jarrah forest near Collie. (Cliff Winfield)

