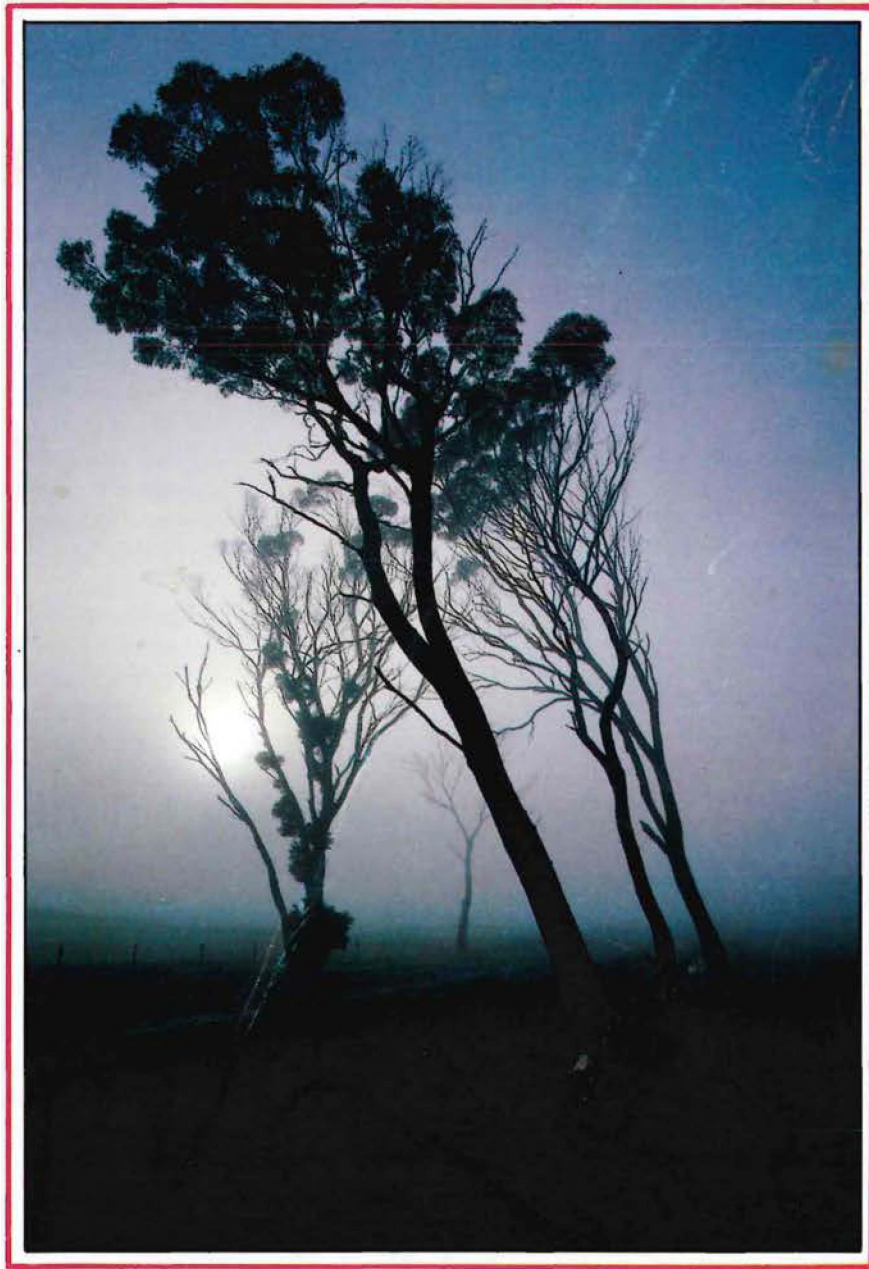


Autumn Edition/April 1988  
\$2.50

# LANDSCOPE

W.A.'s Conservation, Forests and Wildlife Magazine



# LANDSCOPE



Volume 3 No. 3  
Autumn Edition/April 1988

Contents	Page
Restoring Nature's Balance <i>S R Shea and J R Bartle</i> . . . . .	3
Greenhouse Australia <i>J Blythe and P Noyce</i> . . . . .	15
Carry On Camping <i>Andrew Cribb</i> . . . . .	23
Nostalgic Naturalist <i>Old Timer</i> . . . . .	28
Walking Through The Past <i>Avril O'Brien</i> . . . . .	29
Bush Telegraph . . . . .	32
Caves, Waves and Culture <i>Andrew Cribb</i> . . . . .	34
Treated Timber - Is It Safe? <i>Graeme Siemon</i> . . . . .	42
Endangered: Western Swamp Tortoise <i>Andrew Burbidge</i> . . . . .	44
Eye Of The Beholder-a photo essay <i>Aris De Jong</i> . . . . .	45
Urban Antics <i>Colleen Henry-Hall</i> . . . . .	48
From Field and Forest: Edible Fungi <i>Roger Hilton</i> . . . . .	49
Letters . . . . .	54



'Beasties', p.45

Managing Editor: Sweton Stewart  
Editor: Liana Christensen  
Designers: Trish Ryder / Robyn Mundy  
All maps by Department of Conservation and Land Management Mapping Section.  
Offset plates by The Colour Set  
Printed in Western Australia by Kaleidoscope

© All material copyright. No part of the contents of the publication may be reproduced without the consent of the publishers.

Published by Dr S Shea, Executive Director,  
Department of Conservation and Land Management,  
50 Hayman Road, Como, W.A. 6152

## EDITORIAL

The economic development versus environmental protection debate is a constant feature of our society today. No-one will disagree that our environment needs protection; there is also no doubt that Australia must improve its economic performance if we are to maintain our living standards and enjoy the natural environment which we are blessed with. This *Landscape* describes a project which combines environmental and economic advantages.



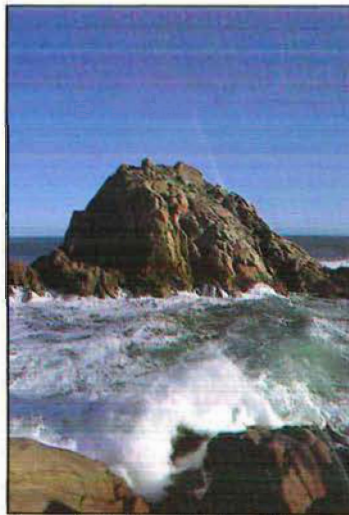
Joys of camping, p.23

Australia's import bill for forest products is \$1.7 billion. Of this a considerable portion is paper which is made from eucalypt fibre. A Perth scientist was the first person to demonstrate that eucalypt could be made into paper, yet it is other countries that have capitalised on this discovery. For example, Brazil, Portugal, Chile, South Africa and Spain have established over 3 million hectares of highly productive eucalyptus plantations. Australia, home of the genus *Eucalyptus*, has only 40 000 hectares of eucalyptus plantations.



Heritage Trails, p.29

Despite our late start, there is no reason why W.A. cannot share some of the rewards which would come from capitalizing on the increasing world demand for high quality paper. We have the land and climate to grow the trees and the skills to do it competitively.



Leeuwin National Park, p.34

Widespread afforestation of the south-west is also an essential prerequisite to ameliorating salination and eutrophication of our waterways. It is unlikely that afforestation of the magnitude required could be achieved unless it is commercially driven. The production of trees for paper could provide the opportunity to carry out the afforestation program necessary for improving the environment at no cost to the State.

### Cover Photo

Trees loom out of the mist at Arnelup near the Stirling Ranges.  
Photograph by Robert Kari-Davies.

It would be ironic if the world demand for the much maligned woodchip provided the solution for what would arguably be two of the most serious environmental problems in south-western Australia.

# Restoring Nature's Balance

## *The Potential for Major Reforestation of South Western Australia*

*by Syd Shea and John Bartle*

**T**he coincidence of a number of factors has provided the opportunity for the establishment of extensive plantations of *Eucalyptus globulus* (Tasmanian Bluegum) on cleared agricultural land in the south-west. If the full potential of this opportunity is realised, a new industry could be created which, by 10 years, could generate up to \$400 million in export income, provide a new source of income for farmers and make a significant contribution to the reduction of salination and phosphorus pollution at no cost to the community.

In the last 150 years, vast tracts of southern Australian native eucalypt woodland and forest have been converted to agricultural use. This has involved nearly complete removal of the tall, perennial native species and their replacement with low, annual crops and pastures. These changes in vegetation density and type have caused major changes in the water balance which in turn profoundly affects soils, streams, rivers and estuaries.

The result, in south-west Australia, was the salination of half the freshwater streams and the pollution of most coastal wetlands and estuaries.

Farmers are not to be blamed. To remain viable, a farmer had to clear native vegetation and fertilise crops. Successive governments provided numerous inducements for farmers to clear land and State departments encouraged the use of fertilisers. All Western Australians benefited from agricultural development in the south-west, so individual farmers cannot be expected to bear the cost of remedying a community problem. But solutions must be found.

---

A typical salt seepage area in the 600 - 900mm rainfall zone. Reduced water use under agriculture provides surplus water to flush out salt stored in the subsoil, which causes valley waterlogging, salt damaged soils and salinised streams (left).



Marie Lochman

# A MATTER OF BALANCE

Water moves in a cycle through complex pathways between and within the continents and oceans. Solar energy powers evaporation over free water surfaces. In the atmosphere, water vapour is distributed in global wind systems to eventually be precipitated as rain, hail or snow. Over land, precipitation may be directly re-evaporated from wetted surfaces, or extracted from soil water storage by plant roots to be evaporated from leaves in a process called transpiration. These two types of evaporation are together called evapotranspiration. Precipitation can also be stored in the soil or infiltrate more deeply to recharge ground water systems.

Direct surface run-off and discharge from ground water systems forms streamflow which returns water to the ocean to complete the cycle. The principle of the conservation of mass applies in the water cycle, i.e. no water can be lost from the system, though it may change state (solid, liquid, gas) and travel along some very slowly moving pathways (deep regional ground water systems, glaciers). Thus the flow of water through an ecosystem is in equilibrium.

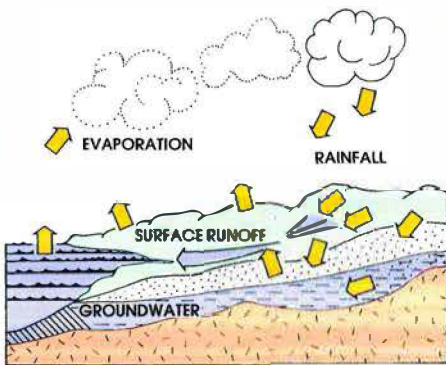
The characteristics of the water cycle of a particular area is studied by constructing a budget. This is a simple accounting of inputs (rainfall), change in storages (soil water, ground water), and outputs (evaporation, transpiration, streamflow, deep leakage loss), where inputs equal outputs, corrected for any change in storages. Water budgets are usually calculated for natural drainage basins or catchments because it is relatively

easy to measure output with stream gauging stations.

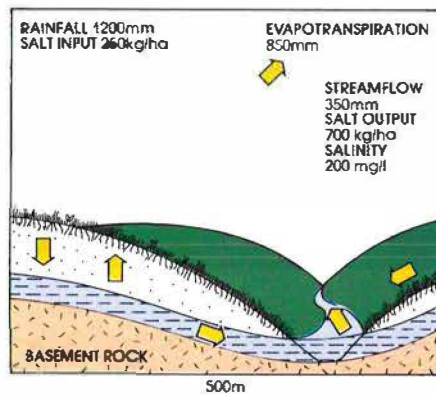
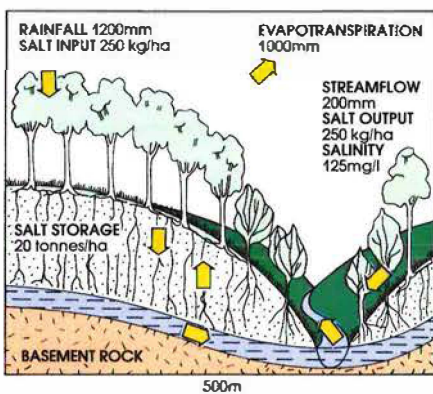
Any changes in the components of the water cycle will cause the existing balance between inputs, outputs and storage to change. The most readily changed component of the water cycle is evapotranspiration. Any change in the density and type of vegetative cover on an area of land will change the water use characteristics of land and its water balance.

Where evapotranspiration is reduced, either storage or other output components must increase to maintain the balance. This might be expressed as an accumulation of ground water, an increase in the area of moist or waterlogged land and an increase in streamflow. Where transpiration is increased, moist areas and wetlands may contract and streamflow diminish.

Changes in land use which have altered vegetative cover and thus changed the water balance are the cause of major environmental problems in southern Australia.

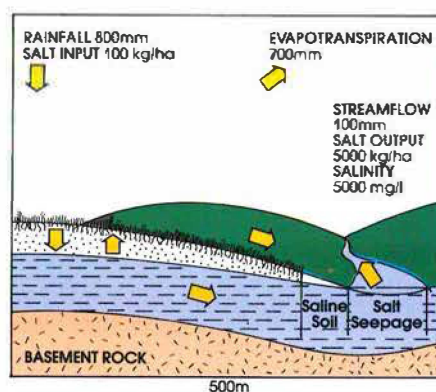
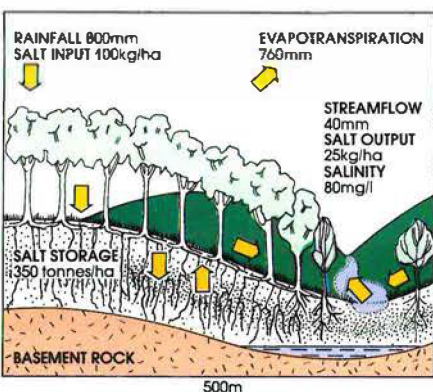


The Water cycle (Left).



In the high rainfall areas sufficient rainfall passes through the soil to prevent salt accumulation, even though the natural vegetation consumes a large proportion of the rainfall. (far left).

The removal of native vegetation causes marked increases in streamflow, but stream salinity does not increase significantly because there is little salt stored in the soil (left).



In low rainfall areas the vegetation uses almost all of the rainfall. Even though large quantities of salt accumulate in the soil the system is in equilibrium and stream salinity is low (far left).

When the high water-consuming native vegetation is removed, evapotranspiration decreases and the water table rises mobilising the salt stored in the profile (left).

# SALINATION

The concepts of 'cycles' and 'balances' can be applied to the movement of salt through an ecosystem. In the south-west of W. A. large inputs of salt in rainfall, deep soils with a large capacity to store water, a generally moderate terrain which results in sluggish drainage and a native vegetation which is highly adapted to consume water, combine to make salt a uniquely important factor in the water cycles of south-west ecosystems.

As the winds which bring rain to the south-west of Western Australia sweep across the Indian Ocean they absorb salt, so that on average between 60 and 260 kg of salt are deposited each year on each hectare of forest.

Where the soil is either porous or shallow, permitting rapid movement of water through the profile, or where rainfall is high, most of this salt is flushed from the soil and accumulation does not occur. However, in lower rainfall areas or where the soils are such that only slow movement of water occurs, the deep-rooted native vegetation consumes nearly all of the rainfall. The roots absorb the water but not the salt. Over thousands of years large quantities of salt have accumulated in the soil over large areas of the Darling Plateau. The distribution of salt broadly follows the rainfall gradient across the Darling Plateau. In the high rainfall zone on

the western edge of the plateau salt storage is low but it increases progressively as annual rainfall falls below 1 100 mm.

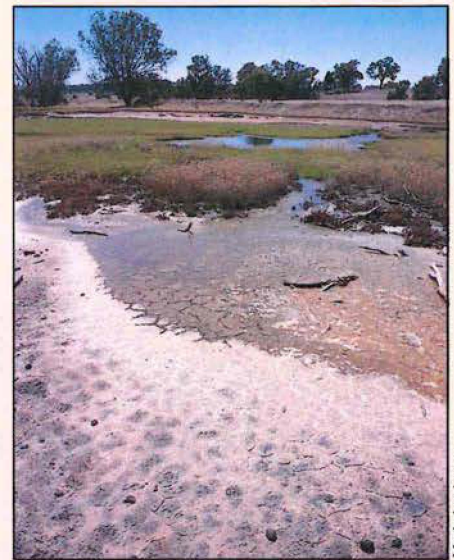
While the vegetation is undisturbed, the system remains in equilibrium and stream salinity is low - even when there are large quantities of salt stored in the soil.

When the native vegetation is replaced by agricultural crops or pastures, there is a reduction in evapotranspiration. The response in water and salt balances varies across the rainfall gradient, such that three distinct zones can be identified. In the High Rainfall Zone (greater than 1 100 mm rainfall per annum), the extra water passing into ground water and out in streamflow never results in a significant loss of water quality. In the Intermediate Rainfall Zone (900-1 100 mm rainfall per annum) a moderate stream salinity effect may be observed. However, in the Low Rainfall Zone (less than 900 mm rainfall per annum) the accumulation of ground water mobilises the stored salt to create salt seepage areas on the valley floors which damage agricultural soils and greatly reduce stream water quality.

Most of the State's agricultural land lies in the low rainfall zone : more than 300 000 ha of previously fertile farmland is salt damaged and about half of the total water resource of

the south-west region has been degraded.

The 600-900 mm rainfall portion of the low rainfall zone is the major target for reforestation. The 600mm isohyet marks the rainfall limit for commercial forestry and also encompasses all of the water catchments with potential for rehabilitation, in particular the Wellington, Warren, Kent and Denmark catchments.



Marie Lochman



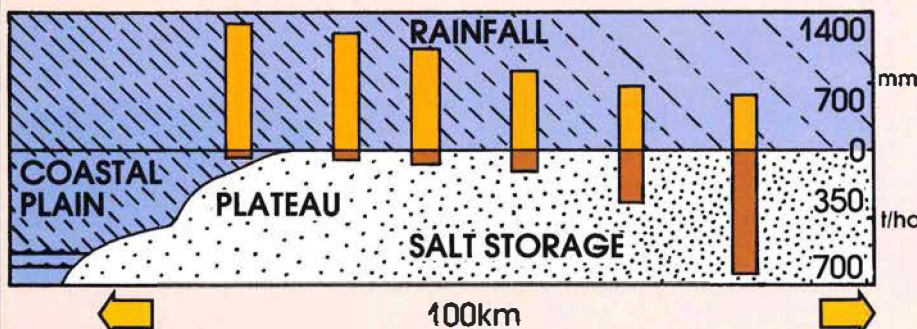
Jiri Lochman

Salt seepage areas in the 600-900mm rainfall zone (above).

Evaporation from the salt seepage areas can cause a surface crust of salt to develop (below).



Jiri Lochman



As rainfall decreases, salt accumulation increases (above).

# WHAT IS EUTROPHICATION?

Agricultural crops need a high level of nutrients, which is usually supplied by fertiliser. Any excess of nutrients can move into streams and drainage lines and end up enriching lakes, wetlands and estuaries. Too many nutrients leads to abundant aquatic plant growth, especially of algae. This process, called eutrophication, has profoundly detrimental effects on the ecology of a water body. Large masses of algae can accumulate on the shoreline, generating obnoxious odours as they rot, and preventing beach access.

The Peel-Harvey Estuary's major conservation and recreation values are severely threatened by

eutrophication. But almost every estuary and wetland in the south-west is suffering to some degree.

Phosphorus inflow to the Peel-Harvey Estuary has increased six-fold in the last three decades; it is the major nutrient causing eutrophication. The phosphorus inflow is greater than the rate of discharge into the ocean. The surplus has accumulated in sediments. The phosphorus stored in the sediments is now so large that it will sustain algal growth even in years of low streamflow and low phosphorus input.

About 60% of the phosphorus input originates as superphosphate fer-

tiliser applied to infertile sandy coastal plain farmland, which makes up less than 9% of the whole catchment area draining into the estuary. These sandy soils have little capacity to bind phosphorus, and are very porous. Winter rainfall readily leaches phosphorus from the soil into surface drainage. The efficiency of leaching is greatly enhanced by the water balance under agriculture: with the trees gone, there is less evapotranspiration of water, causing an increase in the seasonal duration of surface (and shallow sub-surface) water movement and the doubling of streamflow. The construction of drains in some areas has further increased the efficiency of the leaching process.



E.P. Hodgkin



E.P. Hodgkin

Algae deposited on the shoreline at Falcon Beach (above).

Aerial view of floating algae in Austin Bay in the Peel Inlet (left).

Delta of the Harvey River which delivers phosphorus enriched water into the inlet (bottom left).

Drains constructed to reduce water logging in low-lying areas of the Peel/Harvey catchment also increase the amount of phosphorus in the estuary (below).



Robert Karr-Davies



John Bartle

## LOOKING FOR SOLUTIONS

Salinity and phosphorus pollution (eutrophication) involve complex social, economic and technical problems. It is now recognized that no single measure will produce a solution. This has given rise to the concept of 'integrated catchment management' where a range of measures, tailored to the particular locality, will combine to produce a satisfactory solution.

A major step in developing a solution was compulsory bans on the clearing of native vegetation in selected salt-prone catchments. Introduced in 1976, these bans did halt rapid deterioration in water quality. Even if no further clearing of native vegetation occurs, however, stream salinity will continue to increase in areas where native forest has given way to agriculture. Also, the compensation and social costs of the bans were high. Compulsory measures to achieve change in land use can only be a last resort.

The Department of Agriculture has conducted research on systems of agriculture which are less prone to cause salination. The water use of conventional crops and pastures has been determined; there has been better definition of the capability of soil and land to sustain particular water use regimes; salt-tolerant species and management practices have been identified to utilise salt-damaged soils in seepage areas; and perennial grazing shrubs such as tree lucerne have been evaluated. Drainage systems which increase the outflow of surface (or shallow sub-surface) water to reduce water logging and the infiltration to saline groundwater systems, have also been developed.

On the coastal plain a variety of strategies are being employed, or have been proposed, to reduce

phosphorus pollution of the Peel-Harvey Estuary. These include fertilisation modification programs, the regulation of point sources of phosphorus pollution (e.g. piggeries) and the construction of a channel to the ocean to improve water exchange.

### The role of trees

Since salination results from the conversion of forest to agricultural crops, an obvious strategy was to reverse the process by planting trees. However, it was considered that it would be unwise to use native species (for example, jarrah) because of their susceptibility to jarrah dieback. There were doubts that tree species could be identified that would be able to grow on the harsh soils of the Darling Plateau and duplicate the high water consumption capacity of native forest. Consequently research was undertaken to identify tree species with high water consumption capacity and an ability to withstand harsh soil conditions. Several outstanding

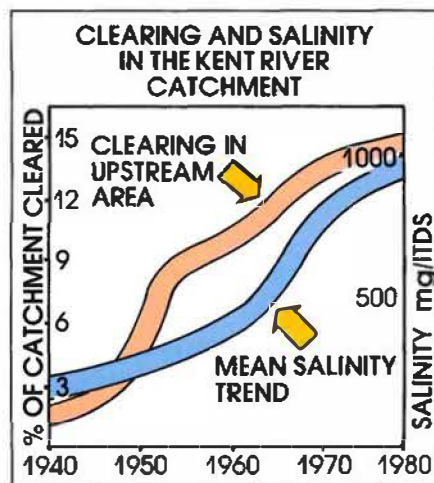
high water-consuming tree species have been identified.

Attempts were also directed at identifying tree species which combined high water consumption, tolerance of adverse soil conditions and high commercial productivity. Trials have also been conducted to evaluate the potential for tree growing at densities which permit agricultural production, i.e., agroforestry.

Unfortunately, most of the tree species which have a high water consumption capacity are not commercially viable.

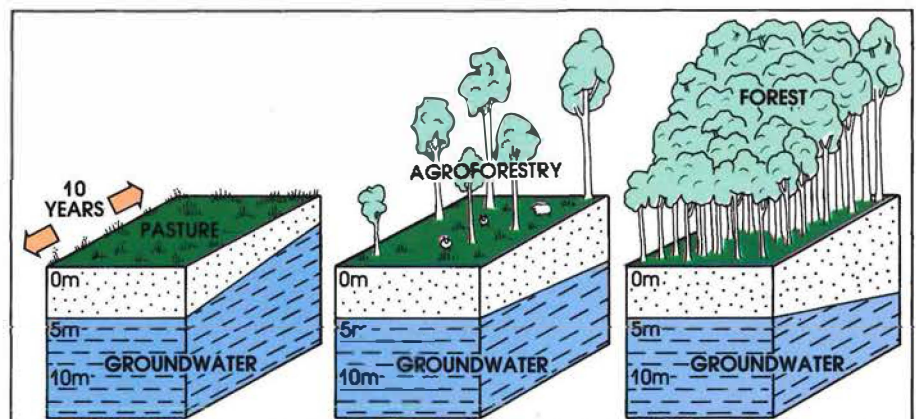
More recent research indicates, however, that high water consumption requirement is not as important as had been assumed.

Dramatic reductions in water table levels have been observed under forest stands of several different tree species, including species with commercial potential. In some areas, the re-establishment of a forest on agricultural land has caused watertables to be reduced by four metres.



The stream salinity trend closely follows the trend in agricultural clearing (left).

Field trials have shown that the re-establishment of forest on cleared land will rapidly cause the water table to fall, which reduces the discharge of salt into streams and the area of water-logged, salt-affected soil in the valley bottoms (below).





Marie Lochman

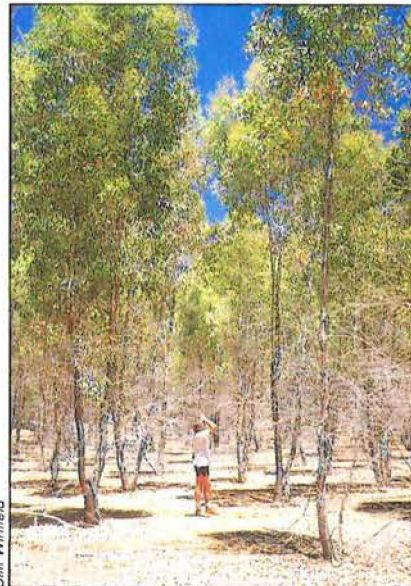


Jiri Lochman

Seven-year-old *E. globulus*, east Wellington catchment. This stand produced 20m<sup>3</sup> per ha per annum (far left).

*E. globulus* can resprout from the stump (coppice) to produce a new crop, doing away with the need to replant (left).

Ten-year-old *E. microcarpa*, east Wellington catchment. This species has high water use but little commercial value (below).



Cliff Winfield

## Trees and the reduction of phosphorus pollution

It is estimated that a reforestation program of 55 000 hectares on soils of the coastal plain which are most susceptible to phosphorus leaching will reduce the total phosphorus input into the Peel-Harvey system by 25%.

Trees are more efficient users of fertiliser because their roots fully explore the soil profile and tap the water table. Thus they are also able to absorb nutrients over a longer period of the year than agricultural crops. Less phosphatic fertiliser is required to grow trees and the application can be timed to minimise direct runoff into streams.

A tree crop's capacity to lower the ground water table will also contribute to a reduction in fertiliser pollution. A reduction in the water

table would reduce lateral surface and sub-surface flows of water which are the principle pathways of phosphorus entry into drains and streams.

## Why Bluegum?

The Western Australian Water Authority has undertaken a major reforestation program in the Wellington Catchment involving the planting of 5 000 hectares of re-purchased farmland. This programme has cost 10 million dollars. The tree species being planted in the Wellington Catchment have primarily been selected for their high water consumption and salt tolerance. Most have little potential for wood production. It will be possible, and in some situations necessary, to establish non-commercial trees. But the cost incurred by the community to compensate for income foregone by farmers makes the large-scale es-

tablishment of non-commercial trees impractical.

The major eucalyptus species which have been planted for wood fibre around the world are *Eucalyptus grandis*, *Eucalyptus saligna* and *Eucalyptus globulus* (Tasmanian Bluegum). In W.A. over a number of decades, trial plots of tree species have been established on different site types. Of the paper producing species, bluegum is the superior performer.

Bluegum has wood quality characteristics which are ideal for high quality paper production. It also has the capacity to grow on a wide variety of soils although its growth rate varies according to soil type and rainfall. The average growth rate in the target area for planting is estimated to be 20 cubic metres per hectare per annum, but on high quality sites it may exceed 40 cubic metres per hectare per annum.

## THE ECONOMICS OF BLUEGUM PLANTATIONS

Growth rates and fibre quality could be significantly increased by tree breeding and more intensive site management.

Bluegum can be grown on a rotation between 7 and 13 years depending on soil type and rainfall. Two further rotations could be obtained after the initial planting at minimal costs because bluegum, like many other eucalypt species, resprouts from the cut stumps.

The economics of bluegum plantations are such that farmers entering into an annuity scheme could receive annual net payments between \$50 and \$250 per hectare depending on site quality. These payments compare favourably with that obtained from traditional agricultural crops.

The projected rates of return for an investor in the scheme - between 10 per cent and 18 per cent real - are highly competitive. The investment is further enhanced because it would qualify as a legitimate primary industry tax deduction.

Annuity payment to landowners in an *E. globulus* sharefarming scheme, for various growth rates and log prices (below).

Profitability of *E. globulus* forestry, for various growth rates and log prices (centre).

Distribution of export revenue in WA from *E. globulus* sharefarming. (Based on a planting rate of 10 000 ha/yr for 10 years (right).

The current price for marri and karri woodchips is \$10.29 per cubic metre. But this type of woodchip material is less suitable for paper production than bluegum. For example, on average the yield of pulp from marri and karri chips is 42 per cent, compared with 58 per cent from bluegum. This and other factors mean that bluegum would be priced between \$15 and \$25 per cubic metre. It is likely because of the projected deficit in wood supply that the price will increase over time at rates greater than inflation.

One of the most simple analyses of the commercial viability of bluegum is to compare cost and returns over the rotation. On an average site, it is expected that it would cost approximately \$1 300 per ha to grow a plantation of bluegum to maturity at age 10 for a return of (assuming wood price at the stump is \$20 per cubic metre) \$4 000 per ha.

But when computing the economic return from tree crops, allowance must be made for the time delay between expenditure and returns. The most simple way of assessing the profitability of bluegum plantations is to compute the rate of return (interest rate) on the investment over the 10 year period of the plantation. Economic models have been developed by CALM which allow a range of costs and price inputs to calculate the rate of return. If a

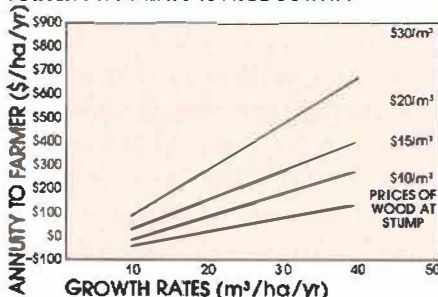
price of \$20 per cubic metre is assumed, on sites producing 20 cubic metres per annum the rate of return would be approximately 14 per cent real. This means (assuming an inflation rate of 6 per cent) the nominal return on an investment in bluegum would be 20%.

Another way of assessing the commercial viability of bluegum is to calculate the annuity which could be paid for a farmer using the softwood sharefarming model. On farms which produced average growth rates (assuming a \$20 per cubic metre price for wood) the annuity rates would vary between approximately \$50 - \$120 per ha. On sites where productivity is higher, the annuity could increase to \$250 per ha.

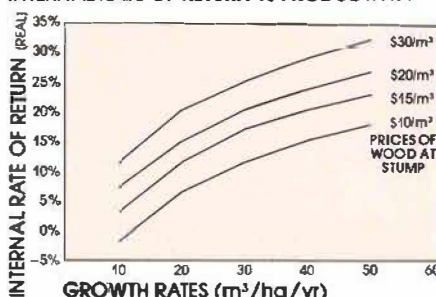
Some indication of the overall benefit of a major reforestation program based on bluegum to the State can be obtained by showing the total costs and returns over a period of years.

If, for example, a 10 000 ha program of plantation establishment was initiated and maintained for a period of 10 years and then two further rotations of bluegum were grown from coppice from these plantations, the gross return per annum in year 10 would be approximately \$120 million. This gross return could be sustained indefinitely at an annual growing cost of approximately \$15 million.

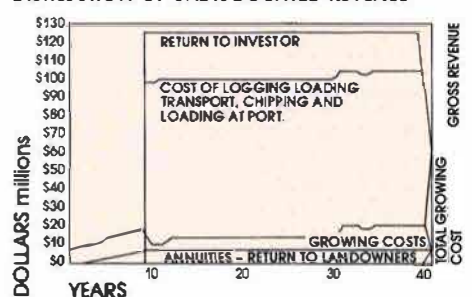
ANNUITY PAYMENTS vs PRODUCTIVITY



INTERNAL RATE OF RETURN vs PRODUCTIVITY



DISTRIBUTION OF UNDISCOUNTED REVENUE



## THE DEMAND FOR PAPER

There has been a significant increase in the demand for high quality printing and writing paper, despite predictions of the development of the 'paperless office'. For example, in the United States the growth in demand for printing and writing paper is increasing 4% per annum. If this annual growth rate is applied to current world consumption of paper pulp suitable for high quality paper - 40 million tonnes per annum - there will be an increase in demand of 1.6 million tonnes per annum.

The suitability of eucalyptus fibre for fine paper production was first

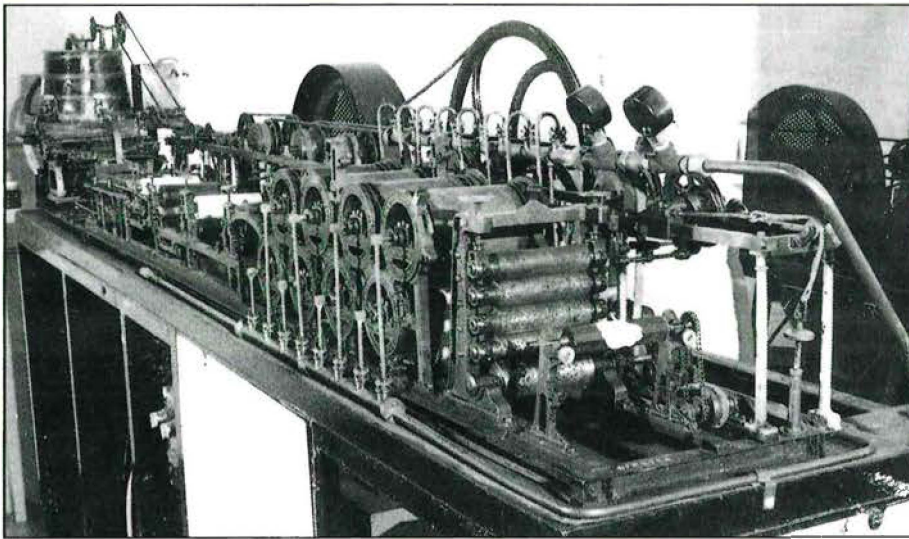
demonstrated by I H Boas at the Perth Technical College in the 1920s. Increasingly, pulp producers around the world are using eucalypts to meet demand for high quality paper. Eucalypts have optimum fibre characteristics for the production of printing and writing paper.

Large quantities of eucalyptus wood fibre are being produced from plantation growing eucalypts around the world. Ironically, Australia, home of the eucalypt, has only 40 000 ha of eucalypt plantations. Brazil has established 2.2 million hectares and Spain, South

Africa and Portugal each have more than 400 000 ha of eucalyptus plantations.

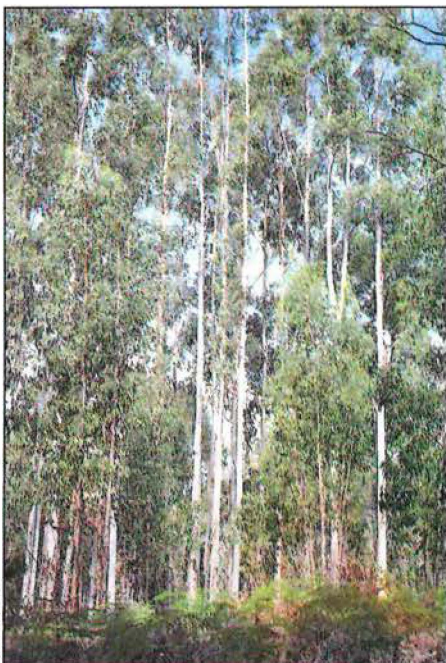
Several countries are proposing to or have increased their plantation establishment rate. But despite this, it is conservatively estimated that by 1997 the demand for eucalypt wood fibre for Japan alone, will exceed supply by 5.5 million cubic metres per annum. This represents a doubling of the current Japanese hardwood fibre imports.

Between 250 000 - 500 000 ha of eucalyptus plantations would need to be established within three years to make up this deficit.



Courtesy C.S.I.R.O.

Some of the early work which established the large world eucalypt pulp/paper industry was done in Western Australia. This machine was used by I. H. Boas at the Perth Technical College in 1918-21 to make paper for comparison of the value of various species and processes for paper making.



John Barille

### Tasmanian Bluegum

Tasmanian bluegum (*Eucalyptus globulus*) occurs naturally in S E Tasmania, the Bass Strait Islands and S. E. Victoria. Its low level of frost tolerance restricts its distribution to low altitudes and near coastal locations.

Its common name refers to the blue-green foliage of the seedling plant. The juvenile foliage is quite different from the mature foliage.

A twenty-year-old stand of *E. globulus*, near Manjimup (left).

The mature tree is smooth-barked, and looks similar to karri.

Seed collected by British and French explorers in the 18th century were the basis of the first overseas plantings. The species proved very adaptable and productive, and it has become the most important temperate zone eucalypt in world forestry. It is also widely planted at high altitudes in tropical latitudes. Its common uses include fuelwood, poles for roundwood construction, sawn timber, and more recently it has become a major pulpwood species. International plantings now exceed two million hectares.



## SOFTWOOD SHAREFARMING

### Area available for planting

Within the 600 mm rainfall isohyet there are approximately 1.5 million hectares of private land within economic haulage distance from the ports of Bunbury and Albany. One-third is located on the coastal plain and two-thirds on the Darling Plateau. Approximately one-third of this land retains native vegetation and under current government policy would not be available for planting. Preliminary surveys indicate that approximately 500 000 ha would either not be suitable for bluegum planting or would be more suitable for agriculture. The remaining, approximately 500 000 ha of cleared agricultural land, could potentially be planted with bluegum.

It is possible to purchase and replant farms, but, apart from the large expenditure which would be required for a land purchase program, land purchase could cause social disruption. Land purchase by government or large companies is perceived by local residents as being detrimental to the community.

In any case, it is unlikely either for environmental reasons or for commercial tree growing that it would be desirable to purchase and replant whole farms. In some situations, whole farms may be suitable for planting. But it is anticipated that on most farms only a proportion of the land will be suitable for bluegum either because the soil conditions are unsuitable, or alternative agricultural crops are more profitable. The environmental benefits of tree planting would also be maximised by strategic rather than whole farm planting. It is possible that a variety of planting strategies could be used. For example, in addition to 'block' plantings, strip planting of various widths could also be employed. Planting locations would be

*Pinus radiata* is a highly productive and profitable species. But it takes between 25 to 30 years to grow to maturity and to realise the income. The softwood sharefarming scheme overcomes this problem by paying farmers an annuity. The scheme also encourages farmers to manage the plantations under contract to CALM thus contributing to on-farm employment. In addition to an annual payment, the farmer receives a percentage of the return from harvesting the final crop. For example, a farmer contributing 100 ha to the scheme on relatively high quality sites would receive \$7 000 per year, indexed against inflation and \$30 000 at the end of the rotation.

Over 3 000 ha has been planted under the softwood sharefarming scheme and it is expected the majority of the State's annual target

specified as part of an integrated catchment plan based on the particular local attributes of that land.

### Farmer participation

Any scheme involving the establishment of extensive bluegum plantations on private land would be voluntary. Individual farmers may choose to undertake tree cropping with bluegum independently, but the most attractive proposition for farmers is likely to be a scheme based on the already proven softwood sharefarming model. Sharefarming permits advanced payments in the form of annuities, minimises the risks to individual farmers, keeps the farmer on the farm and diversifies his income. It also provides the flexibility to make tree cropping competitive with existing agricultural practices and the opportunity to maximise the environmental benefits.

### What's been done so far?

The West Australian Chip and Pulp Company (WACAP) has already

of 2 000 ha per year will be planted on farms using the scheme.

Pine trees will help reduce salinity and phosphorus runoff, but the State's annual planting program of 2 000 ha per year is not large enough to have a significant effect on regional water balance problems. The 2 000 ha program is designed to meet local demand for timber and any additional plantings could only be justified if there was a significant export market for pine timber. This is unlikely to develop in the foreseeable future. But the 'sharefarming' model can be applied to growing short rotation eucalypts. In addition to overcoming the problem of the delay on return from tree crops, sharefarming makes it easier to integrate the plantations with existing farm activities and maximise their environmental benefits.

embarked on a program in the lower south-west which assists farmers using a variety of incentive schemes to establish bluegum plantations. Under this scheme over 1 000 ha of plantation will have been established on 21 different farms by 1988.

The W. A. Government has approved the initiation by CALM of a pilot operational trial of a bluegum hardwood sharefarming scheme which will result in the establishment of between 1 500 and 2 000 ha of bluegum plantations in the catchment of the Peel-Harvey Estuary and the Wellington Reservoir in 1988.

---

As canopy cover increases so the volume of streamflow decreases. It is therefore possible to deliberately thin the forest to increase the yield of water (right).

Above a threshold level of stand density no further increase in total forest growth occurs. Thinning can therefore be used to reduce canopy cover and stand density without loss of growth potential, as well as to improve water yield (far right).

## PROSPECTS FOR A PULP MILL IN W.A.

### Can We Do It?

There is little doubt that W. A. has a significant **comparative** advantage to provide a large proportion of the increasing market for wood that can be used to produce high quality printing and writing paper. Our climate, soils, moderate terrain, technical competence and political stability combine to put Western Australia ahead of most other countries which can grow eucalypts. But this advantage will not persist forever.

The principal factors which will determine whether W. A. can capitalise on this opportunity are the availability of sufficient capital to initiate the scheme and the preparedness of farmers to grow bluegum plantations as an alternative crop.

One of the major criticisms of the current W. A. woodchip industry is that the full potential of the resource to generate export income is not achieved because the woodchips are processed into pulp and paper in Japan. There have been a number of investigations undertaken by WACAP of the potential to establish a pulp mill in W. A. over the period since woodchips were first exported. But up until recently the commercial environment has not been favourable. In the last two years, however, the environment has changed and a new feasibility study is being undertaken by WACAP.

A pulp mill's viability is dependent on size. The minimum size of a viable mill is between 250 000 and 350

000 tonnes per year. A mill of this size would cost \$750 million to build.

Before an investment of this magnitude is made, investors need to be assured of the long-term security and quality of the resource.

A bluegum plantation program of 100 000 ha would ensure the continued supply of high quality fibre to a mill and would significantly enhance the prospects for the establishment of a pulp mill in W. A.

In addition to the employment generated during the construction phase, a pulp mill would provide approximately 300 permanent jobs and would generate up to \$200 million of export income per year.

## THINNING FORESTS TO INCREASE WATER YIELD

The maintenance or establishment of forest on land which has salt stored in the soil profile is essential to reduce salinity. This is because of the high water consumption by forests. For the same reason, dense tree cover on land where the soils have not accumulated salt reduces the yield of fresh water. It would be detrimental to water production to establish dense forest on cleared land which is not prone to salination. Research carried out over more than 15 years has shown that it is possible to significantly in-

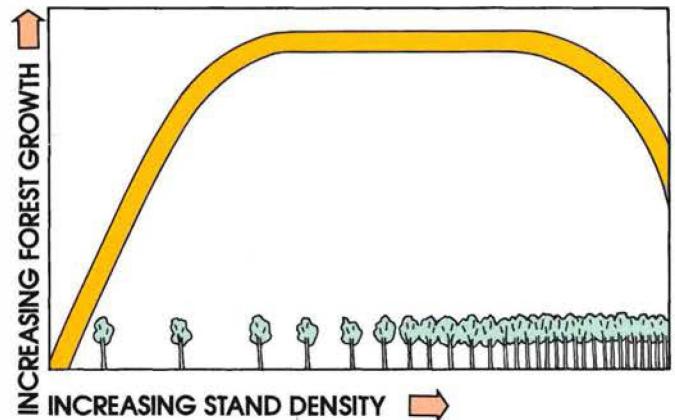
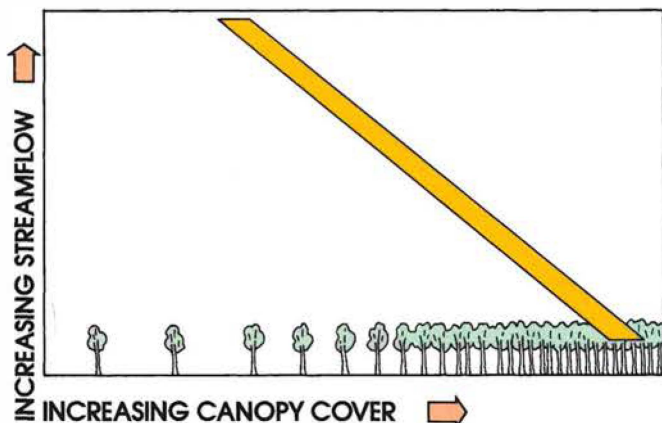
crease the yield of fresh water from metropolitan water catchments by thinning the forest in salt-free areas while at the same time preserving or enhancing other forest values.

### Thinning

Most forests thin themselves naturally as they develop - albeit slowly. Thus a hectare of newly regenerated forest may have 100 000 seedlings. But as the stand develops some trees become dominant and rob their neighbours

of nutrients, water and light. At maturity the forest may have less than 1 000 trees per hectare.

The jarrah forest is unusual in that volume mortality in dense regrowth stands is very low. Yet virgin stands of jarrah typically consist of relatively few large trees with an almost park-like structure. It is possible that in the past, natural thinning of the jarrah forest was brought about by periodic high intensity wildfire. If the jarrah forest is not thinned it stagnates -



remaining as dense, slow-growing, straggly trees.

The practice of thinning has been carried out by foresters for over 100 years and in W. A. there has been extensive research on techniques and effects of thinning on native and exotic forests. Thinning involves the removal of small and defective trees and essentially duplicates a natural process; thus progressive thinning of native regrowth forest results in it developing a structure, over time, similar to that of the virgin forest.

### Thinning and wood production

When scientific management began to be applied to forests in Europe it was assumed that the ideal forest density - that is the one producing the most wood - was one which was abstractly defined as 'normal'. The normal forest was a dense forest and it was assumed that a forest of lesser density was not producing the maximum wood increment. Pioneering work by a European forest scientist, Mar Moller, showed that, in fact, a forest stand produced the same amount of wood over a wide range of stand densities. The so called 'Moller

plateau' principle has since been found to apply to many different forests including W.A.'s native and exotic forests.

By thinning a forest stand, the same amount of wood being produced each year is concentrated on fewer trees, thus increasing their growth rate. For example, individual jarrah trees in an unthinned forest stand may take more than 400 years to reach a mature size, whereas in a thinned stand the same tree may take less than 80 years to reach the same size.

### Stand density and water yield

Not surprisingly there is a strong relationship between stand density and water yield because the denser the forest the greater the leaf area. Broadly speaking, the greater the leaf area or canopy cover, the greater the consumption of water. For example, in high rainfall catchments in the jarrah forest it was shown that a reduction in canopy cover can nearly double streamflow into reservoirs.

It will be possible to achieve this increase in water yield while at the same time maximising the growth

of individual trees and maintaining total forest growth.

There are large areas of regrowth jarrah forest that would benefit from thinning. Since thinning would enhance their development to the same structure as virgin forest, the conservation and recreational values are unlikely to be reduced and tree growth would also be increased.

But the principal benefit would be the impact on water yield of Perth metropolitan catchments. Preliminary estimates indicate that a thinning program on metropolitan water supply catchments would increase the annual water yield by 48 million cubic metres. This extra water could be produced at a cost of between 2 and 8 cents per cubic metre.

The dense *Pinus pinaster* stands which have been established on the Gnangara water mound north of Perth have a negative effect on water production because they use more water than the native woodland they replaced. But the natural water balance can be restored by thinning them to a density which reduces their water use to the same level as the native vegetation.



High quality thinned jarrah forest near Dwellingup. Thinning forest in salt-free areas can increase the yield of fresh water from the forest (left).

### Acknowledgements

*The information that is presented in this article on salination and eutrophication is a distillation of over two decades of research by many people in State and Federal Government agencies, tertiary institutions, and private companies. The complex nature of these problems is such that a number of disciplines must be employed and integrated before the cause and solution can be found. Western Australia is fortunate in that it has been able to achieve a high degree of cooperation and coordination of research on land and water problems.*

*Development of the data on the potential of blue gum has been the responsibility of a team of workers in the Department of CALM. We also acknowledge the pioneering work which has been undertaken by WACAP and Mr Gordon McLean of McLean Sawmills (1966) Pty Ltd.*

# GREENHOUSE AUSTRALIA



Cliff Winfield

Hardly a day passes without an article in the newspapers about the greenhouse effect or the ozone layer. Apart from leaving you vaguely alarmed, you may not be much wiser. What is the greenhouse effect? Where, and what, is the ozone layer? What are the problems, and what is being done about them? JOHN BLYTH, from CALM and PHIL NOYCE, from the COMMISSION FOR THE FUTURE, give you up-to-date answers.

**T**HE greenhouse effect, like acid rain and the depletion of the Earth's ozone layer, is an atmospheric phenomenon caused by humans, which will affect human societies in the future. To understand the greenhouse effect, you must know something about how the atmosphere functions.

A planet's temperature mainly depends on three factors:

- the amount of sunlight it receives
- the amount of sunlight it reflects
- the extent to which its atmosphere retains heat

So, a distant, shiny, airless planet will be colder than a darker, humid, pea-soup-skied one closer to the sun. It all depends on the balance of light in, light reflected and light absorbed. The Earth, as we know, is beautifully situated between cold, thin-aired Mars and hot, steamy Venus.

## There is More to Sunlight Than Meets the Eye

Sunlight is a tricky term; it's much more than what you see. Solar radiation includes the white light, and all the colours of the rainbow, from red right through to violet: but that's just the visible spectrum.

There's also infrared light - the sort you feel when you stand beside a pot-belly stove; and there's ultraviolet light, which is also out of the range of human eyesight. Ultraviolet rays give you a tan and cause skin cancer as proof of their existence. Along with radio waves, cosmic rays and others, ultraviolet, visible and infrared light are part of the spectrum of electromagnetic radiation.

A group of gases in the atmosphere - water vapour, carbon dioxide, methane, nitrous oxide, ozone and, recently, chlorofluorocarbons - are able to absorb radiation in the band of infrared wavelengths. They're

called 'greenhouse gases' because they act a bit like the walls of a greenhouse, by trapping and retaining infrared or 'hot-body' radiation. It works like this: sunlight passes through the atmosphere (most greenhouse gases are transparent to visible and ultraviolet light), reaches the Earth's surface and heats it. Being hot, it emits some infrared radiation back into space. Some of this is absorbed by the greenhouse gases and is thus retained in the Earth's atmosphere. The air warms up, a new ground-air equilibrium is achieved and the temperature of the Earth rises.

That's how it's been since the Earth began.

The problem is not that the greenhouse effect exists - in fact we'd be much colder without it - it is that human activity since the Industrial Revolution has steadily added greenhouse gases to the atmosphere, causing heat to be trapped that would otherwise be lost to space.

As population increases we consume more energy and require more food; these activities increase the production of greenhouse gases. For example:

- Carbon dioxide (CO<sub>2</sub>) is increasing at about 0.4 per cent per year, due to the burning of fossil fuels - oil products, coal and gas. It contributes about half the total warming effect.
- Methane (CH<sub>4</sub>) is produced from ruminant animals, rice paddies, industrial activities involving the use of natural gas, burning wood, coal etc., and is increasing at the rate of 1 % every year.
- Chlorofluorocarbons (CFCs) are used as refrigerants, solvents, propellants for spray cans. They are long-lived, artificially produced substances that are increasing in the atmosphere at the rate of 5-7 % per year.

The total concentration of greenhouse gases will be double the preindustrial level by about the year 2030 and will still be growing!

Compared with the amount of CO<sub>2</sub>, and other trace gases, generated by industry, the impact of deforestation on CO<sub>2</sub> levels in the atmosphere appears to be insignificant. Nevertheless, retention and regrowth of native vegetation, and extensive replanting and tree-cropping as proposed by CALM on much cleared farm land, will have some value, in reducing greenhouse effects. Such steps are, of course, of great benefit for many other reasons.

## How Will Our Climate Change?

The effects on the climate of any particular part of the Earth are influenced by global climatic patterns, by the lag-time in the warming of the oceans, and by regional factors, and are not easy to predict. Some of the projected changes by 2030, however, are:

- A rise in Australia's mean temperature of between 1.5°C and 4.5°C.
- Globally, tropical and sub-tropical areas are expected to become wetter, and mid-latitudes to become dryer. In W.A., summer rainfall may increase and move further south, and the zone of reliable winter rainfall may also move southwards. Thus, while much of W.A. may receive up to 50% more rainfall, it is suggested that the South West region, including most of the wheatbelt, will become dryer due to a decrease of 20% or more in winter rainfall.
- There may be large regional changes in soil moisture, runoff and water supplies. For example, a reduction of 20% in rainfall in the South West of Australia would probably lower the

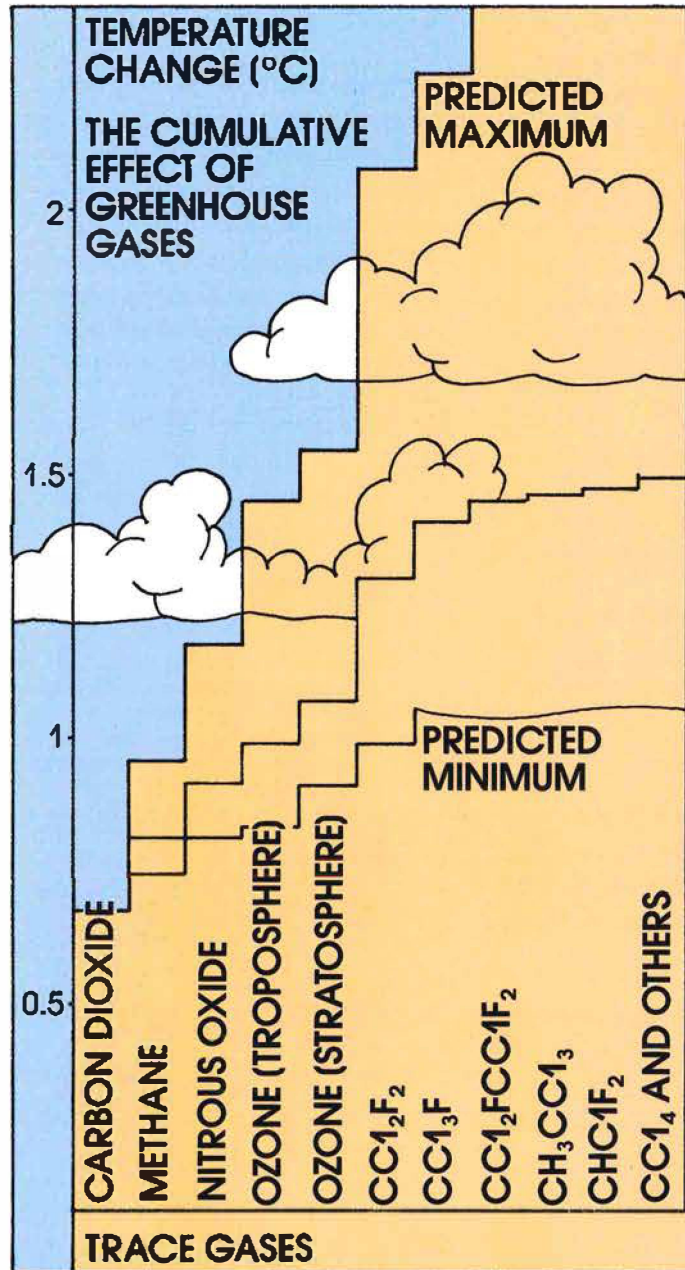
groundwater tables (such as the Gngara Mound) by 20 m.

- Tropical cyclones may move further south and could become more frequent and more intense.
- Extreme weather patterns, such as floods and droughts, may become more frequent.
- Increased rainfall in inland areas could exacerbate salinity problems.
- Trips to eastern Australia for skiing enthusiasts may become a thing of the past, as snowfields are predicted to recede by as much as 75%.
- Increased levels of carbon dioxide have the potential to increase plant growth quite substantially.

Other possible effects include a change in sea level. Water is at its maximum density at 4°C. Above and below this temperature it expands. That's why ice floats - it's less dense than water. So if the oceans get warmer, the sea level will rise. On current projections, a swelling of the oceans will lead to sea level rises of around a metre over the next 30-50 years.

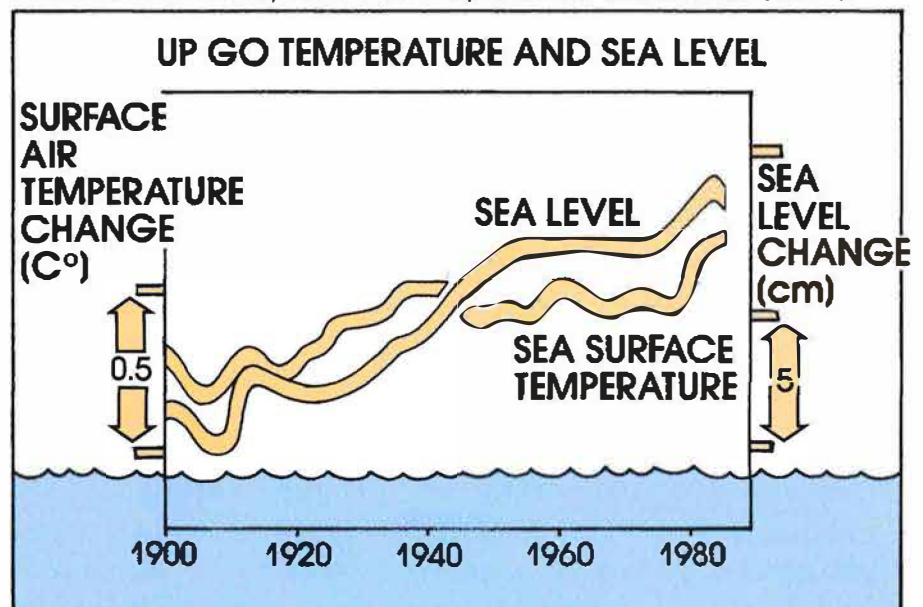
As well as the oceans swelling, melting of the polar ice caps would also raise sea levels. This is not likely to be significant for at least another hundred years, but when it does occur the reflection factor in determining a planet's temperature will come into play. With large expanses of highly-reflective ice removed, the Earth won't reflect solar radiation as well as it does now; that is, it will absorb more heat, leading to a further rise in temperature.

So, minor temperature changes can produce quite major changes to where we live. For example, during the Ice Age of about 150 000 years ago, global temperatures were



Gases other than CO<sub>2</sub> are now expected to contribute at least 50% of the predicted warming of the Earth by the year 2030 (Above).

As the oceans warm up, their waters expand, and sea levels rise (Below).



about five degrees lower than they are today. Correspondingly, sea levels were over 100 m lower. By contrast, during the last interglacial period, 100 000 years ago, it was one or two degrees warmer than today, and sea levels were five to seven metres higher. On current projections, by the early 21st century, average global temperature should be higher than it has been in the past 120 000 years.

## The Scenario for W.A.

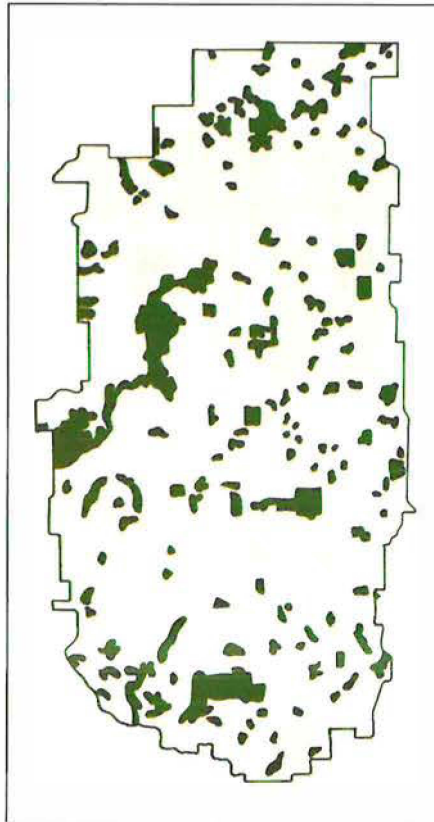
The possible effects over the next 50 years can be summarised as follows:

- for the South West, average temperatures up to 4°C higher, winter rainfall down by 20% or more and runoff down by up to 45%
- large areas on the northern fringe of the wheatbelt and throughout the pastoral zone becoming wetter and more productive
- sea levels from 20 cm to 140 cm higher, with resulting impacts upon human activities and coastal environments largely depending on the extent and severity of any increase in storms and cyclones.

Some implications for conservation and land management in W.A. are:

## Nature Conservation

Wetlands would be affected in a variety of ways, depending on type and geographical position. Those wetlands dependent directly or indirectly on rainfall would be expected to expand in both size and period of inundation in the north and inland areas, and shrink and become less permanent in the



Isolated patches of native vegetation in the Tammin Shire. This is typical of the Wheatbelt (Above).

South West. Most freshwater wetlands on the Swan Coastal Plain could disappear, becoming little more than occasionally wet damplands.

Isolated reserves - the greenhouse effects, if and when they occur in the South West, will be acting upon natural vegetation and biological communities already modified by human activities. The reserve system has been established on the basis of a more or less stable climate, and in many cases refugia may no longer be available, even for the more mobile species. For many sedentary species of plants and animals now 'marooned' on reserves surrounded by cleared farmlands, adaptation to, or migration away from the changing conditions will not be possible.

Some of W.A.'s most precious conservation resources are confined to offshore islands. Many of these are low-lying and extremely important for turtles' and sea birds' nests. A rise in sea level of one metre or more would result in the almost total loss of the Abrolhos and similar low islands, while any additional frequency or intensity of cyclones or other storms could create storm surges capable of threatening even larger islands and the fauna dependent on them.

Courtesy Dept of Agriculture

## Are We Seeing Greenhouse Effects Already?

The factors determining global and regional climates and sea-levels are so complex that proving a causal link between greenhouse gases and any observed changes is extremely difficult.

A number of well-recorded changes over the last 100 years, are however, consistent with those being predicted, on the basis of physical principles and computer modelling, to result from the greenhouse effect:

average air temperatures at the Earth's surface have risen by about 0.5°C;

the warming of the Earth over the last 100 years has been accompanied by an average rise in sea-level of

about 10 cm, and an overall melting and shrinkage of glaciers;

a 10-20% reduction in winter rainfall in the south west of W.A. for the period 1946 to 1978, compared with that for 1913 to 1945, is consistent with the prediction that rain-bearing winter fronts will reach and cross the coast into south-west W.A. less frequently;

comparison of rainfall data for central N.S.W. for the same two periods also shows that an increase in summer rainfall has occurred, which is consistent with a predicted move southward of monsoonal influence on Australia's east coast.



Cliff Winfield

Many low, sandy or coral islands in the north of W.A. would be inundated by a sea level rise of one metre or more (Above).

The loss of low-lying beaches and islands would put at risk the breeding of many sea birds and turtles (Right).

Coastal wetlands like Lake Joondalup may virtually disappear if Perth's rainfall decreases by 20% or more (Below).



Cliff Winfield



Jiri Lochman

## Timber production

Laboratory studies indicate that a doubling of carbon dioxide concentrations (expected by the year 2030) is capable, under conditions of adequate moisture and nutrients, of increasing the growth rate of *Pinus radiata* by 40%.

The same kind of response may also be expected in species of eucalypts. With the right selection of genetic stocks and careful management of supplies of nutrients and water, the opportunity may exist for a considerable increase in the productivity of plantation forests in W.A.

Conversely, the projected drying of the South West, which would result from a combination of decreased rainfall and increased temperature, could have considerable implications for the growth of commercial timber species. Projections of yield based on an unchanged climate may need to be reviewed, and the selection or encouragement of particular species may need to be matched to altered climatic conditions.

## Fire Management

Calculations suggest that a combination of decreased rainfall and increased heat for the forested regions of the South West would greatly increase the danger and intensity of wildfires. The simplified model used indicates that under these conditions, average fire danger during each summer would be at extreme levels, previously only expected to occur once in 50 years.

## What Should Be Done?

We might argue that the obvious solution is to stop the generation of greenhouse gases, but it is not that simple.

The production of greenhouse gases has the whole momentum of the global economy behind it.



Cliff Winfield

---

*'If we live as if it matters and it doesn't matter, it doesn't matter; if we live as if it doesn't matter and it matters, it matters'.*

---

While some agreement may be possible limiting the use of some of the trace gases (e.g. chlorofluorocarbons), it seems highly unlikely that significant reductions in the global use of fossil fuels and the consequent production of carbon dioxide (currently growing at the rate of 0.4% per year) can be achieved within the next 100 years or so. Greenhouse effects, almost certainly in train now, will continue to increase for the foreseeable future.

Thus, whatever steps are taken between nations to limit the continuing increase of greenhouse gases, changes will still occur, and adaptation to them will be necessary at National, State and Regional levels.

Both nationally and internationally there will be advantages and disadvantages, and winners and losers, from the postulated changes.

For Australia, there are three critical requirements for a smooth transition to a warmer world: more precise information on what changes in climate and sea level are likely in different parts of Australia; a reliable inventory of natural and cultural resources, and how they are likely to be affected by the predicted changes; and, above all, a willingness to incorporate predictions into medium and long-term planning.

In most cases the planning and management required to anticipate greenhouse effects is simply 'good housekeeping'. If the predicted changes do not occur, little will be lost by planning on the assumption that they will. Conversely, if the changes do occur, and pre-emptive planning has not been instituted, the costs and lost opportunities could be enormous.



Cliff Winfield

The growth of *Pinus radiata* in the South-West may benefit from increased CO<sub>2</sub>, but only if rainfall does not decrease. (Left).

Intense wild fires may become more frequent in a warmer (and perhaps windier) W.A. (Above).

In the words of the Greenhouse 87 poster - 'If we live as if it matters and it doesn't matter, it doesn't matter; if we live as if it doesn't matter and it matters, it matters'.

## The Greenhouse Project

In October 1985, an international conference of scientists gathered at Villach, Austria, to assess the current status of knowledge concerning climatic change. They came to a unanimous conclusion:

*The understanding of the greenhouse question is sufficiently developed that scientists and policy-makers should begin an active collaboration to explore the effectiveness of alternative policies and adjustments.*

That sentence sums up the thinking behind 'The Greenhouse Project: Planning for Climatic Change'. This joint initiative of the CSIRO and the Commission for

the Future is the start of a campaign to alert the Australian community about the need for some very serious planning for social and economic impacts across a wide range of industries, public services and government departments.

Active collaboration requires a common understanding of the problem and of the ways of addressing it. It's easier said than done, of course: whereas scientists study the natural world in order to understand and explain its workings, policy-makers make decisions about money, time and priorities based on what people see as important issues of the day: less taxes, more leisure, a nicer place to live and so on. They seem to be worlds apart. The task of the Greenhouse Project will be to bring them together, partly by helping with some basic science, partly by forging new networks for people with a common interest.

## Is Ozone Depletion Related To The Greenhouse Effect?

Ozone, a rare form of oxygen with three atoms per molecule instead of the normal two, is produced by the action of ultraviolet light on 'normal oxygen' and by lightning. In the atmosphere it forms a 'shell' of greatest concentration at an altitude of about 25 km, and has the capacity to trap incoming ultraviolet light, so reducing the intensity of this often harmful wavelength reaching the earth's surface.

Chlorofluorocarbons, only produced since the 1930s', and the most rapidly growing of the greenhouse gases, are better known for their capacity to combine chemically with ozone in the Earth's atmosphere, therefore reducing atmospheric protection against incoming ultraviolet radiation.

Although both the ozone itself, and the chlorofluorocarbons are greenhouse gases, that is, capable of absorbing infrared radiation, there is no other link between ozone depletion and the greenhouse effect. The loss of ozone as a greenhouse gas is more than made up for in terms of the greenhouse effect by the increase of chlorofluorocarbons. There is no 'balancing out' between the two processes.

The significance of the ozone depletion relates to adverse effects on human health and (possibly) plant-growth stemming from increased levels of ultraviolet light reaching the earth.

There is little evidence yet to suggest that the observed seasonal 'holes' in the ozone layer over Antarctica are spreading over more inhabited parts of the Earth.

In any case, a reduction in the use of chlorofluorocarbons, recommended by the recent Ottawa agreement to slow down the depletion of ozone, will also help reduce the growth of greenhouse gases.



Cliff Winfield

Reduced rainfall and runoff is likely to reduce populations of water birds, such as Black Duck, in the South West (Left).

Changes to rainfall patterns in W.A. may be critical for the distribution and timber yield of karri forests (Below).



Cliff Winfield

## Greenhouse Project Activities

A National Workshop formally launched the project on 16 September 1987. In this workshop, scientists worked with industrialists, government officials, representatives from the insurance, tourism, construction and other industries on climatic change.

Working groups commenced at the Workshop are continuing to research and gain broader industry or sectoral support.

A Greenhouse 87 conference was held in December for scientists and technologists with particular expertise in matters relating to climatic change. Considerable activity within several states has already grown from that conference.

Greenhouse 88, a pan-Australian community conference will be held late in 1988 and will be linked electronically across all capital cities and other major centres. It will be dedicated to broad public discussion of the potential social, economic and environmental impacts of the greenhouse effect rather than to specific fields of scientific study.

Working groups are being organised around the following eight categories:

- primary industry: agriculture, mining, fisheries, forestry;
- manufacturing industry: building, construction, bio-technology;

- service industries: insurance, transport, tourism, finance;
- public works and services: coastal management, public facilities;
- the water industry: sewage, irrigation, urban water management;
- Government, policy and law: local, State, federal and international regulations, conventions and laws;
- conservation and environment: governmental departments and community groups;
- education: primary, secondary, tertiary institutions, community groups.

In W.A. a multi-agency Policy Advisory Committee on Greenhouse

Effects is proposed, with the following terms of reference:

- to advise agencies and government on long term policies
- to promote awareness of the issue in agencies and the public
- to promote assessment of the likely impacts
- to coordinate investigations and monitoring
- to formulate general strategies for meeting climate changes
- to liaise with national groups

For the foreseeable future, much human activity will need to be planned on the basis of a changing climate. How well that planning is conducted will largely determine how well society copes with the changes.

# Carry on Camping

**ANDREW CRIBB TAKES YOU ON A TOUR OF  
W.A.'s BEST CAMPING SPOTS, COURTESY OF  
CALM.**



*Friday night. Rush home from work. DON'T PANIC... Do the shopping, pack the bags, drag the tent out of the shed. Got the tent-pegs? Where's the blessed cat? It always knows the time to disappear.*

*Cram the car with gear: Ice for the esky? Kids packed? Five a.m. start tomorrow. Off to the wild free places. Who hid the bait?*

*About 8.30 the following morning you finally get on the road. You can almost*

*smell the sea and hear the soughing of wind in the guy-ropes.*

*The great sun-bronzed Australian outdoors waits to embrace you with open arms. Gradually time begins to slow. Flickering past the windscreen the shadows of tall trees and the pungent, dank scent of the forest understorey tug at the edge of your senses.*

*All you need now is the perfect location to pitch the tent. Caravan Park? Too crowded this year. Beach? Can we*

*camp there? Can't find anything but motels and resorts in the guide from the local tourist bureau.*

*Where was that peppermint grove we saw last year when we were sight-seeing in the national park? Other people were camping there, and the ranger didn't seem to mind. Plenty of shade, only half a kilometre from the beach. Great swimming hole, good fishing too. Looked like there were some fascinating walks nearby.*

Whether your favourite country is north or south the national parks and State forests of W.A. offer you a natural alternative for your camping holiday.

Between June and August, when the weather is mild, the North-West is at its best, and if you're looking south we recommend October to December, and April - May.

But camping spots often seem to be closely guarded secrets, and knowing what to expect when you get there is an art in its own right.

Nearly all national parks, and most areas of State forest in W.A. have camp sites with simple facilities,

easily accessible on gravel roads by ordinary car, but natural is the key word when considering bush camp sites as a place to stay.

### THE RITZ — AU NATURALE

Sophisticated facilities were never intended to be a strong point, but if you're happy to provide your own water, sleep under a canopy of stars, and put up with the company of mother nature, you could be staying at the Ritz.

Individual tent and car bays, screened from nearby sites by vegetation, are usually situated off a one-way access road. This means

no through-traffic, and a sense of space around each tent.

In other areas, open sites for groups of tents are provided.

Pit toilets with brown timber walls, green corrugated roofs, and clear plastic skylights for natural lighting blend discreetly into the landscape, within easy access of each tent bay.

The carefully-tailored car bays not only give you a spot in the shade to park your limo, they also stop people driving over the tent pads and ruining the area's appeal.

A rustic timber table and small neo-CALM fireplace near each tent pad

Getting away from it all at Hoffman Old Mill near Harvey



Mane Lochman

complete the appointments, and as a backdrop the fresh scent of gum-leaves (or peppermint, or . . .) sets off the tastefully-decorated landscape, straight from the hand of the creator to you.

The tariff for this luxury? In national parks, \$4.00 per night for two people in a tent, \$2.00 per night for each extra person.

In State forest camping areas, no fee!

CALM staff service these areas, and will call to make sure you are enjoying the facilities, and allow you to settle your account without inconvenience.

You may also like to explore other areas. This is the time to ask for a brochure, or information on other parts of the national park or forest.

Display shelters near most Park entrances, or camp grounds, contain a wealth of useful information and a map. Brochures on most national parks and forest areas are available from the nearest district office of CALM or from CALM field staff.

Perhaps you are keen on exploring the wild on foot? Boldly going where few people have gone before? Unlocking the secrets of this ancient continent?

Variouly described as back-pack camping, wild camping, or just plain camping, you can do it almost anywhere.

Pack your gortex underwear, and put on your thick socks and ruggedest boots. Roll up your super-lightweight, designed-by-NASA-for-use-on-the-moon hiking tent, which doubles as a canoe and hang-glider, fill a large water-bottle, and off you go.

It is wise to contact the Park ranger or CALM district office before disappearing into the wilderness. Someone then knows where you are, in case of trouble.

There is nothing quite like the magic of camping



Jiri Lochman

Large-scale, full-colour maps (1:50 000) of forest areas are available from CALM for only \$5.00 each. For other areas the Central Map Agency, Department of Land Administration, Cathedral Avenue, Perth (PH: 09 323 1222) is the place to contact.

## BAGGING IT OUT

One of the nicest things about outdoor places in forests and parks is that they usually look as if they haven't been visited lately by Attila the Hun and the barbarian hordes.

In some of the most used places rubbish bins are supplied to help keep the litter invisible. These are usually kept empty, with new bin-bags, by CALM crews who could be doing things more vital for conservation.

So here is your chance to keep camp fees low, and camp sites worth coming back to. Bag it out. Anything you bag in, bag out again. Leaving a place looking as if

you've never been there has a certain satisfaction.

## FOREWARNED IS FOREARMED

Planning a natural camping holiday is almost as easy as picking up the phone. CALM produces brochures which give essential information on most national parks and forests.

Brochures include information on most temperate weather or best season for features such as wildflowers; where and how to contact rangers and CALM staff; good places to camp, see, canoe, fish, bushwalk, hang-glide, take your 4WD etc.

The brochures also provide essential guidelines on the 'Code of the Bush': take care with campfires, take your litter home, no picking wildflowers or shooting.

For the Metro area and nearby, the highly acclaimed *Beating About the Bush* is yours for only \$7.95 direct from CALM. Complete with full-

colour maps, photographs and over 80 scenic natural picnic and camping areas for you to discover and enjoy, this is the book to have in your glove-box.

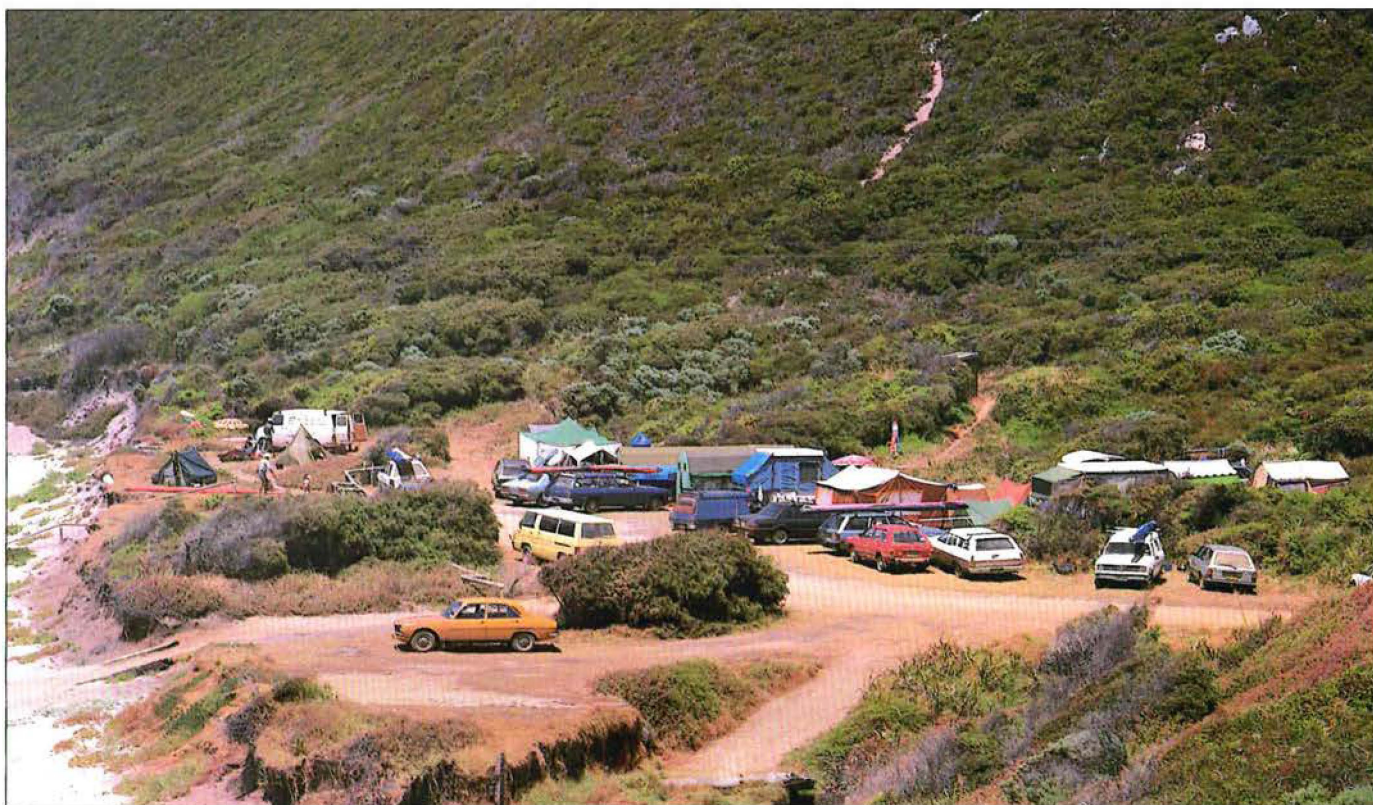
But if you want the wild south, hold on. CALM is producing the definitive camping and touring guide to all the national parks and forest areas from Dwellingup to Eucla.

A key feature of the new guide will be detailed colour maps, and a complete index to more than 300 natural recreation areas in the south of the State.

Articles on each national park and forest give some of the intriguing background to our natural environment, as well as down-to-earth information on facilities, and what to expect.

Superb colour photographs from one of Australia's best new wildlife and landscape photographers help to make this THE guide book you must have. So, keep your eye out for it, mid-1988.

You couldn't get closer to the water than at Shelley Beach, West Cape Howe National Park.



Jiri Lochman

## TOWING THE LINE

*Clare Bramley, freelance writer for the R.A.C. and Sunday Times, gives a few tips for a comfortable and safe caravan holiday.*

It might be a bore to get organised; but it pays guaranteed dividends.

The first thing to do is to make a check list of what you must take, and check each item as you pack it. *Keep the list.*

When you return from your trip, re-check your equipment from the list and replace anything that is missing. Don't leave it until the next trip comes up.

Have a place for everything, and see that it goes back where it belongs. Small spaces need to be well organised.

Don't overload your van. Unless you are going into the wilderness, stores and water can be replenished. Carrying a full tank of water all the way to an established site where water is available is carrying a lot of extra weight for no purpose.

Personal equipment - bedding, food and crockery for a family accounts for between 150 and 200 kg. When loading the caravan the load distribution

ratio should be 60 per cent to the front and 40 per cent to the rear. The tow bar vertical coupling load should be between 10 per cent and 15 per cent of the laden caravan mass.

The caravan loaded and unloaded mass should be displayed on the side of the van. If it is not, the formula is 50 kg per 300 mm approximately.

Remember you are packing a vehicle that will be moving. What will stay in place in a stationary van may not do so when the van is bumping and swaying, plus stopping and starting.

Try to keep the load low in the van, and as much as possible over the axle. Heavy items stowed in high cupboards will tend to make the van unstable, because of the high centre of gravity.

So it is easier to arrange things where you want them when you arrive. To do so before you leave home may result in damage and confusion.

The best place to put gear is on the floor, and, if possible, anchor it. The stretch ocky straps used for surfboards are very useful for this, particularly if you are going over bumpy roads.

A good way to avoid crockery rattling together and getting chipped or broken is to make little individual bags for every second piece. These can be made from old wincy sheets or old towels.

Avoid placing bags, cases or other moveable items on the seats unless they are strapped down.

Don't forget to take a first aid kit, a torch, and some extra clothing to cope with a possible change in weather.

Include among your stores food that does not require refrigeration, such as long-life milk and package fruit juice. These also have the advantage of being in square packs and take up less storage space.

Include a roll of tear-off bin bags to put all your rubbish in, insect repellent, and if you are going where the water is brackish, salt water shampoo and soap. (You should never use soaps or shampoos in rivers or lakes.)

Before you leave, test all appliances.

And, of course, you will make sure to remember the can opener is packed.



Andrew Critch

# The Nostalgic Naturalist

by *Old Timer*

Took a trip down to Albany to see my sister last week. On the way, I thought I'd go and see a mate of mine who grows spuds in Manjimup. In his younger days, he was a timber feller at a place called the Shannon.

'Reckon you should go out and have a look at the joint,' he suggested as we sat on the verandah with our early morning cuppa.

'Get on, it turned up its toes years ago, nothing to be seen but the old golf course.'

'Nah, I'm serious. You should see what they've done with it. Barbeques, camping spots. Besides, you look like you could use some exercise. A quick trip around the walktrail would do you good, ya city slacker.'

'Hah, I spend more time in the bush than you do.'

George knows me. I like to do a bit of exploring off by myself. So I packed some lunch, told him I'd be back at five for tea, and left him to his beloved spuds.

Must say I was surprised. They certainly had spruced the place up. Walktrails, shelters, even a quokka lookout, for heaven's sake. Though I must say anyone who spots a quokka in broad daylight round here is a better man than me.

The rocks walktrail was great. I sat up on the top rock awhile, thinking. Some places in the bush just seem really powerful. On the way out, I went and had a quick squiz at the notice boards. Mokare's Rock was the name of the place I'd been sitting.

There's nothing like small, freshly dug potatoes, and George and I had a fine feed of them that evening then retired to the verandah with our cuppas.

'Hate to say it, mate, but you were right about the Shannon.'

George just grinned.

'Who was Mokare, by the way?'

'Mokare?'

'Yeah, the big rock, it's called Mokare's Rock.'

He shrugged. 'Damned if I know.'

I set off early next morning, with a sack of spuds in the back of my ute. When I arrived I had a bit of time to kill before my sister got home from work, so I headed for the library.

'Gudday, I'm chasing a bit information about somebody called Mokare. Think he might have been one of

those early French explorers. There's a rock named after him up Shannon way.'

'I haven't heard of him, but your best bet would be to contact the Albany Historical Society. They would be sure to have some information.'

She was right. They did. Sure looked at me a bit strange when I asked if they had the gen on the early French explorer, Mokare.

Turns out he was an Aborigine. Boy did I feel like three kinds of a fool. They gave me some sheets of information which I took back to my sister's place and read.

'Bet you don't know who's buried under the Albany Town Hall', I challenged my sister that evening, still feeling a bit miffed by my own ignorance.

She fixed me with her long-suffering Oh-lord-here-he-goes-again look and said 'Who? The cat's mother?'

'Mokare, that's who.'

'Who's he when he's at home?'

'Esteemed colleague of one Dr Alexander Collie, surgeon to the colonies.' I said with a plum in my mouth.



My sister raised one eyebrow, a trick I could never master.

'Mokare was from one of the local tribes, he acted as Collie's interpreter, and they ended up good mates. So good, in fact, that Collie asked to be

buried next to Mokare, at a place that later became the site for the town hall. Four years later John Septimus Roe dug Collie up and moved him to the Albany cemetery. He, of course, has a monument to his contributions to the colony. Mokare, it seems, moulders unremembered.'

'Funny the things you find out about your town, after you've been here for years,' my sister mused. 'Seems a pity, really. So much history unknown.'

'Yeah, it's a good thing I took that walk up the Shannon, or neither of us would have known, eh?'

The astronomical clock above London Court, one of the sites of historical interest on the Perth Heritage Trail, which traces Perth's development from settlement in 1829 (right)

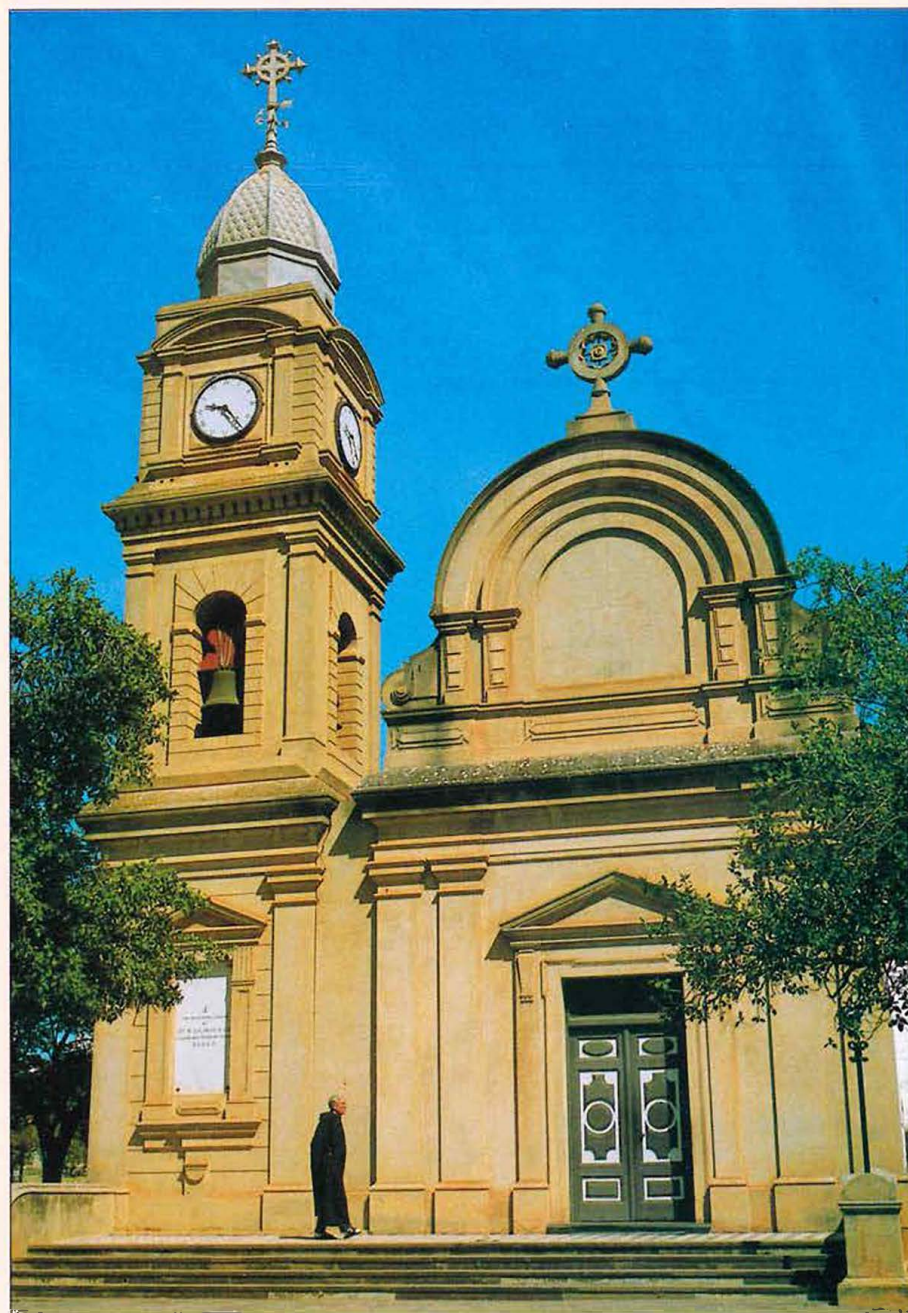
A Benedictine monk outside the Latin-style Abbey Church at New Norcia, where W.A.'s first Heritage Trail was opened in March 1986. (below)

Marie Lochman



## WALKING THROUGH THE PAST

by Avril S. O'Brien



Wade Hughes

*Do something different - explore a Heritage Trail. Stroll through the historic town of Guildford, swim underwater around the wrecks near Rottnest Island, back-pack on the Bibbulmun track, or take a few days to drive through the midwest and study the architecture of Monsignor Hawes at places like Perenjori, Mullewa and Geraldton. The choice is endless. The W.A. Heritage Committee, with a \$1 million bicentennial grant, is coordinating the development of 102 Heritage Trails in various parts of W.A. These trails explore both the natural environment and the impact our forebears had on the landscape.*



Brian O'Brien

W.A. is a land lightly trod. For many thousands of years our heritage was largely natural, because the Aboriginal custodians lived in harmony with nature. The only major modification they made to the environment was through controlled burns, a hunting technique as well as a form of insurance against wildfire.

By contrast, in Europe very little of the natural environment remains - landscapes have been made, altered or completely built over as people reshaped the original environment to meet the needs that arose out of the culture they created.

St Francis Xavier Cathedral at Geraldton, one of the highlights of the Monsignor Hawes Heritage Trail (left).

The Star Swamp Heritage Trail will provide access for wheelchair users to this metropolitan wetlands reserve (below).



Brian O'Brien

Europeans started to impose a basically European culture on the land in W.A. in 1829. In the following decades many of these attempts disappeared. Sometimes because they were foolishly located in an inhospitable environment or, out of necessity, poorly built with unsuitable material; other times because they were intended to be ephemeral.

The major part of our heritage is still vast areas of natural environment. Our European cultural heritage may have few grand artefacts, but it still has much to teach us about the aspirations and beliefs of some of the people who lived here before us.

The Heritage Trails provide great physical recreation (at varying levels of difficulty), as well as intellectual recreation, of various types. Each trail is clearly signposted. You may be motivated to delve more deeply into the history, geology or botany of an area. If so, booklets providing historical and environmental information for each trail can be purchased from local tourist outlets, Holiday W.A. and Shire and CALM Offices. They are not essential, but they will add to the richness of your experience.

The Heritage Trails Network is a uniquely West Australian contribution to the bicentenary, and a lasting community venture.

For the opening of the 'Keeping Track' project Northam Primary School students dressed in period costume and visited the town's historical buildings including Byfield House built in 1898 (above right).

Divers around the plaque marking the site of the *Macedon* which sunk off Rottnest in 1883 and is now part of the Rottnest Wreck Tour, now incorporated in the Heritage Trails network (right).

## Heritage Trails

**Metropolitan:** including Perth, Subiaco, Fremantle, Bilgoman Well, Katta-Moorda and Mundaring Railway Reserve Heritage Trails.

**South West:** including Geegelup, Margaret River, Cape to Cape and Nannup Heritage Trails (a trail guide and sign posts are also in place for the long established Bibbulmun Track)

**Midlands:** including York to Goldfields, Quairading and Koorda Pioneer Heritage Trails

**Central South:** including Albert Facey, Dumbleyung Historic Schools and Roe Heritage Trails

**Great Southern:** including First Settlement, Mt Barker and Katanning-Piessie Heritage Trails

**Goldfields:** including Historic Gwalia and Eastern Goldfields Heritage Trails

**Midwest:** Monsignor Hawes, De Grey-Mullewa Stock Route and Perenjori-Rothsay Heritage Trails

**Gascoyne:** Shark Bay Heritage Trail

**Pilbara:** Emma Withnell, Chichester Range Camel Trail and Karratha Heritage Trail

**Kimberley:** Pigeon Heritage Trail



Lorna Saunders



John & Val Butler

## Eagles' Heritage Park

At the recently opened Eagle's Heritage Park, the first raptor-oriented wildlife park in Australia, Churchill Fellowship scholar Phil Pain offers visitors a closer look at these fascinating birds, so they can discover their immense importance in maintaining a healthy and balanced environment.

Australia has 24 species of raptors and 8 species of owls. The hawks, eagles, falcons and kites, and the osprey, are diurnal, and all have strong hooked bills and curved grasping talons designed to take live prey. Together with the owl family, the raptors' nocturnal equivalent, they live throughout Australia, in cities as well as the outback.

The park features the Hawk Walk, a pleasant stroll among specially designed aviaries, terrific for close encounters. Phil offers discussions and



Phil Pain shows Park visitors how to handle this Black Kite

Jiri Lochman

demonstration, based on his years of experience with major zoos, and extensive liaison with other raptor institutions throughout the world.

An important function of the park is to cooperate with the Society for the Preservation of Raptors in rehabilitating sick and orphaned birds. This requires specialised knowledge in techni-

ques of training the birds to hunt and fend for themselves, and is referred to by aficionados as 'hacking back to the wild'.

The park is open 365 days a year, and is set in beautiful native bushland on Boodjidup Rd., just off Walcliffe Rd., Margaret River. Light refreshments are available.



Terry Barnes

## The One That Didn't Get Away

Anglers often boast about the size of their catch, but rarely catch anything as big as themselves for a single meal.

In the wild, dramas of life and death are acted out swiftly, quietly and preferably without witness, that is why they are seldom captured on film.

This picture taken on the dry bed of a Fortescue River tributary in the Pilbara, depicts the struggle for life of a skink *Ctenotus grandis titan* under attack from a Burton's legless lizard *Lialis burtonis*, and demonstrates the keen observancy of naturalist Terry Barnes.

## Oops!

In a recent article I mentioned a conversation with a ranger in Serpentine National Park. This was a mistake on my part. The park in question was in fact miles from Serpentine. Sorry to Ranger Pete Jeffs for any inconvenience this may have caused him.

### Old Timer

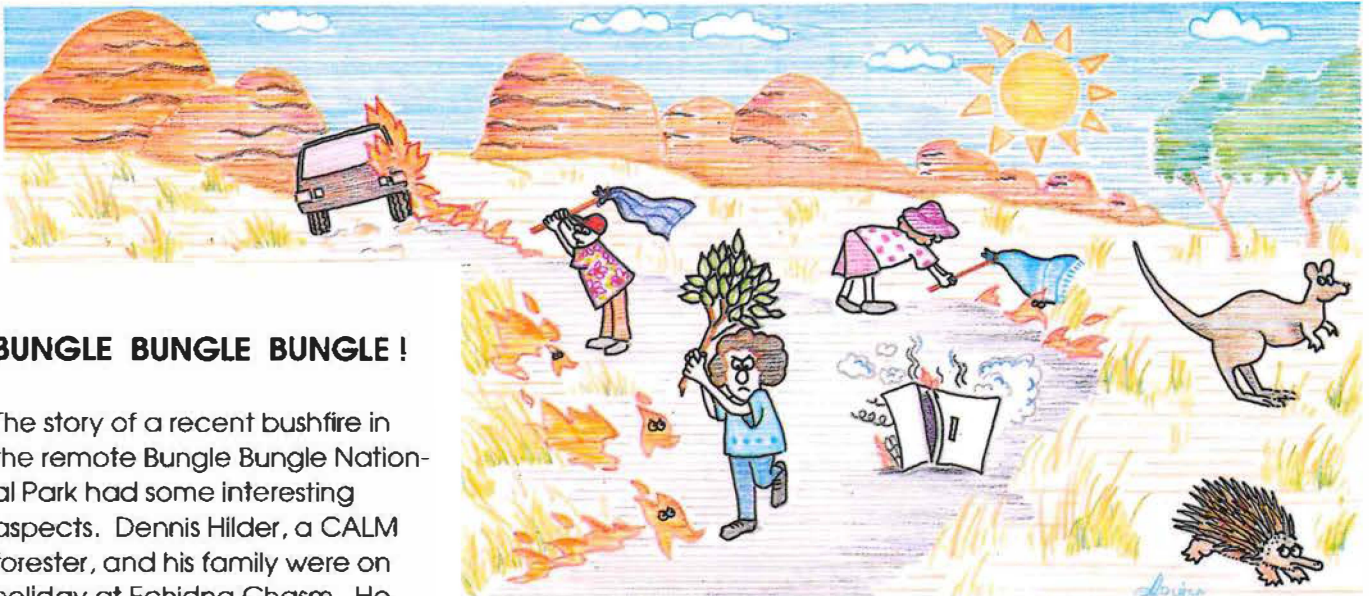
Autumn 1987

The photograph on page 5 of *Ipomea* is *I. costata*, and that of *Banksia* is *B. ashbyi*.

Summer 1987

The photograph is of Lemann's banksia (*Banksia lemmaniana*), not nodding banksia (*Banksia nutans*) as stated.

Thanks to readers for keeping us on our toes.



## BUNGLE BUNGLE BUNGLE !

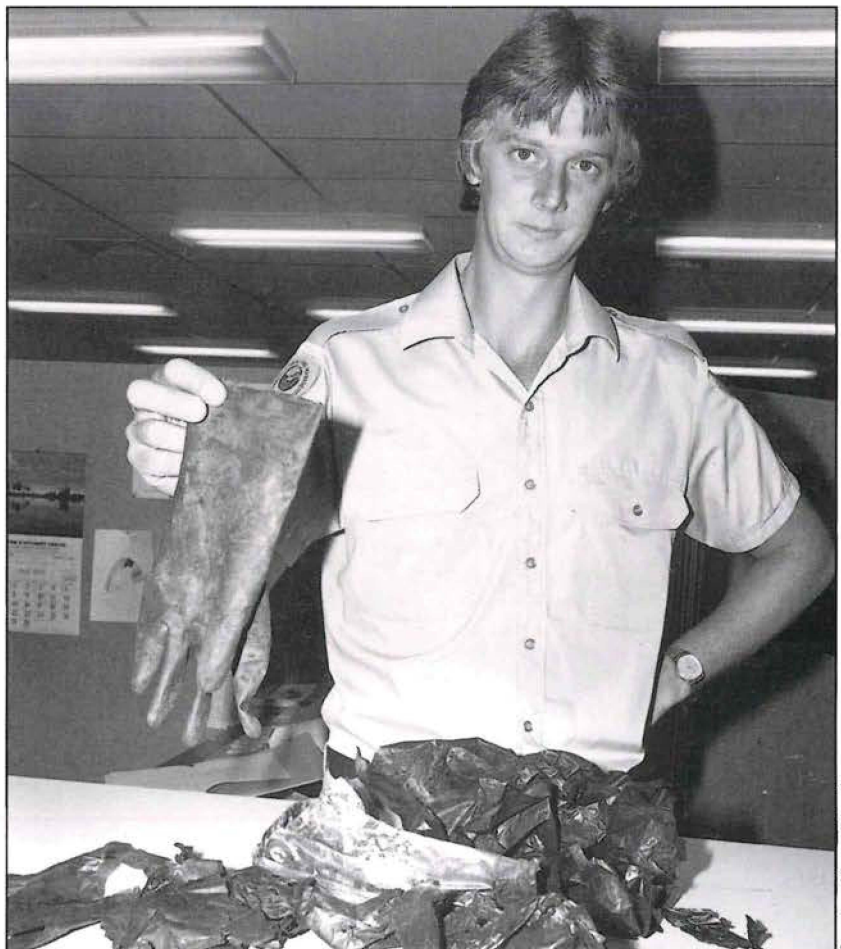
The story of a recent bushfire in the remote Bungle Bungle National Park had some interesting aspects. Dennis Hilder, a CALM forester, and his family were on holiday at Echidna Chasm. He happened to be on the spot, had an HF radio, and submitted a professional fire report via a miniing company headquarters in Darwin. They relayed the message to Chris Done, manager of CALM's Kimberley Region.

Chris radioed ranger Trevor Anderson who was on patrol in the Bungles. Trevor recognised the map references as being that of a popular camping spot, and headed off expecting the worst. On arrival he found a well-organised gang of tourists controlling the blaze. Under the direction of Dennis, an experienced fire-fighter, their enthusiastic efforts paid off. By the time Trevor arrived, Dennis and his crew had the situation well in hand.

And what had been the cause of the fire? An unfortunate tourist had lit the gas fridge in his 4WD station wagon and then gone for a walk. In his absence, the fridge exploded, not only igniting the vehicle but starting its diesel engine. Still in gear, the flaming machine chugged off through the tall, dry Kimberley spinifex, setting it alight as it went.

## Sadwrap Update

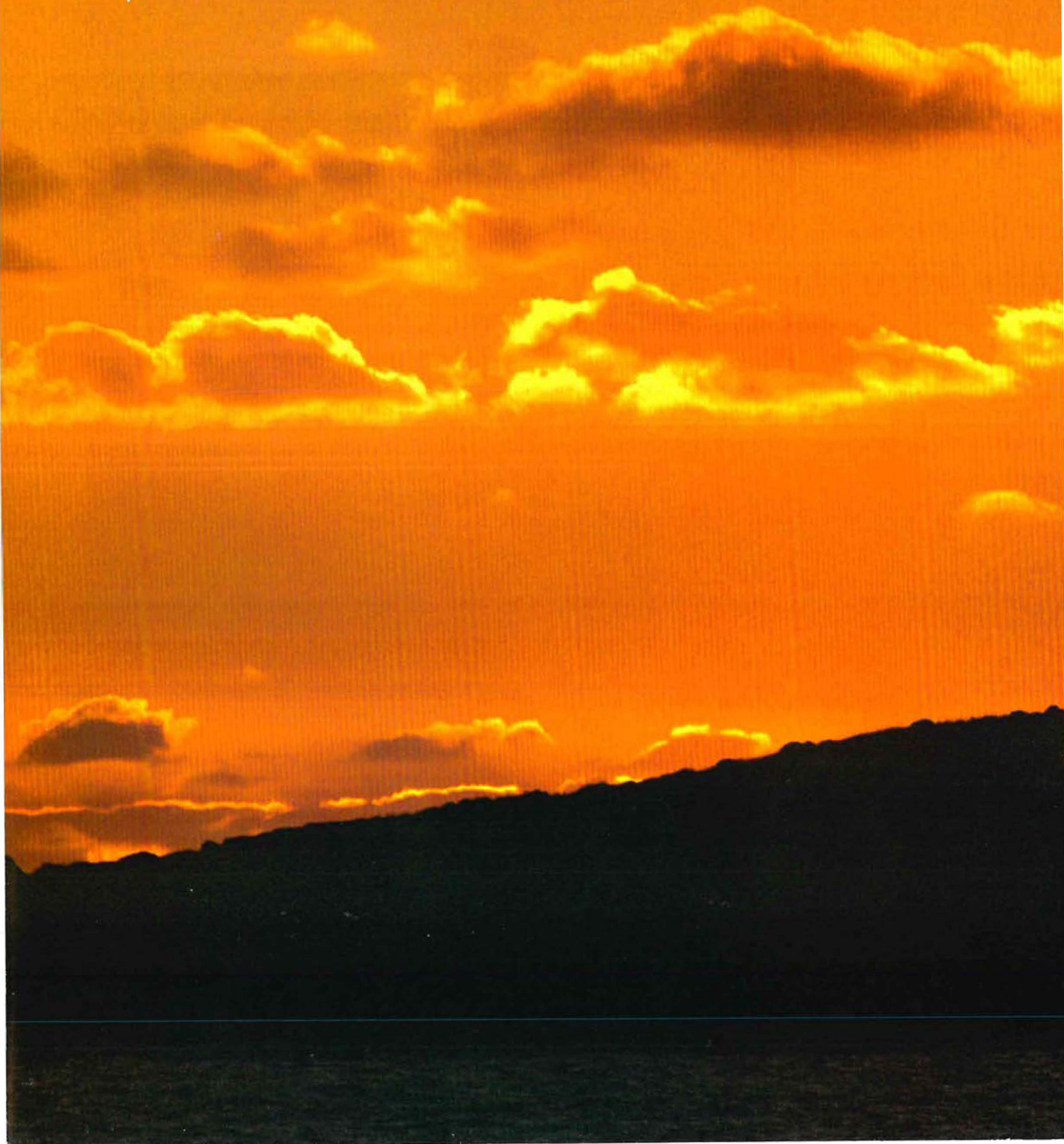
Plastics continue to take their toll on our wildlife. This photograph shows the stomach contents of a dolphin found near Albany.



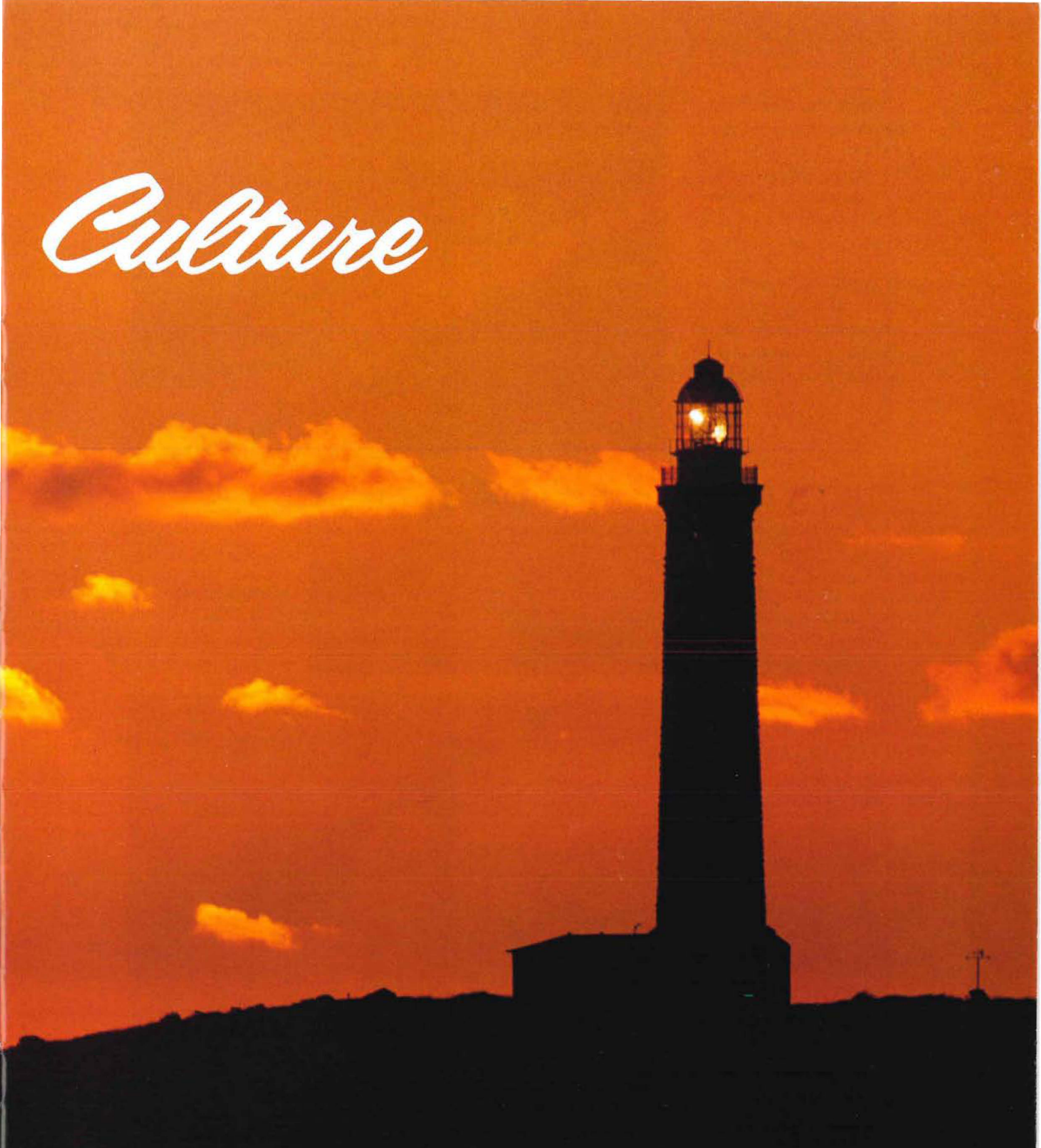
Courtesy Albany Advertiser

# *Caves, Waves and*

*by Andrew Cribb*



# *Culture*



*Caught between the vineyards and the deep blue sea, on W.A.'s south-west coast, the Leeuwin-Naturaliste National Park runs for nearly 100 wild coastal kilometres*

**L**ESS than three hours' drive from W.A.'s major population centres of Perth and Bunbury, the Park's 15 500 ha form an intermittent western border to the thriving shires of Busselton and Augusta-Margaret River.

New hotels, a growing wine industry, and sky-rocketing property values in the region all show the increasing popularity of the area as a destination for holiday-makers and tourists.

In the face of this development the race is on to lay down a management framework for the National Park before people-pressure irreparably damages its more fragile natural features. Last year it was estimated more than 300 000 people visited the Park, ten years ago the figure was less than half that.

Leeuwin-Naturaliste National Park is an integral part of the attractions of this region. From Bunker Bay to Cape Leeuwin spectacular coastal cliffs, jarrah bush, grey coastal scrub, startling pockets of tall karri forest, and the extraordinary cave



Cliff Winfield



Wade Hughes

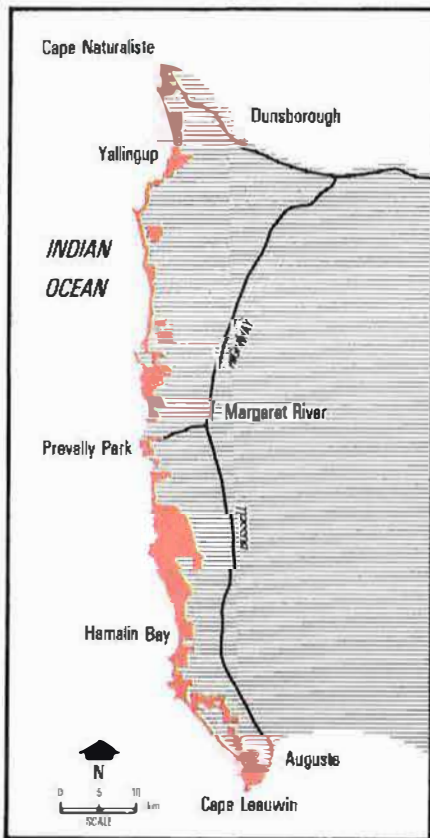
Cosy Corner (Above).

The region is also famous for its fine vineyards (Left).

Meekadarabee: the Moon's bathing place (Below).



Marie Lochman



formations of the Leeuwin-Naturaliste Ridge provide an attractive setting for a huge range of outdoor activities.

The coastline on the western border of the National Park has some of the best surfing in the world. Fishing is an almost universal pastime and a major industry.

Secluded car-based camping areas within the Park, and the Boranup karri forest next door, give adventurous visitors a more natural, but more basic, alternative to the Shire and private caravan parks in and around the towns.

Bushwalking is becoming more and more popular as new trails are opened and the charm of the hidden gullies, springs, forested slopes and the rolling views from the Ridge become better known. Apart from mid-summer the climate is mild enough to walk in comfort, without the need to cope with extreme temperatures or constant rain.

But with the growing enjoyment of the Park, come many of the problems with which land managers must deal.

Leeuwin-Naturaliste has the dubious distinction of being W.A.'s longest, thinnest, and most fragmented national park. Twenty-eight separate reserves, gazetted piecemeal since 1902, make up the Park. There are 242 km of landward boundaries over its 100 km length.

In some places the reserves extend up to five kilometres inland, in other places the 'Park' consists of a narrow coastal band, less than 100 m wide, between the high water mark and adjoining private property.

Enclaves of private property exist within Park boundaries, and similarly enclaves of Park are sometimes surrounded by farmland. This lack of continuity makes management difficult, and affects the Park's viability as a conservation area.

## What The People Think

A visitor survey, conducted by CALM between January and March, 1986, revealed some interesting facts about who uses the Park, and how they feel about the area.

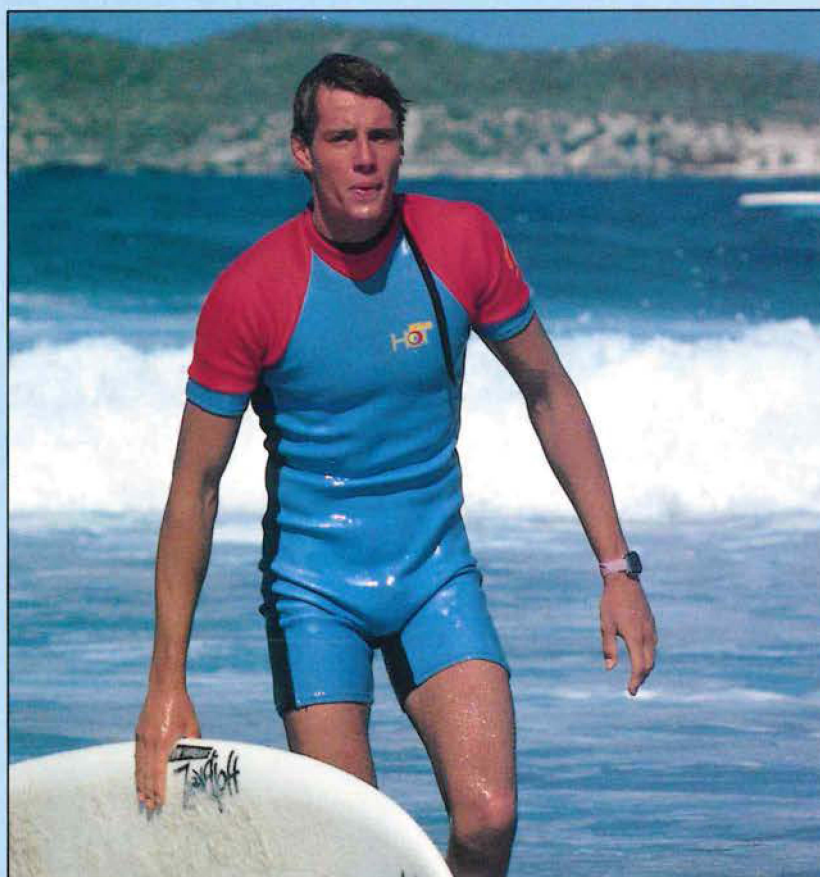
Over 75 per cent of the Park users who responded to the survey came from Perth. Fifty per cent of these were aged between 15 and 25, which is a radical contrast with most other national parks in the State, where the average age of visitors tends to be upwards of 40.

The natural scenery, peace and quiet, isolation and lack of development rated amongst the Park's most important drawcards, perhaps running contrary to assumptions underlying many proposed tourist developments in the region. Forty-three per

cent of the responses cited the environment and its features as their major reason for visiting the area.

Of the visitors to the Park surveyed 64.5 per cent either camped (54%), or stayed in a caravan (10.5%), and during peak periods such as Easter and the Australia Day long weekend this rose to 61 per cent.

Fifty-four per cent of the Park visitors used the Park as access to water-based activities, 20 per cent stated picnicking, sightseeing, and other passive activities as their main interest in the area, and 11 per cent of the responses fell into the 'trail-based' category which includes bushwalking, off-road vehicle driving, horse riding, and trail biking.



Jiri Lochman

Leeuwin-Naturalist - a true surfer's paradise



Marie Lochman

The Carpet Python (*Morella spilota imbricata*) (Left).

Welcome Swallow (Below).



Jiri Lochman

## Wildlife Of The Ridge

The great range of localised environments and vegetation in the Park makes the area particularly valuable as a conservation reserve.

Tall karri forest grows on limestone soils formed from the Ridge, and jarrah and marri forest replace the karri in areas where soils are derived from granite.

On the western slopes peppermint forms a dense scrub with parrot-bush and boronia species, heathlands cover many of the dune areas, and

permanent swamps, often fed by springs, support paperbarks. With the range of plant communities comes a diversity of habitats.

Over 200 species of birds have been recorded in the Park, including such rarities as the Rufous Bristle Bird, Red-tailed Tropic bird, and the increasingly scarce Red-eared Firetail Finch.

Most mammals native to the South-West have been found in the Park, but because many of the reserves that collectively make up the National Park are so small, numbers are low.

Historically, the Park has been viewed by visitors more as an impediment to getting to the attractions of the coast, rather than as a valuable area in its own right. As a result random access roads criss-cross the reserves from east to west.

Today over 40 major tracks and roads give access to the coast via the Park: approximately one every 2.5 km.

The number of access routes into the Park, and better transport, are opening up areas not previously accessible. Ironically, as the number of visitors has increased, so the standard of many tracks has deteriorated from rough 2WD status to boggy sand and limestone outcrops negotiable only by 4WD.

The fragility of the coastal dune systems, and the slowness with which the vegetation regenerates in coastal areas, can easily be seen in many well-used areas.

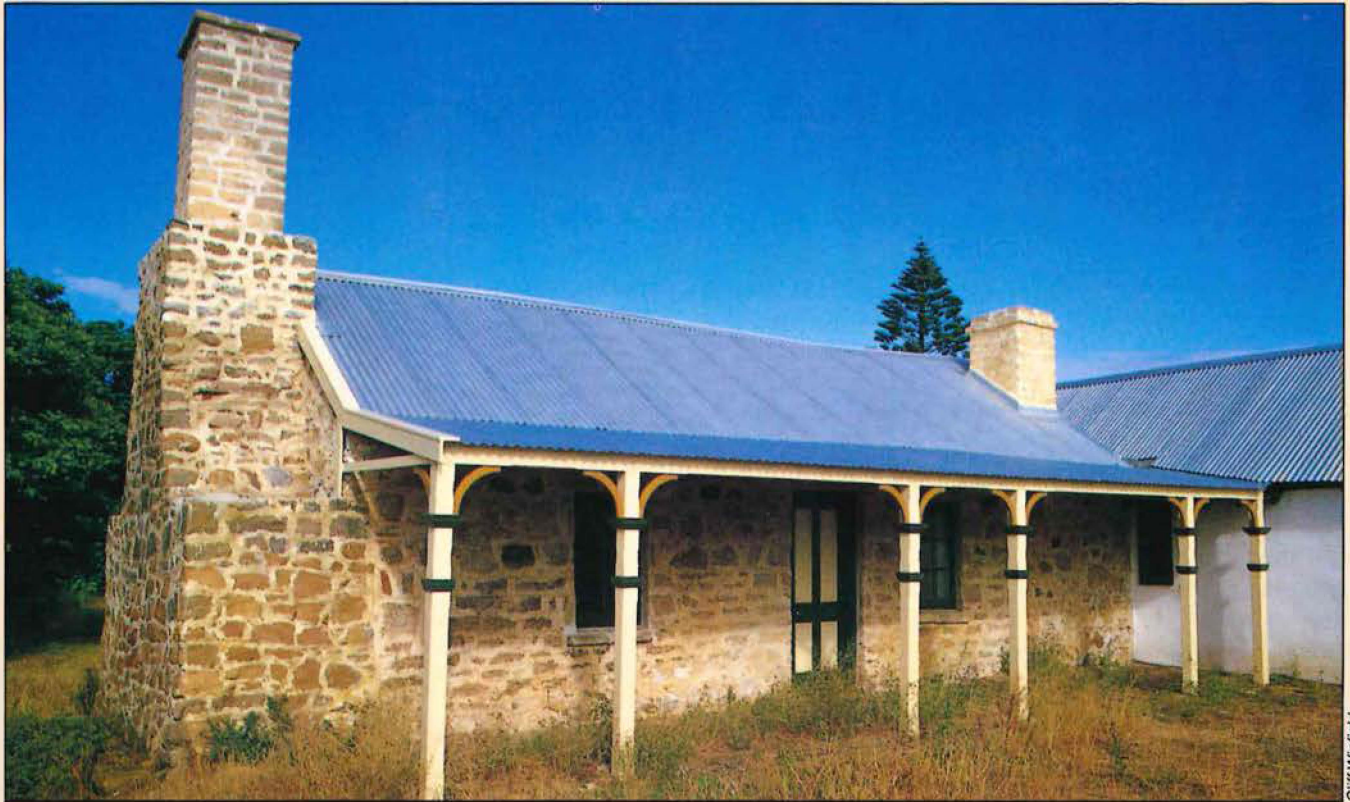
Dune blow-outs, where the encroaching sand has swamped the surrounding bush, are common in places where grazing has occurred, or where tracks have been carelessly pushed through.

After a public workshop for people interested in the Park, and consultation with Shire and other Government organisations, a draft management plan for the National Park was prepared by CALM and released for public comment in November 1987.

The public submission period is now drawing to a close and the decisions which will determine the Park's future are about to be finalized.

Paul Frewer, co-ordinator of the working group which formulated the draft plan, described its key features:

*The plan hinges on defining areas of land as management units. There are four broad categories we have used.*



Cliff Winfield

Ellenbrook (Above).

## The Moon's Bathing Place

One of the many features that give Leeuwin-Naturaliste its value is the wealth of historic, and pre-historic sites in the National Park.

Some of Australia's oldest Aboriginal sites, dating back 37 000 years have been located in the Park and the Boranup forest nearby.

Elsewhere in the Park artefacts, burial sites, and paintings have been found. No systematic survey has ever covered the area, and there are undoubtedly many sites yet undiscovered.

In Mammoth Cave, and others, fossil deposits have been found which contain the remnants of animals now extinct in W.A. including thylacines, koalas, Tasmanian devils and pottoroos. This coast also includes some of the first areas settled by Europeans in W.A.

Ellenbrook farm, recently restored by the National Trust, was built by Alfred Bussell in the 1850s.

Ellen Heppingstone was just 16 when she married Alfred, and they set off from Busselton on their honeymoon through the trackless scrub of the Leeuwin-Naturaliste peninsula.

Alfred led her to the site he had chosen for their homestead, at the mouth of a small stream about 25 km south of Cape Naturaliste.

There, against the shady backdrop of tall peppermints he showed her a small grotto where sparkling water cascaded over mossy limestone to form a tiny waterfall.

'The natives call this Meekadaribee, the Moon's bathing place' he told her.

Alfred Bussell named Ellen's Brook in honour of his young love, and built the farmstead where they lived until 1865, when they moved to Wallcliffe House at the mouth of the Margaret River.

Nearby are the graves of two of their children who died as infants, a convict helper, and Alfred's brother Charles Bussell. Ellen died at Wallcliffe at the age of 42, and was buried by Alfred at Ellenbrook. The family later moved her grave to Busselton to lie beside that of her husband.

At the southern end of the Park, Boranup forest, Hamelin Bay, and the waterwheel at Cape Leeuwin all serve as reminders of the timber Empire of Maurice Coleman-Davies, who set up W.A.'s first karri export trade in the 1880's.

*Natural Areas, which are core areas of the Park, will be protected against disturbance. Managed Natural Areas, which usually form the periphery of the Park, will include fire protection buffers and may be used for limited resource extraction. Recreation areas, managed for visitor use, and lastly Special Areas, which will incorporate sites of special environmental or cultural significance.*

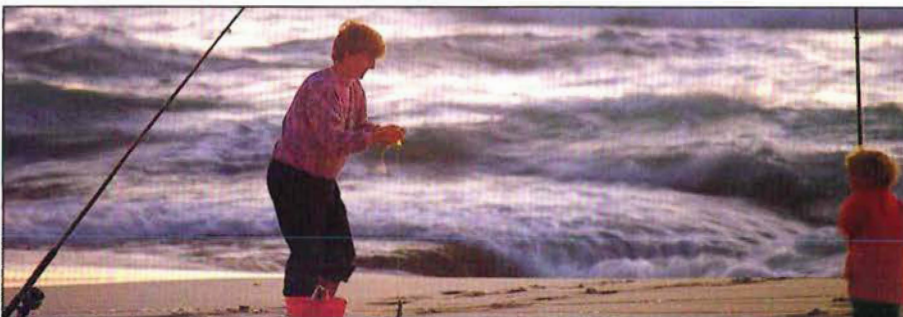
*Good examples of Special Areas may be the old Bussell homestead at Ellenbrook, rare snail habitats at Meekadarabee Falls and elsewhere, and caves which contain very fragile or unusual features.*

*The plan also looks at rationalizing vehicle access, while retaining the Park's scenic attraction, and making foot access easier and more appealing.*

Where roads cross eroded areas, form unsightly scars on the landscape, or put people at risk they will be re-aligned and upgraded to cope with heavier traffic. In other areas, where the road can handle the traffic without deteriorating, 4WD status will be retained to provide the variety of recreation opportunities essential for such a diverse group of Park users.

In places that have suffered from wildfire frequently the vegetation is slow to recover, often taking ten years or more to re-stabilize the underlying sand.

Fire plans for the Park, while still based on the protection of life and property, are being formulated on the fragility, and susceptibility to wildfire of various areas.



Andrew Cribb

## Living Fossils

The rare snail *Austroasiminea lethia* is of great scientific interest. About half the size of a drawing-pin head, the snail is thought to be a relict Gondwanaland species.

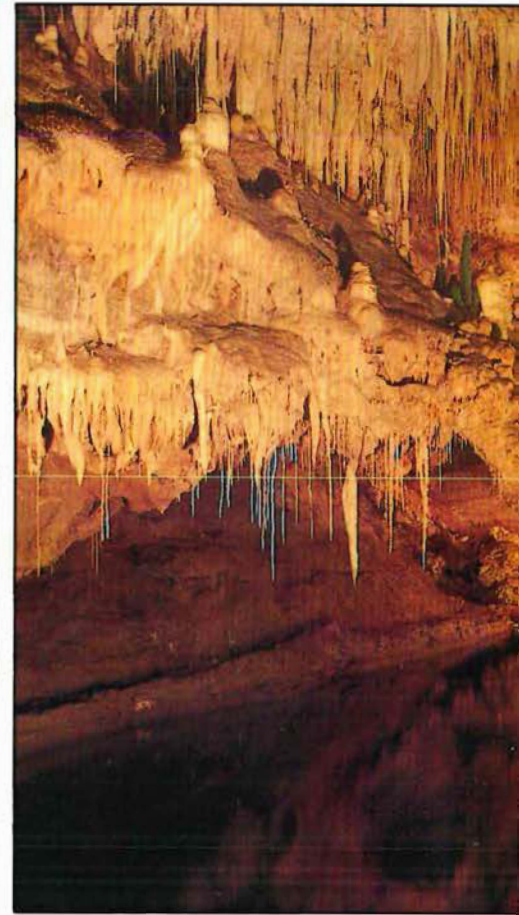
The snail lives only in seepages and moist areas near alkaline freshwater streams which, at some stage, have percolated through the limestone of the Ridge.

Five small colonies, occupying only a few square metres each, have been found in or near the Park. Elsewhere the snail has only been found in fossils dating back some 60 million years.

Very few studies have been done on the native fauna of the Park, and this snail is probably only one of many endemic species yet undiscovered.

The type of work already completed in the Park, such as the re-designing and stabilizing of compacted and eroded areas at Bunker's Bay, will be continued at other areas under pressure, such as Injidup.

The management plan, when finalized will provide guidelines to guarantee the Park's future, both as a recreation area, and as a significant conservation reserve.



## The Crystal World

The limestone that forms the caprock of the Leeuwin-Naturaliste Ridge has given birth to some of the National Park's most intriguing natural features: caves.

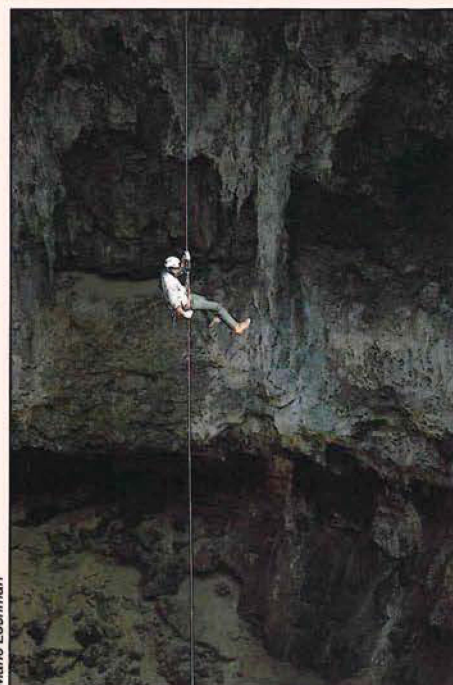
Over 360 caves have been found in the ridge, ranging from narrow tunnels and potholes to enormous caverns such as Easter Cave which runs for over 14 km.

The cave formations of the Ridge are remarkable because they are, comparatively, so young. The limestone in which they occur has been forming for a mere 10 000 years, by contrast with ages from 14 to 350 million years for famous caves elsewhere in the world.

Formed by percolating underground water, and a complex



Lake Cave, near Margaret River (Above)



Marie Lochman

Abselling into Bride's Cave (Above)

process of collapse, erosion by underground streams, and deposition, the Ridge caves are also unusual for their speed of development.

The more ancient, more massive, and consequently more durable pillar and column formations of American and European caves are often absent, but in their place sprout miniature forests of pencil-thin speleothems, as delicate and exquisitely crafted as Limoges china.

Gravity defying twisted helictites, fragile blossoms of dog tooth crystals, pendulites and a vast array of other cave formations adorn the walls, floors and ceilings of even some of the smallest caves.

The formations are all too easily destroyed by a careless step,

and of all the Park's natural features, they are one which once damaged can never be rehabilitated.

As a consequence, the best that most visitors can hope to see are photographs from the skilled and privileged few permitted to enter some of these 'wild' caves.

Most of the wild caves are locked up, and a permit is necessary to enter them. Under the management plan a Cave Management Committee will formally advise CALM on decisions affecting the caves.

The four tourist caves of the area: Jewel, Lake, Mammoth and Yallingup, have long been popular with visitors, and regular guided tours run by the local tourist bureau give the opportunity for people not well-versed in caving

to catch a glimpse of the crystal world underground in comfort and safety.

To allow keen adventurers the chance to explore a wild cave, without putting the rarer and more delicate formations at risk, three 'adventure' caves have been opened by CALM.

Bride's Cave, Giant's Cave, and Calgardup Cave are not advertised, and unless you discover them by accident, or contact Cowaramup Cave Ranger Rob Klok, you may never know of their existence.

In these three caves, there are no guides, only the odd handrail, and real subterranean dark.

Each cave has its own degree of difficulty and excitement. All demand the use of proper caving equipment, and in some cases abseiling gear.

Outdoor groups and others who would like to visit the adventure caves need to arrange their trip through the Cowaramup ranger or the Busselton District Office of CALM.

# TREATED IS IT

by Graeme Siemon

In recent years pine timber, with an aesthetic green colouring, has made a great impact on the outdoor furniture/playground equipment market. This pine has been treated with copper-chrome-arsenic preservative (C.C.A.), which gives it that characteristic colour. Although widely used in Australia for the last thirty years, its increasing popularity on the domestic market causes many people to wonder: is it necessary, and is it safe?

Why is it necessary to treat timber? Our resources of naturally durable timber species have declined, and less durable species can only be used if they are protected against fungal and termite attack. Such treatment extends the service life of treated timber considerably, especially when the timber is used in contact with the ground.

C.C.A. is a 'water-borne' preservative, in which the components of copper, chromium and arsenic are carried into the timber in solution. Copper is a fungicide, arsenic an insecticide, and the chromium 'fixes' these two elements in the wood. The treatment is done in a steel cylinder. An initial vacuum is drawn, the cylinder is flooded with preservative, and pressure at about

1400 kPa (200 p.s.i.) is applied. A final vacuum removes any excess preservative. The chemicals take about three weeks to 'fix' in the timber, after which they cannot be leached. The word arsenic strikes dread into the heart of most people, but traces of arsenic occur naturally in many of our foods, for example, seafoods. Any traces of arsenic on the surfaces of C.C.A. treated timber would be negligible.

A white powder, or perhaps crystals, may be seen on the surface of C.C.A. treated timber during the weeks after treatment. This effect is called 'blooming'. The powder is sodium sulphate, which is not harmful. Most suppliers would keep stocks of C.C.A.-treated tim-

ber in their yards for six weeks after treatment, after which there should be no further blooming. The powder can be removed easily using a bucket of water and a damp cloth. A new formulation of C.C.A. preservative now available avoids this 'problem' completely.

Because the chemicals are fixed in the wood, C.S.I.R.O. scientists have now estimated that a person would have to ingest between 10 and 20 cubic centimetres (roughly the size of a matchbox) in one day to achieve a toxic dose. A fatal dose would need 10 times more.

People are right to be concerned about the safety of any chemical. Australian Standards specify the re-

# TIMBER — SAFE?

quirements for treatment plants in using timber preservatives. These include wearing gloves and washing hands before eating or smoking.

Anybody using C.C.A. treated timber must take particular care in two cases. When sanding wood, wear protective masks and clothing, and keep your work area well-ventilated. This applies to the sanding of any timber, treated or untreated, because particles can affect the lungs. Avoid burning offcuts of C.C.A. treated timber, because it releases arsenic into the air. Under no circumstances should the wood be used in stoves or barbecues. If burning in the open air is unavoidable, dispose of the ash at a proper disposal site.

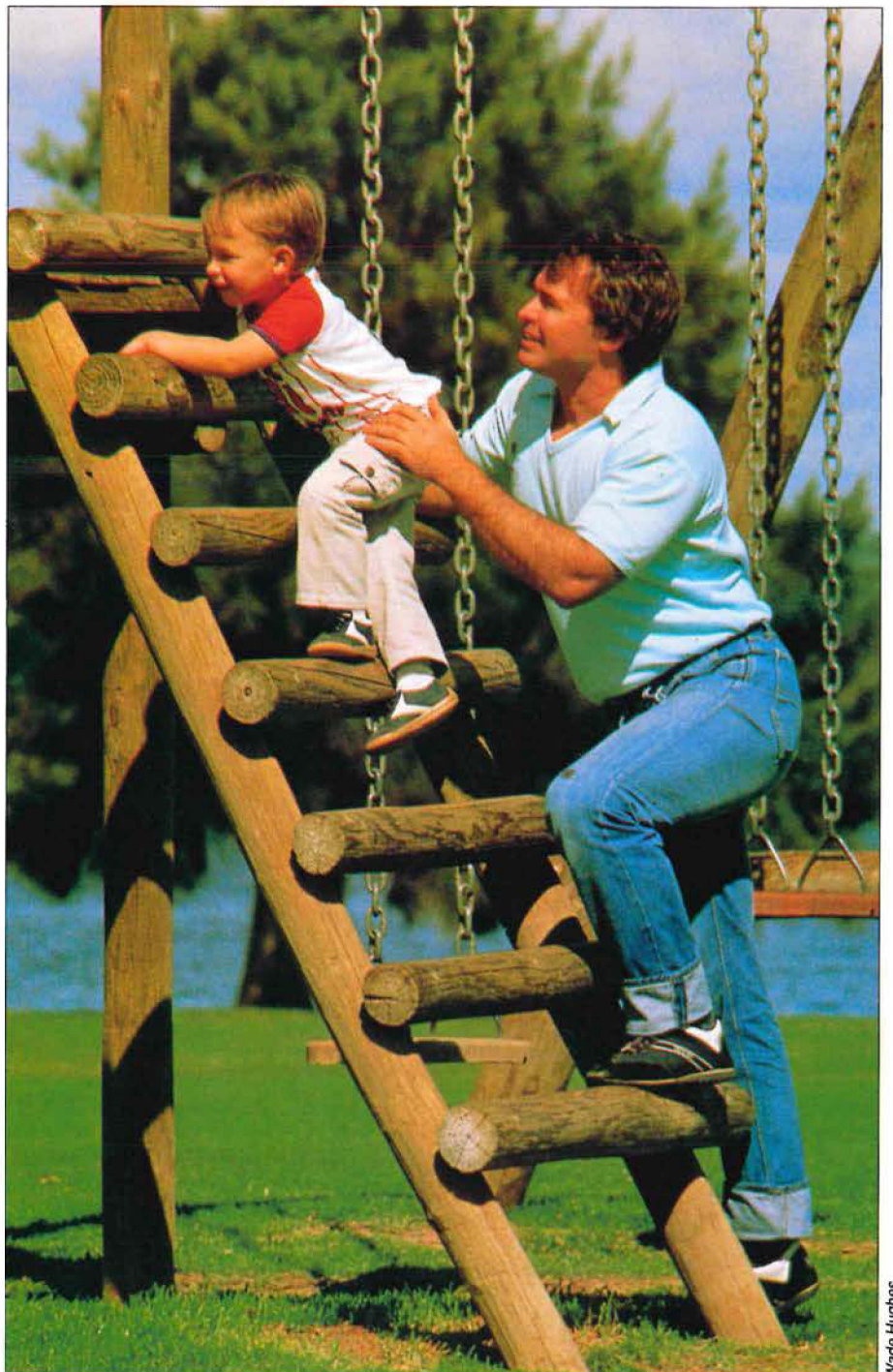
In general, C.C.A. treated timber will provide good service. Because the chemicals are fixed in the timber, it is safe when treated correctly.

## The Test of Time

**Untreated Pine** - CSIRO durability class 4 - less than eight years life in the ground, but more likely two to three years.

**Jarrah** - CSIRO durability class 2 - 15-20 years in the ground.

**Treated Pine** - 40-50 years in the ground, substantially more above the ground.



Wade Hughes

# ENDANGERED!

## The Western Swamp Tortoise

by Dr. Andrew Burbidge

The Western Swamp Tortoise, *Pseudemydura umbrina*, often called the Short-necked Tortoise, is W.A.'s most endangered vertebrate. Fewer than 50 animals are known to exist.

The tortoises live in freshwater swamps that contain water only during winter and spring. When the swamps contain water the tortoises swim around feeding on small aquatic invertebrates. When the swamps dry they aestivate (go into torpor) in holes in the ground or under leaf litter. The females lay three to five hard-shelled eggs in a hole dug in the ground during late November or early December, and the eggs hatch the following May or June.

reproductive potential is low. Most Australian tortoises lay two clutches per year, each of eight to thirty eggs.

Unlike most species, which live in permanent water, it inhabits only temporary clay swamps, a very restricted habitat. It seems that the total geographic range of the Western Swamp Tortoise at the time of European settlement was very small, being centred in the Swan Valley and extending from near Pearce to Perth airport. Most of this area was developed for agriculture many decades ago. Now the tortoise is known to occur only in two small nature reserves, Ellen Brook Nature Reserve at

enough to withstand the drying out that occurs each summer. The slow growth rates mean that it takes from 10 to 20 years for them to reach sexual maturity, a very long time for such a small animal.

The final straw for the Western Swamp Tortoise was the arrival in W.A. of the European Red Fox. Foxes take a heavy toll of tortoises that aestivate under leaf litter, and also dig up and eat the eggs.

The combination of marginal habitat, a series of dry winters and predation by foxes has led to the virtual extinction of the population at Twin Swamps Nature Reserve, where aestivation takes place mostly in leaf litter. At Ellen Brook, where aestivation is mostly underground, foxes do not seem to have had the same effect, but the population has been unable to increase and remains at a very low number.

The future of the species may now rest with the development of techniques for captive breeding. This has not proved easy. Recently, CALM developed a research proposal to employ Dr Gerald Kuchling, an Austrian expert in tortoise reproduction, currently based at the University of W.A. The project will be jointly funded by CALM and the Australian National Parks and Wildlife Service, and an application for additional funds has been made to World Wildlife Fund Australia.

In addition, staff from CALM's Metropolitan region are attempting the daunting task of eliminating foxes from their reserves.



Wade Hughes

Why is this inoffensive reptile so endangered? Over 20 years of research have clarified the reasons for the present parlous situation, but as yet there are no easy answers to reversing the trend towards extinction.

The Western Swamp Tortoise has a biology different from other Australian tortoises. It is the smallest Australian tortoise and the

Upper Swan and Twin Swamps Nature Reserve at Warbrook.

Research has shown that these reserves contain only marginal habitat because the swamps do not fill for long enough to allow sufficient time for the tortoise to feed and grow. In dry years females do not get enough food to produce eggs and hatchlings do not survive because they do not grow large

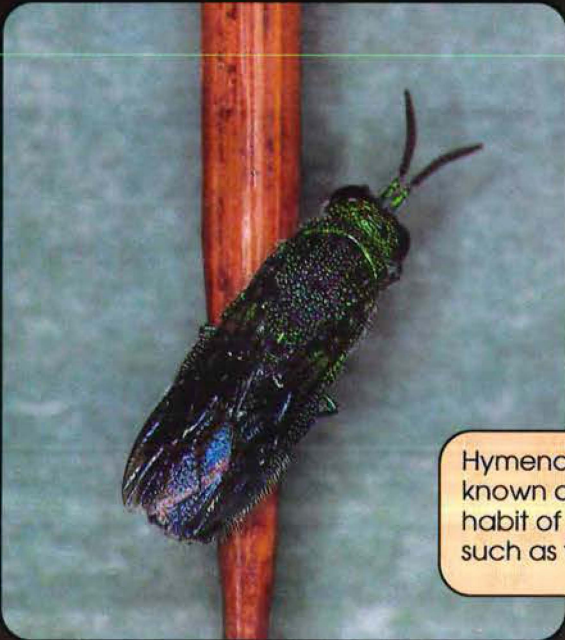
# THE EYE OF THE BEHOLDER

Beauty is often found in the most unexpected places. The average suburban backyard is full of nature's art and design, if you pause to look. Of course, you might have to overcome a few prejudices about which creatures are beautiful. Spiders and insects are not warm-blooded, seldom furry and never cuddly; but as Aris de Jong of Parmelia will tell you, it is very much a question of the 'eye of the beholder'. Aris found and photographed this array of beautiful beasts in and around his garden.

This Salticidae (Jumping Spider) has excellent eyesight, like all members of its species. After all, jumping spiders have eight eyes, two large ones at the front, a pair of smaller ones on each side and four on top in a square pattern.



Jumping spiders are hunting spiders. They stalk their prey in daylight, and may take five to ten minutes to jump on it. They then drag it into their retreat, which is a little tube rather than a web.



Hymenoptera Chrysididae is commonly known as the cuckoo wasp because of its habit of laying eggs in other insects nests, such as those of the mud dauber wasp.



*Maratus pavonis*. This male jumping spider has typically bright colouring (left).  
Diptera Dolichopodidae (below).





Hemiptera Lygaeidae, *Melanerythrus mactans*. These insects feed on seeds and are commonly found on the ground in the bush.



Jumping Spider  
(Salticidae)



---

# Urban Antics

---

## Sting in The Tale

by Colleen Henry-Hall

Everyone has their favourite beach. Favourite beaches are SAFE. You know where the rocks are, where the rips develop, how the waves break on shore. But most importantly, you know there hasn't been a shark sighted on your beach for years, and you know that, in any case, lifesavers will sight the shark before it sights you.

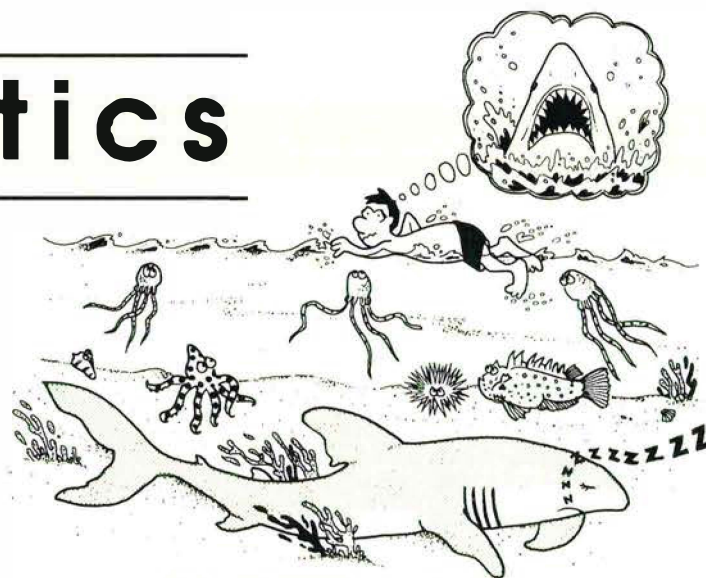
Fear of sharks, conscious or not, manifests itself in a number of ways: ocean swimmers who swim so close to shore they brush the sandy bottom on their downstroke; people who won't venture outside the clear, sandy patches along the shore; swimmers who do their laps in mask and snorkel, so they can see what's coming to get them. Saddest of all are those people who refuse to venture into the ocean at all.

Our fears of the unknown creatures lurking in the depths of the blue-green sea is probably as deep as those ocean waters. Nightmares **do** occasionally come true. The recent experiences of three men and a shark in a boat off Bunbury prove that. But you know the statistics: you're more likely to die in a car accident on your way to the corner shop. Knowing it doesn't make a bit of difference when all you can think of is the movie **Jaws**.

What many of us don't realise is that real dangers are posed by some smaller inhabitants of the sea. There are bities and nasties that can cause us pain, and some that can kill us. Many marine animals have a poisonous venom to either catch their prey or protect themselves from predators. When left alone, they leave us alone; if disturbed, they fight back.

Imagine: a blockbuster thriller movie based on the exploits of a killer box jellyfish. It sounds ridiculous, but the box jellyfish, the sea urchin, the cone shell and the blue ring octopus are much more likely to hurt beachgoers than the fearsome white pointer shark.

The blue ring octopus is the deadliest sea creature on our southwestern coast. It is well-camouflaged with its brown coloring, but when angry, its small blue rings positively glow. You may come across the octopus living in discarded bottles or cans on the ocean floor. If you're collecting, look carefully, rinse the shell and look



carefully again. If you're walking on reefs in the northwest, nothing short of safety boots can keep out the spines of the deadly stonefish.

The small box jellyfish is a painful nuisance in the summer and autumn on sheltered beaches and coves along the coast. Called 'stingers' for very obvious reasons, they embed capsules of poison into your skin. The only way not to get stung is to stay out of the water.

Live cone shells look innocuous, but with 'harpoons' they use to paralyse prey they can inject a strong venom into an unwary collector. Sea urchins spines contain a small amount of poison and can embed themselves into skin easily. Handle them with care. Spines, harpoons, stinging capsules. These are the dangers of the deep you really should look out for.

Your major weapon against any jellyfish is household vinegar; it can neutralise even the sting of the box jellyfish in 30 seconds. If somebody has been stung by a cone fish or blue ringed octopus, they are unlikely to feel pain, but their lips and tongue will shortly become numb, and as paralysis increases they will cease breathing. It is vital for someone who knows the technique to keep up the victims' oxygen supply with Expired Air Resuscitation, while somebody else sends for urgent medical aid. Stings from fish such as stonefish or cobbler should be immersed in hot water - check the water temperature to avoid scalding. With stonefish stings, it may also be necessary to maintain resuscitation, but always send for urgent medical aid.

Oh, there is one other sea-going creature, much more dangerous than even the white pointer shark. With fast boats, spearguns and whirring propellers, humans should beware of other humans in the ocean.

*Note: More information on poisonous marine invertebrates can be found in : **Sea Stingers**, Loizette Marsh and Shirley Slack-Smith, WA Museum, 1986.*



Jiri Lochman

The Jelly Fungus  
*Tremella mesenterica*

# From Field and Forest

## *Edible Fungi in W.A.*



Neale Bougher

*Descolea maculata*, a rusty-spored gill fungus related to *Cortinarius*

**I**T IS AUTUMN, and a gourmet's fancy turns lightly to thoughts of mushrooms. For some people, especially those with a European childhood, it is one of the special joys of this season to go out after the first rains in search of mushrooms. Many others, however, are nervous. Fearful of collecting the wrong type of fungus, they confine themselves to the cultivated mushroom found in the marketplace. That is a pity because there are so many delicious fungi to sample; and if you are ever unlucky enough to be stranded in the bush knowing which fungi you can and can't eat could mean the difference between life and death. ROGER HILTON, mycologist recently retired from the University of W.A., tells you all you need to know to enjoy this 'season of mists and mellow fruitfulness'.

---

Few orders of plants appear to contribute more to the support of animal life in Western Australia. Many species, Particularly, the genus *Boletus*, are used as food by the natives and directly supply no inconsiderable portion of their support for several months of the year.

James Drummond, the pioneer botanist of W.A.

---

Regrettably, the great body of Aboriginal knowledge of fungi has been lost, and is having to be gradually re-built.

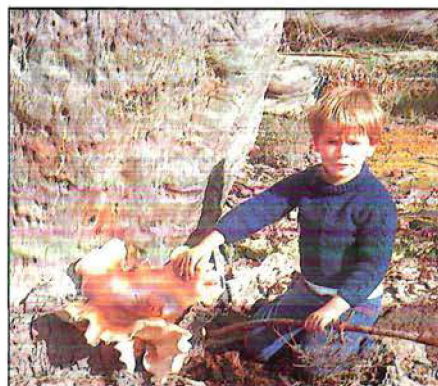
The best known mushroom is the common mushroom, of which there are many varieties. Before considering fungi as food one must learn to distinguish the common mushroom from the deadly amanita. So long as you keep these two distinct, you're unlikely to come to great harm as the vast majority of inedible fungi are merely unpleasant - not deadly.

### The common mushroom

Start by getting familiar with the cultivated mushroom as bought in shops. The base of the stem will have been cut off, but note the ring which represents the remains of a delicate skin which clothed the gills at the button stage. The gills under the cap are very pale pink, darkening as the mushroom ripens. Finally, they are dark chocolate brown. If a ripe cap is placed on a piece of paper the minute spores - which are the 'seeds' of the mushroom - fall from the gills and make a coloured print with the outline of the gills. Note that the gills do not quite reach the stem; this characteristic helps to tell the mushroom from other dark-spored species with which it might rarely be confused. The top peels, but so do those of many toadstools. The top of the most common variety of cul-

tivated mushrooms is smooth and pale. Field mushrooms differ from cultivated mushrooms in size and flavour - some are inferior in flavour, others better - but all have pale gills darkening to dark brown spore powder, a ring, and a stem base free from a cup. The larger ones are known as horse mushrooms. You can always check the base by levering it up out of the ground with a knife blade or stick. The top may be smooth, but one common W.A. variety has fine scales over the cap.

**Warning:** there are varieties which give a yellow colour when cut near the stem base. These are yellow-staining mushrooms and are highly indigestible to some people.



The 'Ghost Fungus', *Pleurotus nidiformis*

### Magic Mushrooms

The so-called magic mushrooms (certain species of *Panaeolus* and *Psilocybe*) have a dark spore powder and grow in similar situations to field mushrooms. They are sometimes accidentally eaten by careless mushroom pickers, who get the fright of their lives. Their real danger is that people in search of stimulation may deliberately and ignorantly eat various small, dark-spored toadstools, some of which are deadly.

### The Amanitas

**Danger,** several of the most poisonous fungi known belong to this group. Some are harmless, or even good to eat, but one should avoid all on principle. They are

common in W.A., and many are large, with a solid flesh which makes them tempting to eat. First look at the base; it either sits in a cup, called the volva, or is swollen, with the cup represented by large scales. Then note the ring; there are amanitas where the ring is almost invisible, but the combination of ring and cup is a certain sign of amanita. Note the gills; they are white, and stay white, giving a white spore powder. Many amanitas have a sour smell. One of the most common large white amanitas of our local woods (*Amanita preissii*) is covered with a white meal which comes off on your fingers. The famous red amanita with white spots, the fly agaric, has not been found in W.A. It has an effect similar to the 'magic mushroom' and should not be eaten, although it is not as deadly as sometimes believed.

### Parasol Mushrooms

These have heavily scaly caps, white spores, prominent ring and no cup at base; most are good to eat but there is the danger of confusion with amanitas because of the white spore powder. The shaggy parasol (*Macrolepiota rhacodes*) is excellent, but a similar form with pale green spore print should be avoided.

### Volvarias

Anyone who has eaten Chinese soups may have fished out a wholesome mushroom in which the cup is even better developed than the cap. It is the padi straw mushroom (*Volvariella speciosa*), commonly cultivated in S.E. Asia. The scientific name for the cup, the volva, gives this group its name. In contrast with those other volva fungi, the amanitas, the gill colour and spore colour is pink not white. The most common volvaria locally (*Volvaria volvacea*) is found growing in long grass in abandoned gardens. It has a sticky cap, no trace of a ring, and a tough stem which is not good to eat. Despite a statement

## What Are Fungi ?

Fungi are living things that are neither plants nor animals. In many ways they are plant-like, but are devoid of the green colour (chlorophyll) of true plants. Nutritionally they are more equivalent to vegetables than meat, but they do contain vitamins and can be a valuable source of food. A few of them, however, contain powerful poisons, and it is important to be aware of precisely what one is eating.

Mushrooms and toadstools are the best known fungi, but the brackets and jellies on rotting wood, puff balls, stinkhorns, yeast and the common moulds on bread are all fungi. A **mushroom** is an umbrella-like fungus which is good to eat, a **toadstool** one that is either inedible or actually poisonous. Of course, any fungus may be poisonous if it is old and rotten.



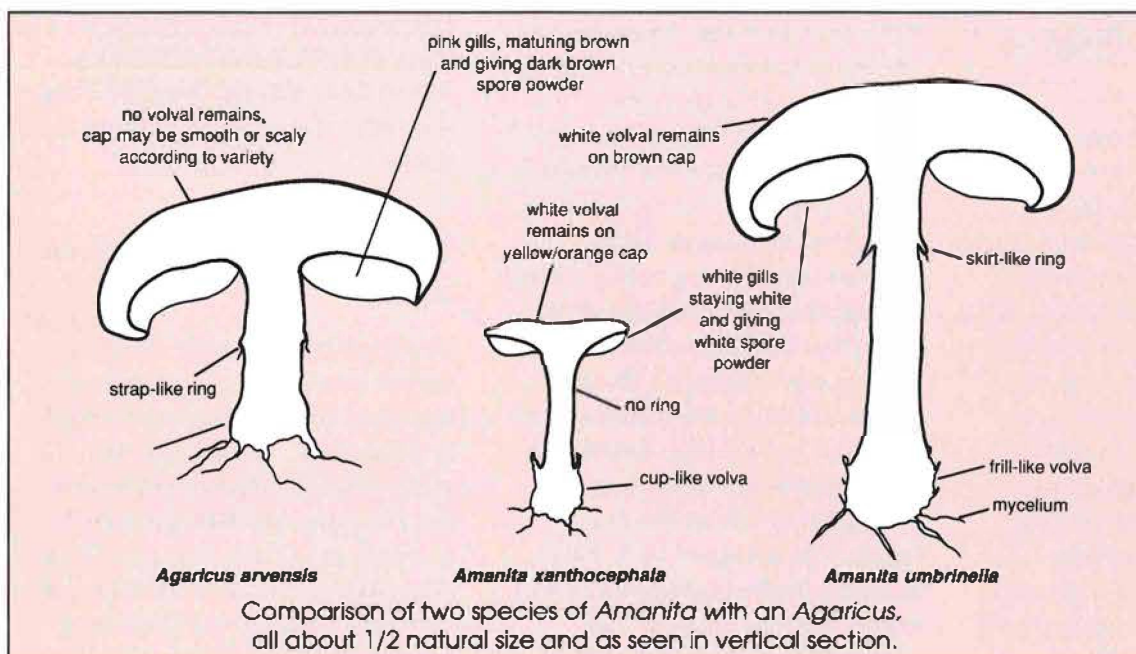
Roger Hilton



Roger Hilton

Dissected fruit-bodies of an *Agaricus*. Note from the cut base that the species shown is a 'yellow stainer', not recommended for eating (Top).

One of the species of *Amanita* with well-developed ring and volva, a combination of features found in some of the most poisonous species of this genus (Left).



in J.B. Cleland's book on South Australian mushrooms that it is poisonous, it is eaten in Europe and has been sold in the local markets in Perth.

### Ink caps

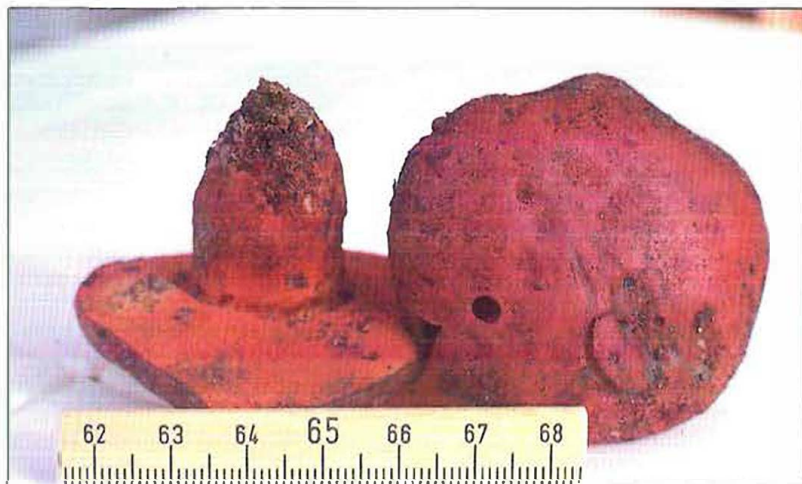
These fungi are easily recognisable because of the habit of the older specimens dissolving into an inky mass. They can actually be used as ink. This is not putrescence, although you would not want to eat them at this stage. They should be caught just before the flesh begins to darken, and they are delicious cooked in a little fat. The best known is the 'shaggy cap' or 'lawyer's wig' (*Coprinus comatus*). These mushrooms come up from buried wood and rubbish in the soil and are common on filled building sites or road verges. In the desert country there is a stalked puff ball called *Podaxis* which looks similar, and is fit to eat when young.



*Coprinus Comatus*

### White-spored gill fungi on wood

A good example is the oyster mushroom of Europe (*Pleurotus ostreatus*). Beware of the largest of these, the ghost fungus (*Pleurotus nidiformis*), as it is known to cause vomiting several hours after being eaten. It is a cream-coloured gilled bracket, common on peppermint trees and sometimes growing at ground level. At night it emits a greenish phosphorescent glow, whence the name ghost fungus. There are several other white-spored, gilled, bracket fungi which are eaten in South East Asia. One is the easily recognised split-gill



A bolete (*Boletus caesareus*) showing the pores that make this genus different from gilled agarics.

(*Schizophyllum commune*) which is not uncommon in W.A.

### Rusty-spored gill-fungi on wood

Some may not be poisonous, some definitely are, so they are all best avoided.

Rusty-spored gill fungi on the ground include the numerous and colourful species of *Cortinarius*. None are recommended for eating.

### The Boletes

All the fungi mentioned so far have gills under their caps, but there is a large group of fleshy umbrella-like fungi, which have pores underneath just like the common bracket fungi found on logs. These boletes are an important source of food as few, if any, are likely to be poisonous - and then not deadly. They are fleshy, but unfortunately are often spoilt by being badly attacked by fly maggots. Many varieties show strong colours when cut, but this does *not* necessarily mean that they are poisonous. The famous cep or steinpilz (*Boletus edulis*) of Europe is a bolete, and although it has not been found in W.A., relatives of it are here. The aboriginal *woorda* or *wurdo* is a bolete. The boletes of W.A. have not been studied sufficiently yet to make recommendations, but known to be wholesome are the

slimy-topped pine boletes (*Suillus granulatus* and *Suillus luteus*) so common in plantations of *radiata* pine. Another is the giant bolete which occurs in pastures in the western wheat belt, known as the salmon gum mushroom (*Phaeogyroporus portentosus*).

### Beef-steak fungus

Similar to a bolete growing out of wood, it is unlike one of the bracket fungi only in that it is soft and fleshy. It looks like an animal tongue sticking out of a living tree, usually jarrah, and in some countries is known as ox tongue fungus (*Fistulina hepatica*). The colour is red, the flesh meat-like, and the underside has pores which are separated, almost like thick, hollow hairs. The whole cuts like a piece of meat, but it has nothing like so fine a flavour! Nevertheless, it is safe to eat. It is the aboriginal *numar*.

### White-spored pore-fungi on wood

These are very often the cause of timber rots. The local varieties are too tough to eat, though not actually poisonous. Two of them, the punk fungi (*Piptoporus portentosus* and *Piptoporus australiensis*) may be as much as 1/2 m across and 15 cm thick. They grow from the trunk of large gum trees. Dried, they have the property of conserving fire for



Jiri Lochman

The Scarlet Bracket Fungus (*Pycnoporus coccineus*), one of the most common white-spored pore-fungi.

hours as they smoulder away and are known to have been used by Aborigines for this purpose.

### Coral fungi

Another fungus associated with jarrah trees, but growing up from the ground amongst the trees, is the richly-branching coral fungus (*Ramaria*). There is a canary yellow and a pale-pink form, both safe to eat. Younger coral fungi that have not opened out may be called cauliflower fungus.

### Hedgehog fungus

So-named from the short spines projecting from below the cap. Its scientific name is *Hydnum repandum*. It is easily recognised and good to eat.

### Puffballs

Avoid most wild fungi in the button stage, as they are too young for characters of stem, gill and spore colour to be evident. The common puffball, however, occurring on practically every lawn, does not have even rudimentary stem or gill, and is so familiar that it can be safely collected. It should be broken open and only eaten if the flesh is still white and not coloured. The matured puffball, which is full of spore powder, would be most un-

pleasant to eat, although not actually poisonous.

### Morels

The morel fungi (*Morchella spp.*) can occur in great abundance in the forest, especially after extensive fires. They are firm and odourless, with a deeply furrowed head growing on a white stalk. They have been appearing in bark chips covering flowerbeds in the metropolitan area. Both head and stalk are hollow, and the recommended method of eating them is to stuff them with morsels of meat and then to bake them in butter. You are not likely to confuse them with the somewhat similar stinkhorns (*Phallus spp.*), which have a froth-like structure and an abominable smell.

### Blackfellow's Bread

This is an underground fungus consisting of a mass of tapioca-like material encased in a black rind. The whole may weigh as much as a kilogram. The contents may be



Roger Hillman

Three Morel fruit-bodies

eaten raw, and have a pleasant acid flavour. They are normally found embedded in the sides of road cuttings or are turned up when farmers are ploughing, especially in the karri country around Pemberton. Pored, tough, white, inedible mushroom-shaped fruit bodies (*Polyporus mylittae*) are produced sporadically.

### Truffles

These are underground fungi much prized in Europe as fine-flavoured food. Several are known to be valued by Aborigines in W.A.: the Elder truffle (named after the expedition that collected the first specimen to be scientifically described) is about the size of an egg, and occurs under trees in the Great Australian desert near Lake Hazlett and Lake Mackay, where it is found just breaking the surface in loose sand.

### Yeasts

Grow naturally on plant sap. They are very rich in vitamin B and their deliberate culture on rice extracts in Prisoner of War Camps in S.E. Asia during the Second World War saved many lives.

### Moulds

We eat mouldy cheese without coming to harm, and mould on food is not normally harmful (although it may indicate that the food is 'off', and unfit to eat). Boer soldiers used the skin of mould from food as dressings for wounds and abscesses - pre-dating the discovery of penicillin (which is made from moulds) by 50 years.

Fungi have a number of uses in a survival situation - perhaps some yet to be discovered or rediscovered. But their main use will always be as a source of food. Some of the items make a pleasant addition to your regular diet. Armed with this information, why wait for an emergency to start exploring fungi as a source of sustenance?

# LETTERS

## Local Heroes

We make reference to the article, 'Local Heroes', in the December issue. We've travelled from the U.S.A. (Montana) especially to see some of Australia's national parks, and the Fitzgerald River National Park (FRNP) was on our list from the beginning because of its designation as an international biosphere reserve with the UN's Man and the Biosphere (MAB) program. There is a worldwide network of such sites, but FRNP is only one of two MAB sites in W.A.

Some of the 'local heroes' are also importantly involved in directing the management of FRNP to fit MAB objectives, which include the demonstration that man can successfully pursue his necessary activities, such as food and fiber production, while maintaining the functional integrity of natural ecosystems. Citizens living near FRNP have formed Fitzgerald Biosphere Project (FBP) with a steering committee. The FBP committee realizes that wheat and sheep production may have significant impacts on the park's natural values, inducing some changes that may be irreversible. Therefore, the committee is contributing its thoughts to the CALM team developing a comprehensive management plan for FRNP; the plan should accommodate problems and concerns originating outside of the park boundaries. We know of a few MAB sites in the world having project committees operating like this, and we commend the progress being made.

Having visited dozens of MAB sites in North America and Australia, we were impressed with what we saw at FRNP, and we hope this Biosphere Reserve will continue to serve as a living 'learning centre' of national and international importance. We only hope that every national park in Australia is as well guarded by 'local heroes' as is the Fitzgerald River N.P.

Dr and Mrs James R. Habeck,  
University of Montana, U.S.A.

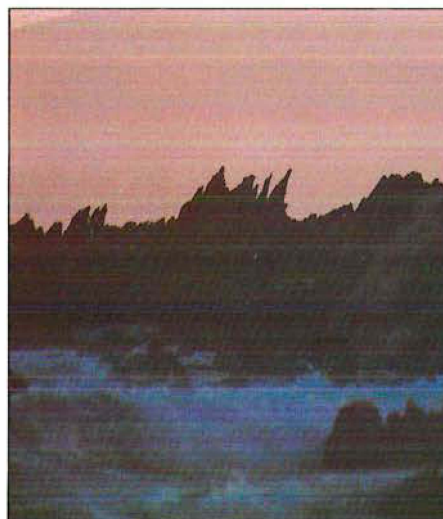
## Coleman Davies

I read with interest your article of M.C. Davies and family (*Landscape*, June 1986), but I was suprised that your article ended 'the remains of Davies Karridale estate has disappeared almost without trace'.

As a member of the August M/River Tourist Committee I would like to inform you that the committee worked hard and created a permanent monument out of the remains of the Davies timber mill and mounted a plaque with the history of the town and the mill. we also made a park around the remains and an entrance to it off the Caves Rd between Augusta and Hamelin Bay.

We also took control of a magnificent stand of karri on the roadside opposite the park.

W. Horrocks, Safety Bay



Robert Garvey

## Railway Lines

In my role as Botanical Guide with Westrail I find *Landscape* to be of immense interest to the passengers. For some years I have subscribed to these publications, *Swans* etc. and handed them around the coaches and always recieved very interesting comments.

J.C. Morgan, City Beach

## Lost Pleasures.

I was most interested to read in *Landscape* the story by Syd Shea and Roger Underwood about the new forest management plans. I know a lot of people will be delighted by the big increase in National Parks and reserves in the forest. To a point I agree. As I see it, National Parks have the great advantage of public security - it doesn't seem to matter whether the area is rich in wildlife or spectacular in scenery, if it's called a National Park, it must be special and the public will spring to its defence when needed, and will visit it, irrespective of alternative attractions.

I also know some other people will bemoan the tying up of mineral and timber wealth in the new parks. However, I write about another cost, one which is rarely taken into account by the decision makers. I am one of many people who are distinctly disadvantaged in a recreation sense by an increase in National Parks, especially in forest areas close to Perth.

Nearly all my life I have visited the forests near Perth regularly. I go there for firewood, to picnic, to walk and to camp. My pleasure comes from the company of a good dog, the warmth and security of a campfire, finding a secluded spot miles from anywhere and camping overnight, yarning by the fires at night, cooking in a camp oven, boiling a billy over a fire in the old bushman way. I do not shoot or molest wildlife, pick wildflowers, let my fire get away or leave a mess. I obey road signs, and I leave little trace of my visit. No-one would ever have had to tidy up after me.

Its getting harder to find places where such simple pleasures can be had and the expansion of National Parks is one reason. Every National Park I have ever visited has 'welcomed' me with a huge sign saying NO DOGS. I have found that in a National Park I can't simply find a camping spot and camp the night there, but I have to crowd in with others in a designated campsite. I can't light a campfire in most parks anymore and yarning around a primus lacks a certain

Your letters are welcome. Please address any correspondence to:

The Editor  
Landscape  
50 Hayman Road  
Como WA 6152

something. In some parts of some of the parks in the south of the state the bush has been allowed to become so thick and the roads are so poorly maintained that only the very young, fit and dedicated can push their way through.

I am also not one to break my heart over timber cutting in the forest. So long as the bush is regrown it soon looks beautiful again. I actually love to visit old timber cutting areas and to explore abandoned mills, discover a fine trestle bridge or an old tramway. It captures my imagination to study and admire the axework on old stumps. In short I like the romance of the bush, just as much as I like its quiet beauty.

So while I don't stand up and complain about the new parks, I hope the authorities recognise that one of the costs of their creation is a loss of recreation for many. I write in praise of State Forests. I am sorry to see them shrinking.

A.J. Taylor, Fremantle

## Striking a Balance

For many years I have keenly read issues of *Forest Focus* and more recently *Landscape*. I have all the back copies of these publications and they provide a valuable source of information concerning forestry practices.

The superb photography and layout of *Landscape* makes this publication a pleasure to read, but my comments are not without criticism. Recent issues of *Landscape* seem to lack scientific content which is an integral part of land management. As a student of Agricultural Science at UWA, I appreciate articles relating to conservation issues, but without any scientific basis they lose much of their significance.

I suggest that *Landscape* could continue to be a magazine appealing to a wide range of public interests if it were to strike a balance between story and scientific fact. I look forward to the return of 'The journal of the W.A. Department of Conservation and Land

Management' and the departure of the 'W.A. picture book' format.

Martin Van Bueren

## Thoughtless Acts

Congratulations on your summer edition (Dec '87). Thanks to Liana Christensen for bringing home the sad facts of yet another thoughtless act of human over-indulgence (or should I politely say opulence). I can't help but offer little hope for ourselves as we constantly and continuously dirty our own nest. The use and abuse attitude is probably quite natural but its unfortunate that we are educated in a total materialistic and mammonish way, only to be offered environmental awareness as a passing thought in subjects which are optional in our schooling. Environmentalists are the true humanists, and we must shudder with fear as we alienate ourselves from the true standard of living.

Harold Willows, Esperance.



Red Casey/Courtesy Fisheries Dept.

## Praise from Author

In once again renewing my subscription to this splendid publication, I cannot let the occasion pass without expressing my very sincere appreciation to you and your Department for being responsible for producing a magazine and its supplementary material of such a high calibre. Your editorial staff deserve every praise for both the let-

ter press and the magnificent illustrations, which surely place this publication very much in world class.

To me *Landscape* is doubly valuable in that, not only does it deal so brilliantly with W.A.'s nature, but it is also printed so very well in that same State. With so much of our printing work done abroad this too is most refreshing, particularly as it illustrates so well the ability of people in this part of the world to produce a work four times a year, of such endearing beauty and equally beautiful and informative supplementary material.

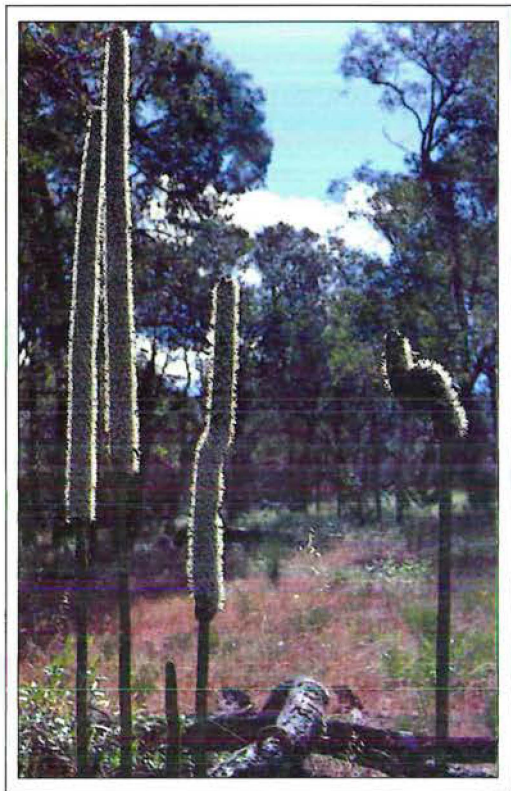
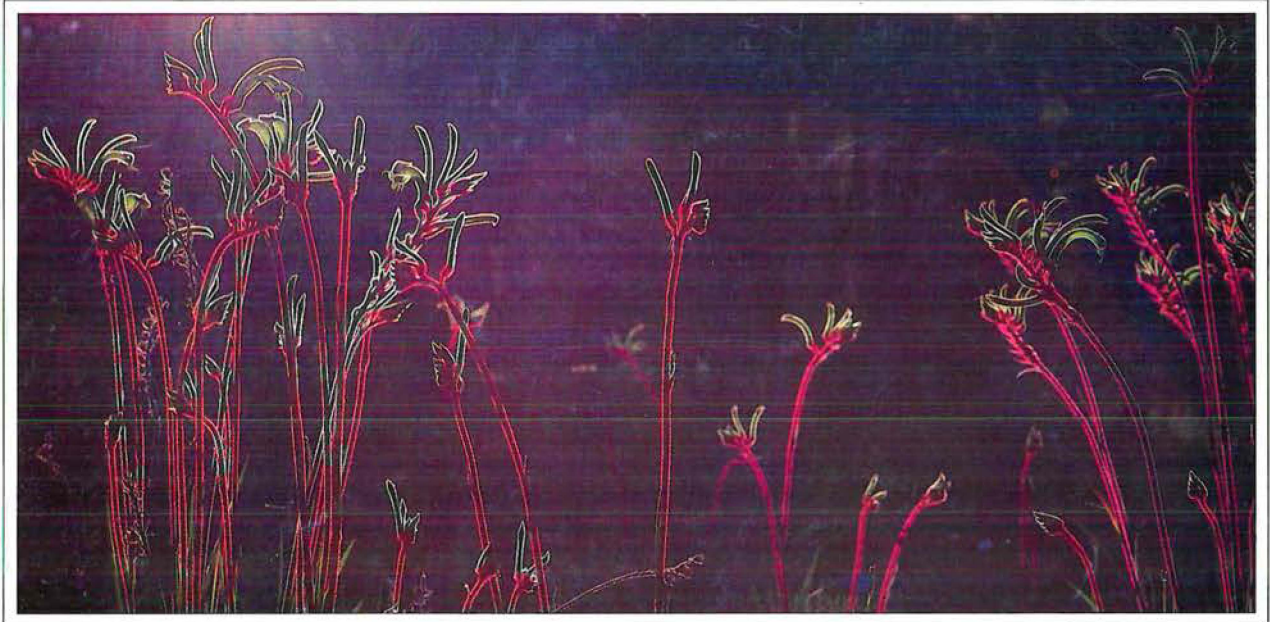
The evolution of your department from the one I knew so well from 1958-69 to its present form is a fine concept, based very much on the solid work of the officers I knew so well. As the Principal of the nearby Koonawarra School I was instrumental in the movement to turn school areas into places of great natural beauty, and with the ever present help in so many ways from the officers then, this we did to great effect in that time. That my concept has since then not been continued as it should is a great pity, but in that eleven years we turned out children with such a great eye to natural beauty and the desire to conserve it, that as the local Councillor of the Como Ward, year after year I could report the school and district free of vandalism. As an original Warden in the District I took an active part in the preservation of the parks and gardens and the turning of the local swamp into a fine reserve.

At the present time publications such as yours and the conservation efforts such as yours are doing a wonderful work in making people realise how much the natural resources of the State still mean. I am now past active participation in such activities but I am able to enjoy in my sunset years, what you are still striving for by regularly keeping in touch through *Landscape*. Every commendation to your fine editors and contributors.

Paul Buddee Cit. W.A.

**Paul Buddee is a well known writer of children's books and former principal of several W.A. schools. Ed.**

# Looking Back



**Backlight casts a magic glow over even the most common subjects. In these pictures Aris de Jong has an unusual vision of the beauty of our familiar native plants.**