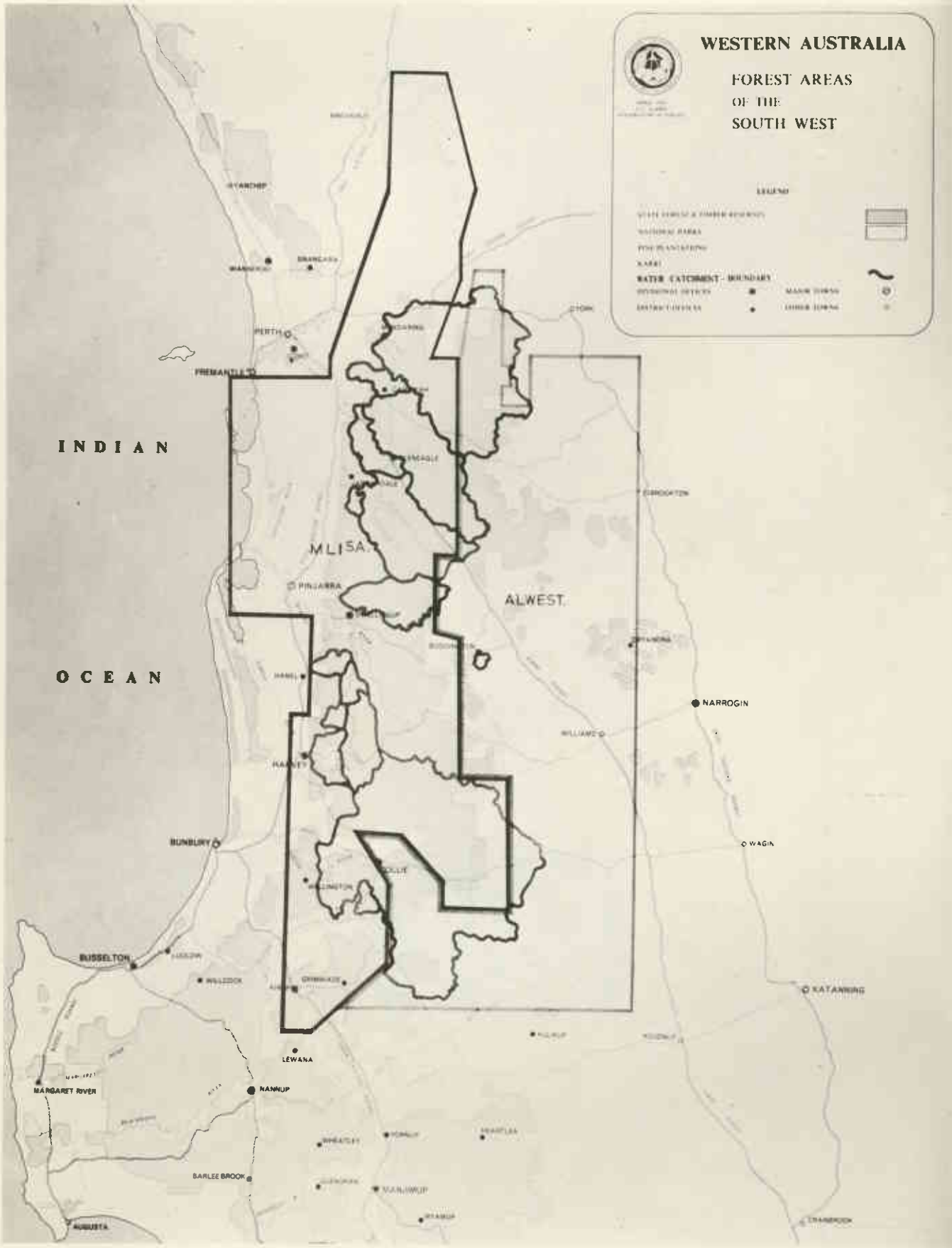
11.

FOREST FOCUS

NUMBER 11 SEPTEMBER 1973


WESTERN AUSTRALIA
FOREST AREAS
OF THE
SOUTH WEST
LEGEND
WATER CATCHMENT - BOUNDARY
INDIAN
OCEAN
PERTH
FREMANTLE
MLISA
ALWEST
PINJARRA
NARROGIN
BUNBURY
WAGIN
BUSSELTON
KATANNING
LEWANA
MARGARET RIVER
NANNUP
BARLEE BROOK
AUGUSTA

FOREST FOCUS

Number 11 September 1973

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Front cover

This photograph is indicative of many land use situations where several possible uses are immediately apparent. In this case they are timber production, recreation and—as the stream rises and is fed by forested catchments—good quality water.

Depending on the circumstances, there can be varying degrees of compatibility or conflict.

◀ *This section of a Forests Department map indicates State forest and water catchments, and shows how both are almost entirely covered by mining leases.*

FOCUS on Land Use Conflicts in the Northern Jarrah Forest

by J. J. HAVEL *and* F. E. BATINI

Timber, water, recreation or mining? Which of these or several other uses is to take priority?

In the northern jarrah region (the area from Mundaring southward to Collie, and from the coastal plain eastward to the main agricultural belt) competitive land uses are vying for precedence. In view of the value of the area to the community, and its proximity to the State's major population concentration, everybody will be eventually affected by what happens there.

The area's renewable resources include timber and its various products; water for home, industry and irrigation; and agricultural products. The area is an important source of minerals, in particular bauxite, gravel and blue-metal.

The area is also important for the conservation of indigenous plants and animals.

Many urban dwellers use the locality for their leisure-time activities and find peace in the natural environment.

The bulk of the zone is dedicated State Forest, managed by the Forests Department of Western Australia. However resource utilisation involves both government agencies and private companies.

It is inevitable that some conflicts between the users arise. Some are of a peripheral nature and are readily solved, but others require conscious and deep reflection on the whole concept of land use and its various bases.

As our population grows and its needs for these products increases, the degree of conflict is likely to escalate. The manager has the choice of adopting a *laissez-faire* attitude and doing as little as possible, or attempting to plan

▼ *Hills pasture near Roleystone, showing areas of exposed rock.*

▲ *Five different land uses: water, softwood and hardwood production, grazing and recreation.*

▼ *Suburbia spreading up the Greenmount slopes.*

wisely for the needs of the community in the future.

Some of the principles which need to be considered, and the approaches being used, are covered in the following pages.

Landscape and land forms

Decisions about land use should not be undertaken without an adequate knowledge of the land, its relative suitability for each possible use and the interactions between alternative forms of land use. As the area under discussion is very large, it is desirable to subdivide it into a number of relatively homogeneous units. This has been done, firstly on the basis of landscape and secondly on the basis of vegetation.

The landscape approach, used by the C.S.I.R.O. Division of Soil Research in mapping of the Helena and Collie River catchments, is based on topographic position and shape of the landscape units. It is assumed that these, in turn, reflect the distribution of soils and of vegetation. More detailed mapping based on site-vegetation types has been carried out by the Forest Department on a smaller scale in several key areas.

▶ *Quarrying east of Gosnells.*

This is based on the proven assumption that the controlling factors of the environment, such as climate, topography and soils, are reflected in the composition and structure of the vegetation. The two approaches have been integrated, and can be used interchangeably depending on the size of the area under survey, and the detail required. The landscape approach is better suited for a broad reconnaissance. However as several soil types and several vegetation types frequently occur within one landscape unit, the vegetational approach is more suited for detailed mapping.

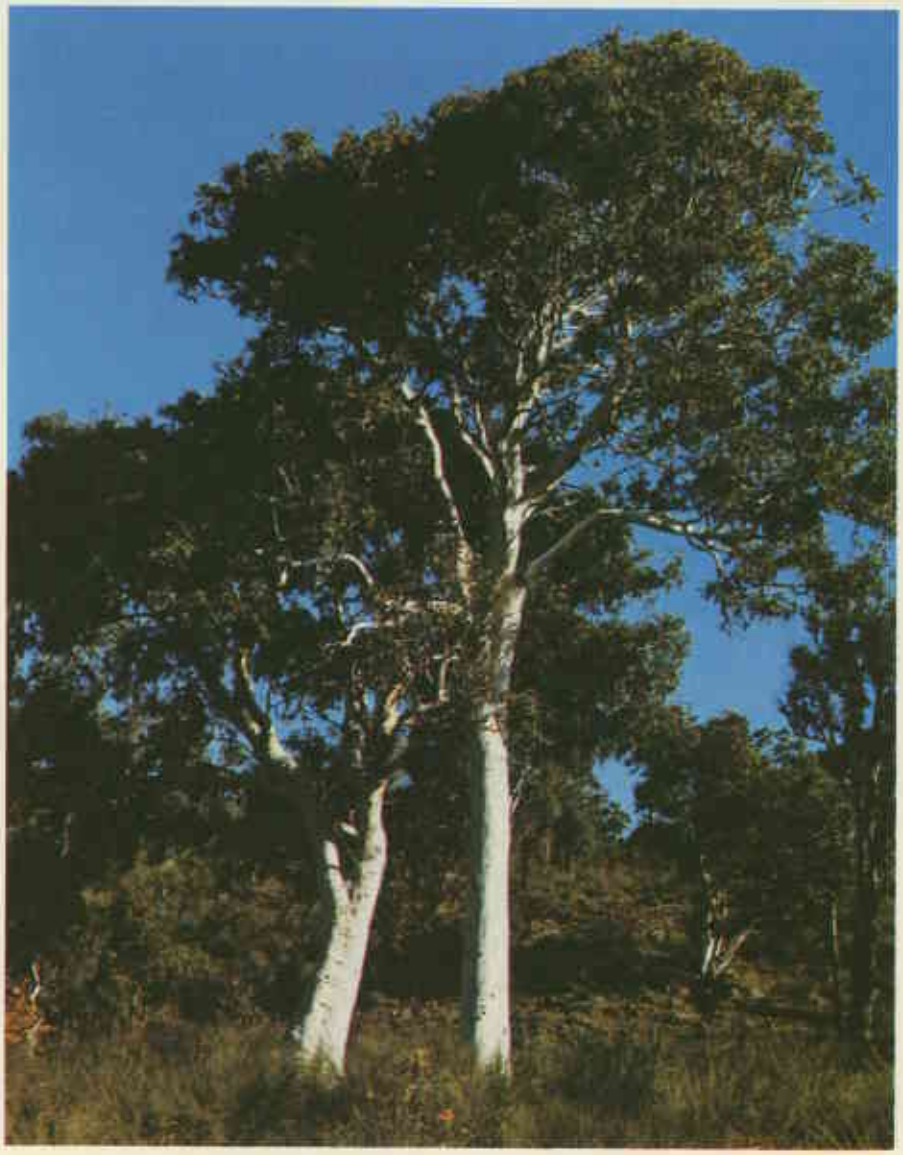
As the various units are not equally suited for all forms of land use it is desirable to deal with each in turn.

The scarp unit

This surface is bounded by the lateritic soils of the Darling Range to the east and by the Swan Coastal Plain to the west. It is characterised by steep slopes, with podsolic soils overlying fresh country rock. Granite exposures are a feature. The major river systems such as the Helena, Canning, Serpentine, Murray and Collie emerge into the plain through sharply incised river valleys. The dominant eucalypts include marri (*Eucalyptus calophylla*), salmon white gum (*Eucalyptus lane-poolei*), butterbark (*Eucalyptus laeliae*), wandoo (*Eucalyptus wandoo*), mountain marri (*Eucalyptus haematoxylon*) and jarrah (*Eucalyptus marginata*).

Most of this land system is privately owned. Various areas (Serpentine Falls, Kalamunda, Greenmount Hill, Lesmurdie Falls and John Forrest) have been designated as National Parks and the remainder is held as State Forest. The lower slopes have been largely cleared and converted to pasture. Nearer Perth, some of the scarp has been quarried for blue metal and much of the remainder has been opened up for subdivision and home-building.

The agricultural and timber production potential of the upper slopes is poor due to steep slopes, shallow soils and frequent rock outcrops. The unit is located down-stream of the existing dam sites and difficulties in dam construction prevent the full utilisation of the high rate of run-off. It supports a varied flora and the rock faces provide suitable habitats for mosses and lichens, as well as



▶ *Butterbark, a species found in the scarp unit, has a limited occurrence on rocky slopes.*

reptilian fauna. These habitats are not unique and similar habitats are to be found in the deep river valleys and monadnocks to be discussed later. The area offers many very attractive views (in a State remarkable for its paucity of hills) and is popular with recreationists, whether motorised or on foot.

In the Perth Metropolitan Area there are obvious conflicts between quarrying, urban spread and aesthetic values. In parts of the farming area, the hills are periodically ravaged by fire. These are relatively localised in area and, over the lengths of the scrap, the current and foreseeable conflicts are few. Many representative sites have been preserved within the National Park system, though the reserves tend to be small. The main value of the area appears to be as a recreational resource—especially on land which is publically controlled.

Recreational development within the farming properties appears to be an obvious avenue for the future.

▲ *Hiking, Mt. Cooke. Mts. Vincent, Cuthbert and Randall on the horizon*

The monadnocks

Several peaks rise above the lateritic plateau of low relief. These residuals (or monadnocks) of an older, higher plateau provide natural observation posts, and have been utilised for many years as sites for fire lookout towers. This unit is probably best represented by Mounts Cooke (580 m), Randall (500 m), Vincent, Cuthbert and Eagle Hill, which form a chain just to the east of the Albany Highway. Others include Mount Dale (550 m) and Mount Solus (570 m), two fire lookouts well known to the recreating public.

Apart from the typical lichen, moss, angiosperm ecotypes of the rock faces themselves, the predominant eucalypts include marri and wandoo, with butter-bark and jarrah as minor components in the vegetation. The rock faces provide suitable habitats for a variety of reptiles and many birds are found in the surrounding shrubbery This land unit is well suited for recreation. Visitors may choose from either the more passive forms (picnics, views) or highly active forms of enjoyment (bushwalking, rock climbing). The monadnocks provide some of the most spectacular views to be had within a relatively short distance (80 km) of Perth.

This unit has many similarities with the scarp unit but where the latter is largely cleared and held as private property, the monadnocks are mostly forested and held as State Forest.

This land unit is most important for its recreational and conservation values. It is of minor value for most economic activities.

▼ *Swamps are the main habitat for quokkas and other small marsupials.*

The swamp units

Minor development of swamp associations is found on the fringes of most streams, but is best developed in broad, gently sloping valleys. In the western swamps, the main trees are bullich (*Eucalyptus megacarpa*), black-butt (*Eucalyptus patens*) and flooded gum (*Eucalyptus rudis*); which occur either in pure or mixed stands, with understorey of swamp banksia (*Banksia littoralis*) and a tall shrub (*Agonis linearifolia*). The soils range from silty to sandy loam alluvium and are often brightly coloured. These swamps tend to act as soaks for much of the rainfall, and use much water during the summer. Clearing for agriculture or destruction of vegetation by disease can greatly increase the water yield.

The swamp is the main habitat for

marsupials such as the mardo (*Antechinus flavipes*), the short-nosed bandicoot (*Isoodon obesulus*) and the quokka (*Setonix brachyurus*) and many birds.

The jarrah trees in the swamp margins are often severely affected by the root rot disease caused by the fungus *Phytophthora cinnamomi*. This significantly lowers forest productivity and considerable areas are being replanted with exotic eucalypts and pines which can tolerate the disease. Some valleys are held as private property and have been cleared for market gardening, orchards, pig raising and cattle grazing. Drainage may be necessary and permanent water for spray irrigation is readily available.

The swamp units do have recreational potential especially on farmland resumed for water supply purposes.

The river valleys

As they approach the scarp, the main streams and tributaries cut progressively deeper into the plateau. In many cases, they have eroded through the lateritic mantle into the underlying decomposed country rock (saprolite), resulting in the formation of soils referred to as gravelly earths.

This unit is typified by steep slopes, often with small exposures of granite, and fertile red to brown soils. Marri is the dominant species with jarrah a lesser component, but on some sites excellent stands of blackbutt and marri have developed. In the south-west of the area, peppermint (*Agonis flexuosa*) also occurs. This unit is largely unaffected by disease and supports many birds and a few mammals, such as the water rat (*Hydromys chrysogaster*). Some areas have been cleared and planted to the fast-growing exotic conifer radiata pine (*Pinus radiata*). Considerable areas are held as private property, with orchards predominating; but with some market gardening and cut flowers being raised closer to Perth.

Clearing of the forest cover leads to an increase in runoff. Because of the steepness of the terrain and the erodibility of the soil, especially when ploughed, serious erosion may result. The site has little potential for mining but great potential for recreation due to its scenic views and attractive forest.

In the floor of the valley, the river is flanked by a narrow band of swamp vegetation. Where the river has not yet been dammed, e.g. the Murray, it is important for water based recreation, such as canoeing, swimming, fishing and marroning. The developed picnic sites are heavily used and wild camping is prevalent. Most of the streams have

▲ *Bullich, a species common to the western swamps, with dense shrubby understory.*

▼ *Orchards at Karragullen.*

▲ *Fishing in the Murray River. Les Harman.*

▲ *Water and steep terrain give the river valley unit a great potential for recreation.*

▼ *Excellent stands of blackbutt develop on some river valleys.*

▼ *The effects of* Phytophthora cinnamomi *on native forest near the swamp units.*

▲ *Pine forest at Harvey Weir.*

▲ *Powderbark wandoo sometimes mixes with jarrah in the eastern zone of the plateau.*

▼ *Logging operations in the jarrah forest.*

already been dammed for water supply and irrigation purposes and so a large proportion of this land unit has been flooded and irretrievably altered.

Present legislation discourages recreational activities which may lead to pollution of the water supply and the public is urged to stay at least 1 km away from the top water level of the dams. The only natural site which remains available for recreation is the river downstream of the dam wall. Its attractiveness largely depends on the amount of water which, either naturally or artificially, is allowed to spill from the reservoir.

On Metropolitan Water Supply reservoirs, no form of recreation is permitted. Boating, fishing, swimming and marroning have been permitted on dams built primarily for irrigation. The dam itself is a strong attraction for recreationists and the barbeque and the picnic facilities often provided near the wall are very heavily used.

The lateritic plateau

The Darling plateau, occupying part of the western fringe of the Great Plateau of W.A., is a broadly undulating upland 280 to 340 m above sea level. It is by far the most extensive unit in the study area. The soils consist of lateritic sandy gravels over an ironstone cap which is underlain at depth by kaolinitic (clayey) materials developed from decomposed (saprolite) rock, and

▼ *By far the best development of jarrah is to be found on the lateritic plateau.*

▲ *Jarrah regeneration, 53 years old, east of Dwellingup*

sometimes subdivided on the basis of colour into mottled and pallid zones. Slopes are gentle and by far the best development of jarrah is to be observed on these sites. To date, these fine stands have been only slightly affected by *Phytophthora cinnamomi*.

The height, density and structure of the forest is determined by the climate. In the moist western zone the stands may exceed 35 m in height and 40 m^2/ha in basal area, and have a second storey of small trees such as bull banksia (*Banksia grandis*) and sheoak (*Casuarina fraseriana*). By contrast forests on similar soils in the dry eastern zone tend to be only 20-25 m high and often have basal areas of only 20 m^2/ha. The second storey of small trees is largely missing and even the shrub storey is very low, giving the forest a very open appearance. Powder bark wandoo (*Eucalyptus accedens*) sometimes mixes with jarrah on these sites.

Much of this surface is potentially suited for bauxite mining. This involves open cast mining which varies from 2 to 9 m in depth. All of the State Forests north of Collie are currently held under mineral lease for bauxite by Alcoa, Alwest and Pacminex companies. Revegetation of the mined-over site with trees and shrubs is included in the agreement between the State Government and the companies.

The plateau is not greatly suited for either agriculture or pine plantations due to poverty of its soils. It is also less suited for recreation and fauna conservation than the valleys.

It appears to contribute little to the total streamflow as the bulk of the rainfall is stored in the very deep soil and is transpired during the summer months. Parts of the underlying saprolite are very saline and clearing may lead to excessive stream salinity.

The main competition for the land is between jarrah production forestry and bauxite mining. Before the latter is extended to the projected scale envisaged by the mining companies, there is a real need for a detailed study of its effects on the salinity and turbidity of the streams.

Eastern valleys

Just as the eastern part of the uplands differs from the western part in the height and density of vegetation, there are also differences in the valleys. The further one follows a major valley upstream, the broader and shallower it tends to become. As a result, there are fewer rock outcrops, and the soils tend to be older and deeper. The change in vegetation is even more pronounced. The place of marri and blackbutt is increas ingly taken over by wandoo, which forms rather open, and only moderately tall forest. Where the valleys are particularly broad, flat and poorly drained, the valley floor is either completely treeless, or only carries very open stands of paperbarks (*Melaleuca preissiana*), flooded gum (*Eucalyptus rudis*) and swamp banksia (*Banksia littoralis*). From

▲ *Seedlings planted on what remains of the forest soil after bauxite mining*

▼ *A salt effected eastern valley near Wundowie*

▲ *Virgin wandoo—aesthetically pleasing due to the open, parklike nature of the stand.*

▲ *Swamp, surrounded by wandoo, in a broad eastern valley.*

▶ *The numbat (W.A.'s new fauna emblem) is mostly recorded in the eastern region.*

▼ *Swampy valley floor.*

the point of view of timber production the wandoo forests are only low yielding and the swamps are completely devoid of economic value. Both are however, important habitats for fauna. Such relatively rare species as the numbat (*Myrmecobius fasciatus*) and the tammar (*Macropus eugenii*) are mostly recorded from the eastern region. Aesthetically the wandoo forest is also very pleasing due to the open, often parklike nature of the stands, and the smooth, creamy-white bark of the trees.

It is in this portion of the landscape that clearing for pasture has taken place on private properties adjacent to the State Forest. Generally the clearing has led to a rise in the ground water table, which in turn tends to bring salt to the surface. The ultimate effect of this is the death of the vegetation and a change in the soil properties, rending such areas open to surface and gully erosion. It also makes the creek water unsuitable for irrigation or stock, and ultimately spoils the quality of the water in the down-stream reservoirs. It is chiefly for this reason that agriculture has been largely excluded from the catchments of the Helena, Canning and Serpentine Rivers.

Sandy deposits on valley slopes and depressions

The lower slopes of the broad valleys and the depressions in the uplands are often covered by sandy deposits. In

▲ *Low banksia and Christmas tree woodland on leached sands in depressions.*

their most extreme form (leached, dry, grey sands), they carry a low woodland of banksias (*Banksia attenuata, Banksia menziesii*) and Christmas tree (*Nuytsia floribunda*). The shrubby understorey is rich in heath-like plants of the families Proteaceae, Epacridaceae and Myrtaceae, many of which have beautiful flowers. It is this variety of flowers that is necessary for the honey possum (*Tarsipes spencerae*) found within this type. Where the sands are somewhat less leached or less dry, an open jarrah woodland with a heath-like shrub understorey replaces the banksias. Botanically this is one of the richest components of the Darling Range system. So far it has not been greatly affected by dieback chiefly because it occurs in isolated and out-of-the-way places. The site is possibly too dry for the disease to become readily established, but many of the species occurring in it are highly susceptible. So far there has been only a minor conversion of this low quality forest to pine plantations. Investigations are under way to ensure that the short period without tree cover does not affect the quality of the water resource.

Dissected slopes

Although mild slopes tend to predominate in the eastern half of the forest, in areas such as the headwaters of the Helena and Dale Rivers, the reverse applies. Here the creeks cut sharply into the flanks of the upland plateau creating a broken pattern of valleys, breakaways and ridges; with outcrops of granitic and epidiorite rocks. There is a corresponding diversity in the soils, which range from the lateritic gravels on the remnants of the old surface, to pale clayey soils formed on the kaolinitic zone, shallow grey-brown sandy loams developed from granite and stony red loams developed from epidiorite.

The vegetation ranges from jarrah forest on the lateritic gravels through wandoo woodlands on the slopes to the fringes of flooded gum and blackbutt along the creeks. The greatest diversity is found around the rock outcrops where there is a change from a thin lichen layer on the bare rock, through thick shrub thickets and groves of granite sheoak (*Casuarina huegeliana*) to the wandoo woodland on the deeper soils. The variety of land forms and vegetation creates a very pleasing landscape, which is rich in both wildflowers and fauna. Some of the animals found here are the echidna (*Tachyglossus aculeatus*), pigmy possum (*Cercartetus concinnus*), ring-tail possum (*Pseudocheirus peregrinus*) and red-tailed wambenger (*Phascogale calura*). The timber production, agricultural and mining potential of this unit is low.

Resolution of conflicts

The outline so far has described the major land systems and discussed the current and foreseeable land uses in each. It is obvious that the problem of land use planning in this area is a complex one.

Which objectives should be pursued?
What is the criterion for success?
Should firm land use plans be implemented?
How much control should be exercised over the respective users?

Some forms of land use are unable to coexist and are mutually exclusive at present (e.g. agriculture and pine plantations, reservoirs for domestic supplies and water based recreation). These current practices could well be altered by changes in technology or through public pressures. Other forms of land use result in strong conflicts of interest (e.g. mining in National Parks or State

▼ *Granite sheoak beside a lichen covered rock outcrop.*

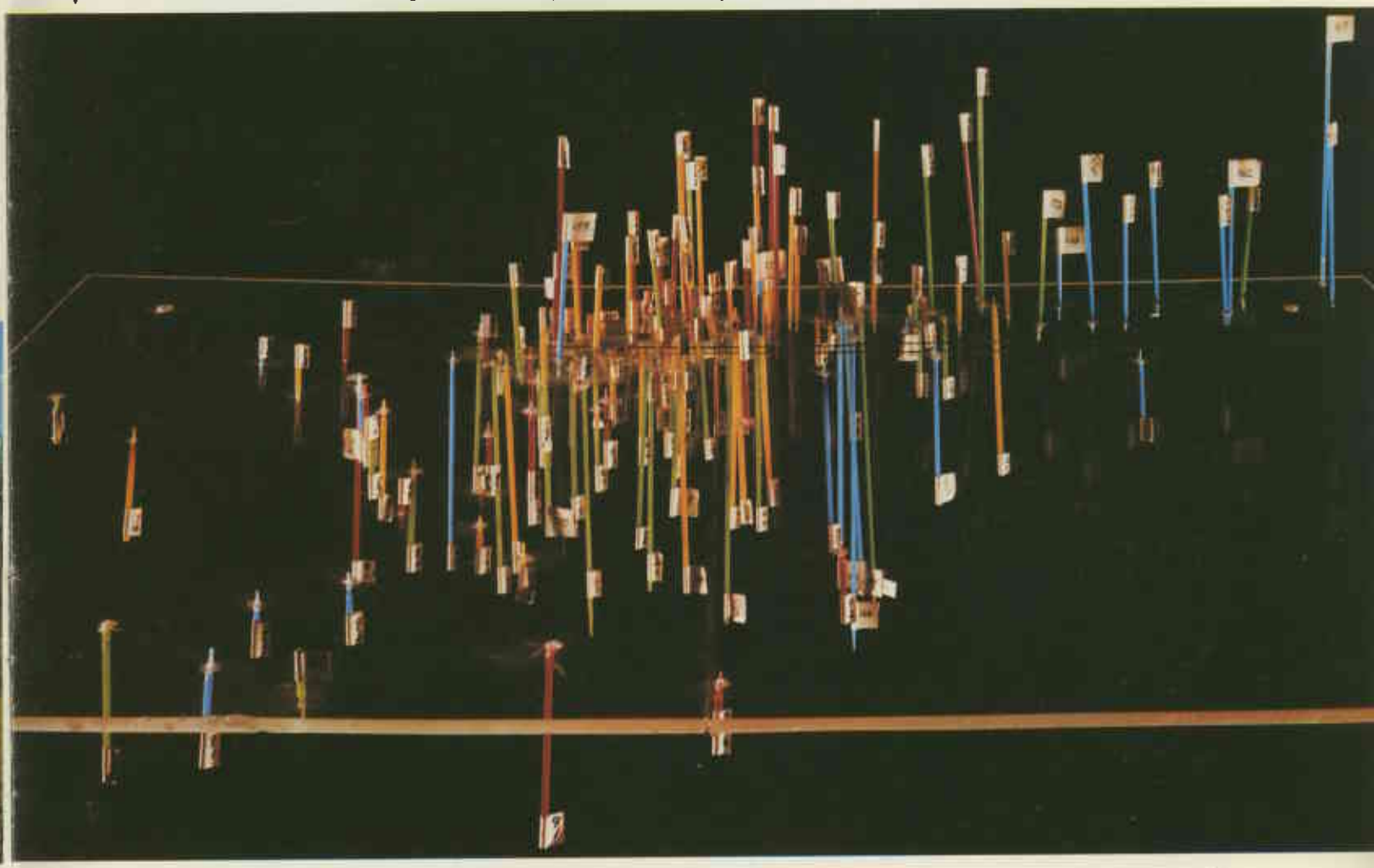
Forests). Within a single activity such as recreation, there could be distinct conflicts between users (e.g. swimmers and power boat enthusiasts, campers and shooters).

Even when the activities are zoned into separate areas conflicts may still occur. The forester's pines may be burnt by an escape from a farmer's burn—and the opposite could also occur. Farmers may resent National Parks or conservation areas close to their boundaries, and regard them as harbours for pests. Clearing for mining or agriculture could lead to increases in salinity and effect the water quality in a dam many kilometres away. Motorised recreationists could readily spread *Phytophthora cinnamomi* into currently healthy forest.

There appears to be a real need for each user to be aware of the requirements of others and to modify his own use to achieve the greatest public good. Resource use, should be technically sound (feasible), economically sound (gainful) and in harmony with the

▲ *The echidna is among the animals found in the dissected slopes unit.* Les Harman

▼ *Four dimensional model of ecological relationships in the northern jarrah region.*



standards of society (adoptable). Land use cannot be a static concept and periodic revision of the plan is essential if the manager is going to cope with the growing and perhaps changing demands, for the various products which society desires to obtain from the area in question.

Officers of the Forest Department have been involved in land use studies for some considerable time. Areas which have been investigated include:

(*a*) The Swan Coastal Plain north of Perth.
(*b*) The Pemberton region.
(*c*) The Nannup Sunklands, and
(*d*) The South Coast Project.

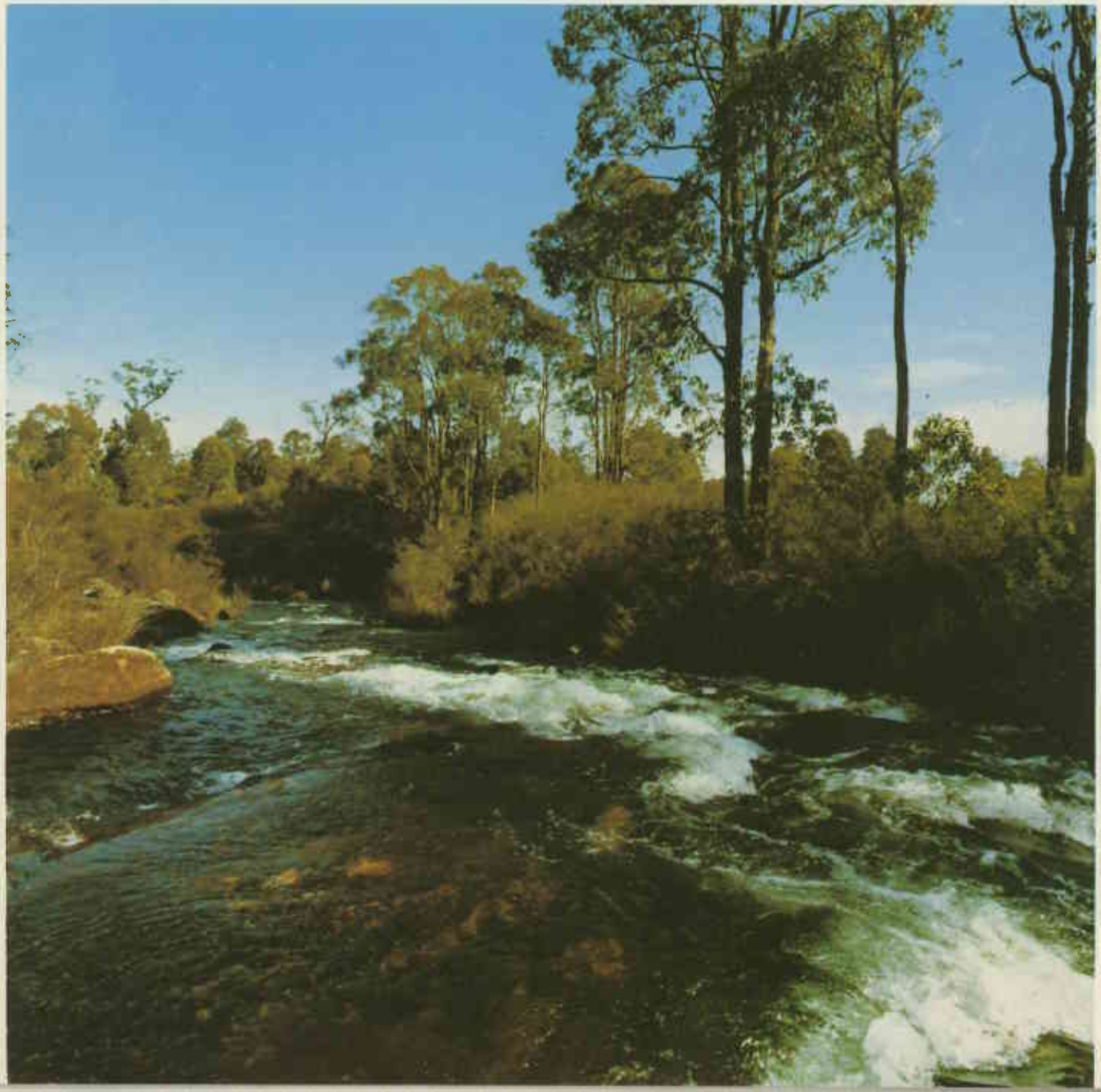
Within the northern jarrah forest, detailed research has been carried out by departmental staff, sometimes working in conjunction with other organisations.

Aspects include:

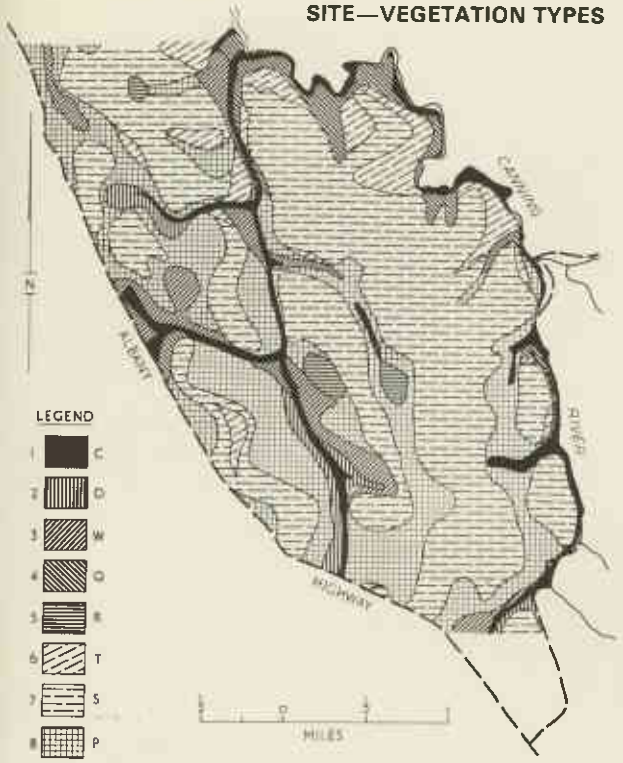
(*a*) An inventory of resources.
(*b*) Research studies into several relevant aspects including--jarrah dieback, fauna research, fire research, mining pit rehabilitation (in conjunction with ALCOA), species trials, silvicultural techniques.
(*c*) Recreation surveys by officers and through the medium of questionnaires have attempted to evaluate the numbers, reasons, preferences, likes and dislikes of visitors to the forest area.
(*d*) Detailed ecological surveys of four large areas have been completed.
(*e*) Within the Wungong catchment the relationship between soils and resource use has been described (jointly with C.S.I.R.O.).
(*f*) A system analysis study of the Murray River Catchment is in progress in conjunction with C.S.I.R.O., other government and private organisations. The objective is to maximise the merit or utility of this catchment to the community and it involves the allocation of optimal sets of activities to each of the landscape units previously described.

These projects aim to provide a sounder knowledge of the technological, sociological and economic bases for land use decisions within this important resource.

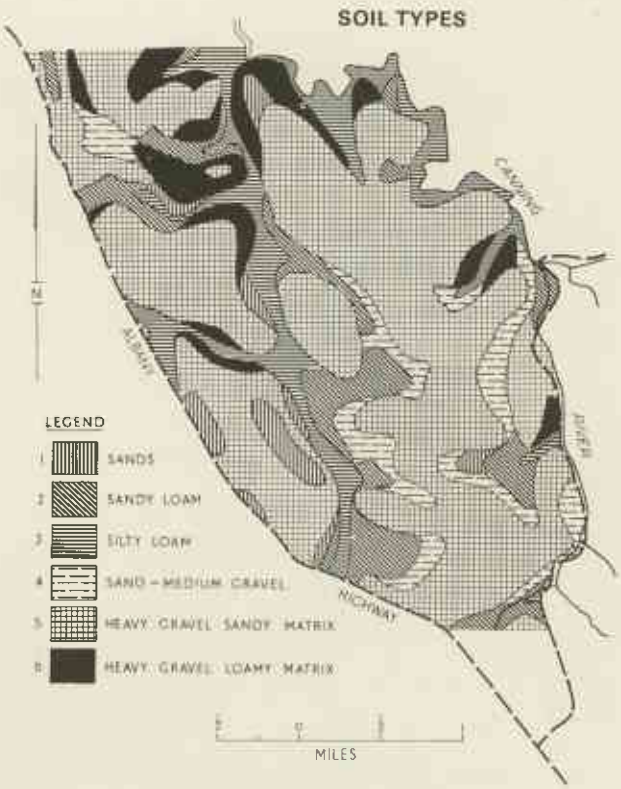
▼ *Rapids on North Dandalup River.*



SITE—VEGETATION TYPES



SOIL TYPES



Detailed Ecological Survey of Gleneagle Test Area

SITE-VEGETATION TYPES

C. Wet Banks, River and Creeks: *Agonis linearifolia, Grevillea diversifolia, Banksia littoralis, Leptocarpus scariosus, Mesomelaena tetragona.*

D. Moist Flats: *Hypocalymna angustifolium, Leptocarpus scariosus, Mesomelaena tetragona, Dampiera alata, Synaphaae petiolaris.*

W. Moderately Fertile Lower Slopes: *Hakea lissocarpha, Hypocalymna angustifolium, Eucalyptus patens, Mesomelaena tetragona, Lepidosperma angustatum.*

Q. Moist Fertile Slopes: *Hakea lissocarpha, Hypocalymna angustifolium, Eucalyptus patens, Trymalium spathulatum, Eucalyptus calophylla.*

R. Shallow Loamy Gravels Near Granite Outcrops: *Hakea lissocarpa, Eucalyptus calophylla, Leucopogon propinquus, Leucopogon capitellatus, Macrozamia reidlei.*

T. Gravels with Loamy Matrix mainly on Steep Slopes: *Eucalyptus marginata, Lasiopetalum floribundum, Leucopogon capitellatus, Leucopogon verticillatus, Macrozamia reidlei, Pteridium esculentum.*

S. Sandy Coarse Gravels of Upper Slopes and Plateaux: *Adenanthos barbigera, Eucalyptus marginata, Leucopogon capitellatus, Macrozamia reidlei, Phyllanthus calycinus, Styphelia tenuiflora.*

P. Gravelly Sands and Sandy Gravels Middle and Lower Slopes: *Adenanthos barbigera, Casuarina fraseriana, Eucalyptus marginata, Grevillea, wilsonii, Patersonia rudis.*

SOIL TYPES

The textures given here refer to top soil only.

On Soil Types 1-3, the only major obstacle to establishment of exotic species could be excessive wetness.

On Soil Types 4-6, the main obstacles are phosphate fixation and/or stoniness.

DIEBACK AREAS

Hatched areas are those definitely affected by dieback—a disease caused by the fungus *Phytophthora cinnamomi* which affects jarrah (*Eucalyptus marginata*), banksias and numerous shrub species.

DIEBACK AREAS