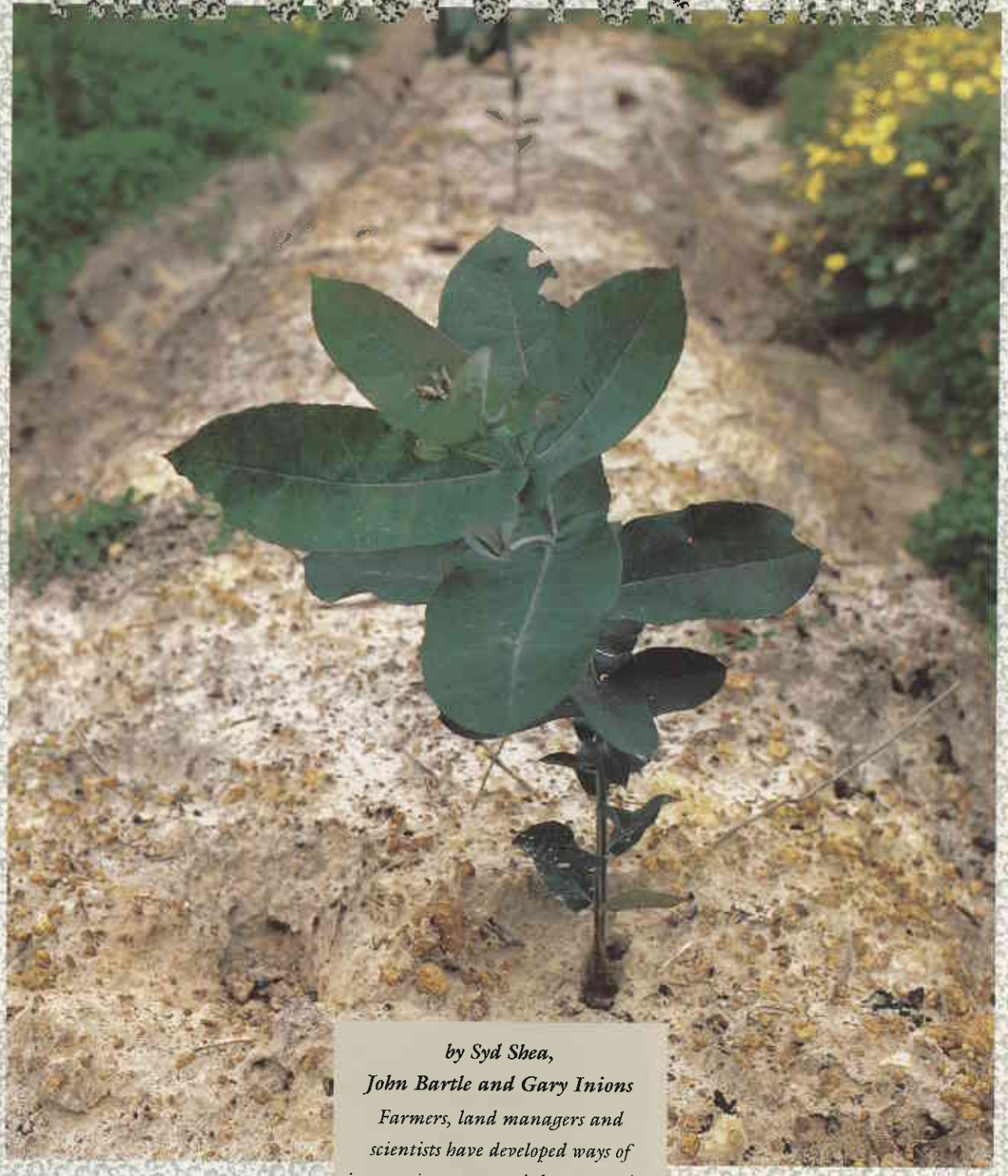
TREE CROPS FOR FARMS



by Syd Shea,
John Bartle and Gary Inions

Farmers, land managers and scientists have developed ways of integrating commercial tree growing onto the farm. We can create a massive new export industry based on wood fibre - while maintaining agricultural production, restoring damaged ecosystems, and even conserving native vegetation!

Agriculture in this State in the last 30 years has generated more than 30 billion dollars of export income, wealth made possible by efficient farming. But the clearing of native vegetation to create farms has been at a cost: the serious degradation of soil and water.

Rainfall in Western Australia contains small amounts of salt. Over hundreds of thousands of years, large quantities accumulated naturally in the underlying clay soils. The system remains balanced as long as the consumption of water keeps pace with the supply, but when native vegetation is replaced with crops which consume less water, water accumulates in the soil and the water tables rise. Salt deep in the soil is mobilised, and when the water table reaches the surface, the soil becomes waterlogged, salt is concentrated by evaporation, and saline water is flushed into streams. Salination bares the soil and damages its structure, making fertile valley-bottom land prone to erosion.

Salinity is not the only problem. Remnant native vegetation degrades because of soil compaction and grazing. The lack of tall perennial vegetation cover exposes the land to wind erosion. Fertiliser pollution of streams and wetlands can also increase because of excess water run-off.

RESTORING THE BALANCE

We could re-establish the hydrological balance in farmland by re-establishing native vegetation - but this would eliminate our agricultural industries. Maintaining remnant vegetation on farms and re-establishing perennial native species can contribute to improving farmland ecosystems. But broadscale re-establishment would be costly and would result in a massive loss of farm income. On the other hand, planting vigorous commercial trees, strategically located on parts of the farm, can achieve a similar result (see 'Restoring Nature's Balance', *LANDSCOPE*, Autumn 1988) without reducing agricultural production, and providing a new cash crop for the landowner.

Trees not only increase water consumption. Planting trees on pasture or crop land re-establishes natural root pathways for water to pass rapidly into the sub-soil. In addition to opening root channels, tree crops add large quantities of organic matter into the soil, thus reinvigorating soil processes.

In our climate the potential for evaporation greatly exceeds the rainfall. If a tree-covered area has access to stored water it can consume the equivalent of up to double the rainfall, whereas a pastured area may only consume 75 per cent of rainfall. If trees are placed so that they can exploit the water not used by the pastured areas, it is possible to achieve a 'water balance' by replanting a relatively small proportion of the farm.

This means finding the right trees and putting them in the right places. Extensive field studies carried out over a number of years show that certain trees can rapidly cause water tables to lower. For example, stands of vigorously growing trees in the Wellington Catchment have lowered the water table by eight metres in 10 years. The farmland needed to carry perennial vegetation to re-establish the hydrological balance varies according to rainfall - the higher the rainfall, the greater the proportion of land to be planted. But if trees are strategically located, planting as little as 20 per cent of the land will reduce water table levels significantly.

This can happen without loss of production. Tree crops also modify their immediate environment in a way that increases crop yield and reduces animal losses; animals can graze within the tree crops for much of the rotation. Since the tree crops themselves produce income, total farm productivity is increased substantially.

Commercial tree plantings can also help conserve remnant vegetation on farms. For example, by surrounding patches of native vegetation with vigorously growing trees, rising water

Previous page
Bluegum seedlings grow vigorously in the first spring after planting.
Photo - Jon Green

Above right: Crystallised salt concentrated by evaporation from saline groundwater seepage.
Photo - Jiri Lochman

Below right: An algal mat in nutrient-rich waters draining from farmland.
Photo - Jiri Lochman

Below: Valley bottom tree-planting in the Wellington Catchment designed to lower groundwater and reduce stream salinity.
Photo - Robert Garvey

tables and exposure to wind are reduced. These planting configurations also make it economically feasible to fence the remnant native vegetation.

DEMAND FOR WOOD FIBRE

It would cost $200 000 to establish and maintain 200 hectares of permanent tree cover on a 1 000-hectare farm. Even when the agricultural economy is buoyant, few farmers could afford such expenditure if the trees planted gave no commercial returns. However, international studies of supply and demand for wood consistently show a strong increase in demand for wood fibre in all its forms. They also conclude that there will not be a wood famine; the increase in demand for wood will be met by those countries that can produce it efficiently.

Until recent times, Australia has not done very well in international wood fibre production. Our imports of wood products exceed 1.5 billion dollars annually; that includes products like eucalyptus pulp, eucalyptus veneer, tannins derived from wattles, and even eucalyptus oil. Yet Western Australia could be world-competitive, given our climate, soils, large land base, local tree-growing technology, and potential for developing synergies between agricultural and wood fibre production.

There are three principal species used for commercial wood production in Western Australian plantations - *Pinus radiata*, *Pinus pinaster* and *Eucalyptus globulus*. The pine species provide raw material for products ranging from particle board and medium-density fibre board to structural timber and plywood. The principal market for sawn timber products is domestic, but many board products are exported. The expansion of the softwood sawmill located at Dardanup to international scale raises the prospect of exports of structural pine timber into the Asian market.

Eucalyptus globulus is grown to produce wood fibre for high-quality paper. This species produces the best wood fibre in the world. The market for high-quality wood fibre is based primarily in Japan, where many of the world's high-quality paper products are made. If a pulp mill can be established in Western Australia, there will be a significant market for wood produced from this species for local processing. But with or without a pulp mill, there is still a huge market for high-quality wood fibre overseas, where the established pulp and paper industry is short of wood fibre. Western Australia can easily supply wood fibre for both a domestic pulp mill and overseas processors.

Pine species generally take between 25 and 30 years to mature, although they can be periodically harvested during this period as they are thinned. *Eucalyptus globulus* is ready for harvest after 10 years, and then can be regrown at least once from the coppice that sprouts from the cut stumps. All three species are highly productive and, with proper management, growth rates and cost of production are as good as or better than anywhere in the world. All three species have particular site requirements and they cannot be established where rainfall is less than 600 mm per annum. But in the south-west of Western Australia within this rainfall belt, there are more than one million hectares of cleared agricultural land on which it would be possible to grow commercial tree crops.

MONEY FROM TREES

The economic return from tree crops varies according to the species, site productivity, cost of establishment and management, and the price for which

Above left: Bluegums linking remnant vegetation into a corridor.
Photo - Jon Green

Left: Bluegum-planted areas can provide shelter and grazing from an early age.
Photo - Robert Garvey

the wood products can be sold. A general indication of potential returns is shown in the Table below.

Wood, like other primary industry products, is subject to international competition. But the economics of tree-based industries are different. Wood production is sensitive to transport costs, because its value per unit of weight is much less than other primary products. Efficient harvesting and transport are also sensitive to scale. Large areas of plantation and large processing plants are required to keep unit production costs down. For example, the production of softwood sawn timber around the world is increasingly being derived from plants that use 400 000 cubic metres of logs per year. Annual production rates of more than a million cubic metres are required before it becomes economical to establish processing plants for domestic pulp production.

Western Australia is fortunate in that it has an established forest industry which already provides much of the infrastructure; but distance to processing plants is still critical, and where new transport and processing facilities have to be established, scale is very important.

Like all primary products, wood fibre does not escape the laws of supply and demand. So the price for the products will vary, but Western Australia can produce wood fibre as efficiently as anywhere in the world.

SHAREFARMING

For almost a decade, CALM has been developing economic and legal packages which facilitate joint ventures between landowners and investors. These 'sharefarming' ventures allow the landowner to share the profits from the use of his land with an investor. The landowner and the investor may be one and the same, but farmers often do not have the cash flow to establish the tree crops.

Sharefarm financing is flexible. The landowner can be paid for his temporary contribution of land, and for whatever he pays towards the management of the tree crop during its growth, in a lump sum at time of harvest. The return he receives is directly proportional to the input, including the value of his land. Alternatively, subject to the investor agreeing, the farmer receives part of his payment as an annuity, calculated as a proportion of the landowner's contribution to growing the crop.

CALM's legislation enables it to use an old common law process, *profit à prendre*. This makes it possible to secure the rights of the landowner and CALM to a share of the returns from the tree crop without affecting the ownership of the land. Under a lease the owner may have no rights except to payment of rent; *profit à prendre* is superior because, in one simple, flexible document, it enables the landowner to share the profits from the use to which the land is put, but also to continue using it himself (if the use does not conflict with the agreement).

Sharefarming under *profit à prendre* greatly assists integration of trees into the farm. It provides legal security and practical flexibility, accentuating economic returns to the farmer and the investor and maximising the environmental benefits of tree planting.

Tasmanian bluegum (*Eucalyptus globulus*).
Photo - Marie Lochman

Cows grazing between belts of radiata pine (*Pinus radiata*).
Photo - R Moore

Far right: Maritime pine (*Pinus pinaster*).
Photo - Jon Green

OTHER CROPS, OTHER PRODUCTS

While in Western Australia only three major species are being grown to produce traditional timber products, the potential of many other species and products is being investigated. More than 40 different tree crop species are being evaluated in field plantings throughout the south-west of the State. In particular, CALM with a variety of partners is investigating tree-crop planting beyond the 600 mm rainfall zone; this will show if it is possible that a commercial tree-establishment program will help reverse soil and water degradation in more arid regions.

POTENTIAL RETURNS FROM TREE CROPS ON FARMS

SPECIES	ROTATION LENGTH	COST OF ESTABLISHMENT & MANAGEMENT	YIELD AT HARVEST (m^3)	WOOD PRICE ($/m^3$)	REAL RATE OF RETURN ON INVESTMENT
E. globulus	Two 10-year rotations	$3000 - 3500[1]	200 - 300	20 - 35	10 - 20%
Pinus	25 - 30 years	$3000 - 3500[2]	400 - 600	23 - 37	7 - 10%

[1] 20-year period with two harvests

[2] One rotation over 25 years

These studies include the potential market for a variety of products, including eucalyptus oil, wattle species for specialised pulp and tannin production, and wood for solid and liquid fuel.

Revegetation on a scale large enough to reverse the salinity in our farmland would produce an enormous woody biomass resource. Most of this resource would be low in value and distant from ports or markets. Desirable uses must therefore have large market volumes and be capable of decentralised processing. On a large enough scale, 'biomass fuels' for transport and electricity generation are a possible use.

THE FUTURE: PUTTING IT ALL TOGETHER

For most of Australia's history, tree crops have been produced by Government agencies or large private companies. The trees have been grown for commercial wood production in large plantations in block formations. This approach has served us well, and there are economic benefits from large block planting. Nearly a decade ago, however, CALM concluded that for economic, environmental and social reasons all new commercial tree plantings should be on cleared land in partnership with farmers. The success of this depends on achieving the optimum mix and location of tree and agriculture crops, so that the integrated package maximises the benefits to agriculture, forestry and the environment, and above all is profitable. This can only be achieved by sophisticated farm and catchment planning.

Since CALM's move to integrated tree planting on farms, there have been major technological advances. In the past, a soil survey was the only way to select plantable land. We are now able to look below the surface using geophysical techniques developed by the Western Australian Department of Agriculture and private companies. These reveal patterns of underground water movement and allow us to place trees near extra water. We can precisely predict tree growth, wood production and wood quality throughout the south-west of the State. Advances in genetic improvement, site selection and silvicultural techniques will increase productivity by more than 50 per cent within five years.

This technical information can now be managed using geographic information systems (GIS), which are capable of rapid, interactive farm and catchment planning and mapping. Farm plan options can also be subject to automated economic evaluation using the Western Australian Department of Agriculture's 'Farmula' economic model, which generates analyses of long-term cash flow and cost benefits.

Several catchment-scale farm planting demonstrations have been completed or are in progress. These include a project in Denmark, where farm plans designed to control salinity have been developed by the Western Australian Department of Agriculture in conjunction with farmers.

The move to integrate tree crop production into farming practice in Western Australia is no longer a dream. It's happening. In the last several years more than 15 000 hectares of trees have

ETHANOL

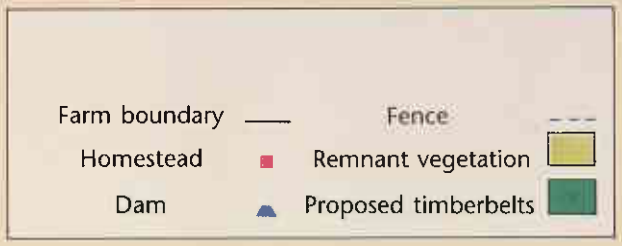
Ethanol is already widely used in some parts of the world as a liquid fuel. It is made by fermentation of starch and sugar feedstocks. In recent years there has been rapid improvement in the technology for converting woody feedstocks to ethanol. By using cheap woody feedstocks, the price of ethanol as a liquid fuel is approaching parity with petrol and diesel. The non-fermentable lignin component of wood has many potential uses, but in large-scale ethanol production the large lignin residue could be used for electricity generation.

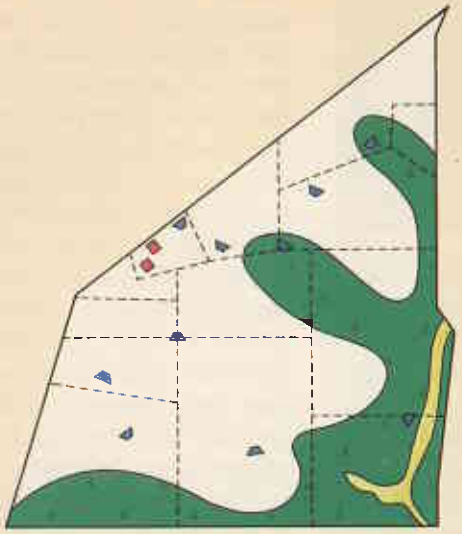
Ethanol production is viable in small-scale decentralised plants, thereby overcoming the transport constraint. It can be readily blended with existing liquid fuels in proportions of up to 20 per cent without the need to modify motors; hence easy market development is possible. Biomass fuels could provide a dedicated residue used to improve the economics of other tree products, such as eucalyptus oil and sawn timber. Woody biomass will be a cheaper and more reliable feedstock for ethanol production than cereal or sugar crops due to its lower harvest cost and the absence of competitive uses. A wood-based ethanol industry could also provide an economic use for cereal straw.

Wood's potential to compete with coal as a solid fuel for electricity generation is limited by coal's low price. However, recent studies have shown that for small off-grid power stations such as the one at Esperance, where cheap coal-based power is not available, fuel wood competes with diesel as an economical fuel. Esperance presents an attractive opportunity to develop joint ethanol-electricity production from wood. Indeed, a proposal is now being evaluated.

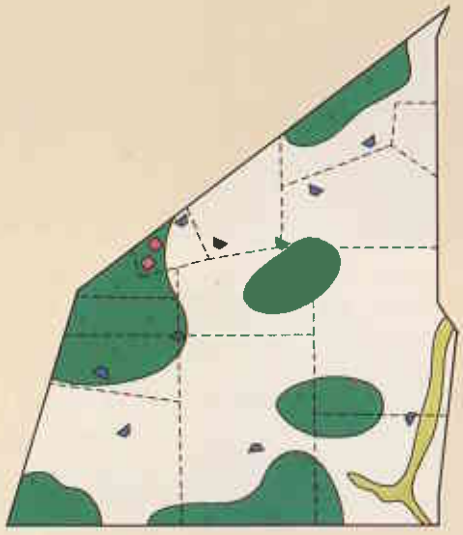
INTEGRATING TREE CROPS INTO FARMING SYSTEMS

Trees can benefit farms in three broad ways: by controlling salinity and waterlogging; by protecting soil, crops and animals from the wind; and by generating income from tree products. The farmer must decide what balance of these benefits most suits his property, which would then determine the most appropriate layout of trees.

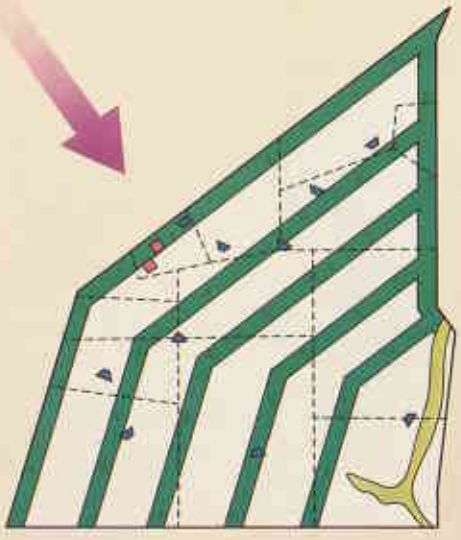




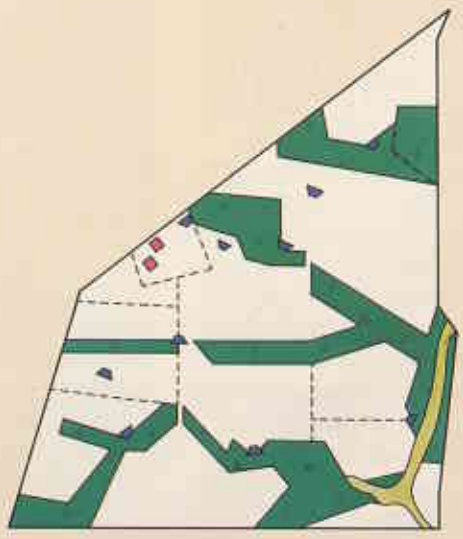
Controlling Salinity
Distribution of trees can be designed to maximise water use, thereby lowering the water table. This relieves waterlogging and reduces the amount of salt in the surface soil.



Growing Tree Products
Tree crops can be placed on areas of the farm which will give the greatest yield. These areas are selected by detailed assessment of land quality.



Providing Shelter
Soils, crops and animals can be protected against erosion, buffeting and chilling by placement of trees across the path of prevailing winds.



Gaining Multiple Benefits
Most farmers will wish to gain several benefits simultaneously. To achieve this, tree distribution can be designed to provide an optimum balance of crop yield, shelter and salinity control.

been established on farmland by CALM, farmers and private companies. Next year, up to 10 000 hectares of commercial tree crops will be established on farms. If we remain efficient and capture the confidence of the marketplace, Western Australia could have 200 000 hectares of fully integrated tree crops on farms within 15 years. The industry could generate more than 500 million dollars of export income per annum, without reducing agricultural production. It could provide a new cash crop for farmers, while at the same time making a major contribution to restoring nature's balance on the farmlands of Western Australia. ▣

Aerial views of timberbelt sharefarm planting in the Albany region.
Photos - Jon Green

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EUCALYPTUS OIL

Eucalyptus oil is one potentially commercial product from trees which can grow in low rainfall areas. Studies by the Agriculture Department have shown that strategically located mallee eucalypts, which used to occur naturally in the Wheatbelt, would have a significant effect on salination because they consume so much water. CALM is working with Murdoch University and the international engineering company Merz to determine the potential for an industry based on the production of eucalyptus oil; 30 hectares of mallee eucalypts have been established for the purpose at Woodanilling.

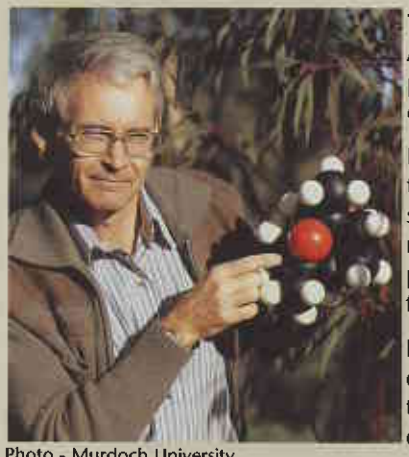

Photo - Murdoch University

Traditionally, eucalyptus oil has been used in the international pharmaceutical industry, yet Australia is increasingly excluded from the international market by low-cost overseas producers. With efficient production, Western Australia could replace imported eucalyptus oil and perhaps compete internationally.

For a number of years, Professor Alan Barton from Murdoch University has been investigating the production of eucalyptus oil from Western Australian mallee species. He has found that several of them have particularly high contents of cineole in their oils. Apart from its use in medicines, cineole is an excellent solvent and may become a competitive alternative to petrochemical-based solvents, which have industrial health risks and are derived from a non-sustainable resource.

Mallee species could be grown on a two-year growth cycle producing more than 70 kg of eucalyptus oil per hectare. Modern harvest and steam distillation techniques would need to be developed, but the work carried out so far shows that a 5 000-hectare estate could economically produce eucalyptus oil, given its current value of $10-12 per kilogram.

Twenty-three captive-bred chuditch were recently released in the Julimar forest in an attempt to establish a new population. The story of the 'Return of the Chuditch' is on page 10.

'Back in the Outback' (page 34) follows the trail of endangered mammals recently reintroduced into the Gibson Desert from Barrow Is.

LANDSCOPE

VOLUME EIGHT NO. 2 SUMMER ISSUE 1992-3

In a remote corner of the Gibson Desert lies Lake Gregory, a birdwatcher's paradise. See page 16.

A silent workforce of volunteers assist CALM with a multitude of projects. Colin Ingram tells us more about these 'Volunteers for Nature' on page 28.

The urban cat vies with its feral cousin and the fox for top spot in the predator stakes. See 'Masterly Marauders' on page 20.

FEATURES

REGULARS

COVER

The chuditch (Dasyurus geoffroii) *was once found in every State and Territory of mainland Australia. Now it is only found in the jarrah forest and parts of the southern wheatlbelt in the south-west of WA - about two percent of its former range.*

The illustration is by Philippa Nikulinsky.

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