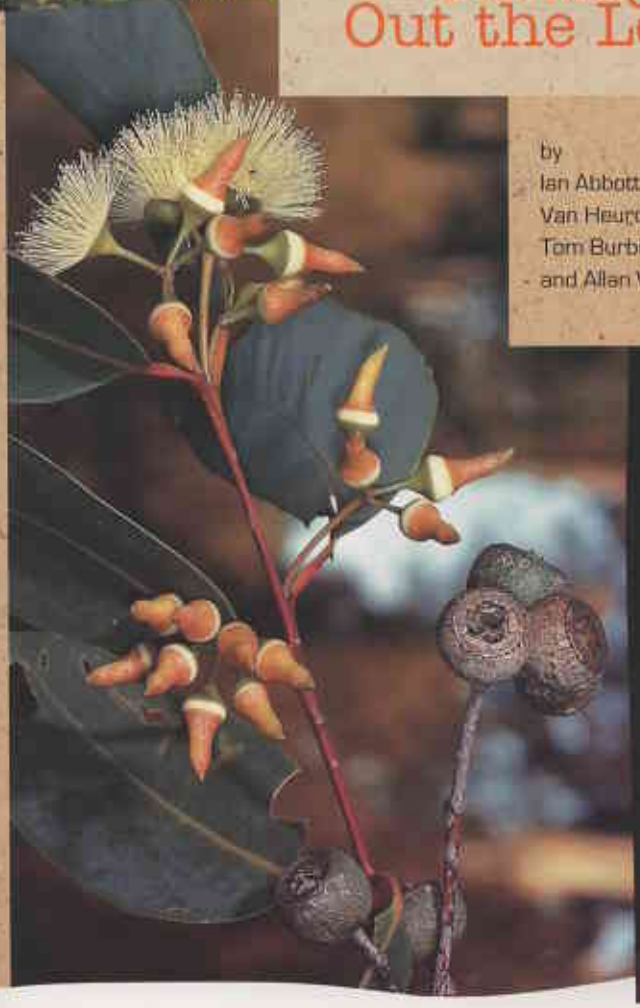
# Cutting Out the Leafminer

by
Ian Abbott, Paul Van Heurck, Tom Burbidge and Allan Wills



Unlike most forested parts of the world, the hardwood forests of Western Australia did not experience insect outbreaks until 30 years ago. One concern is that forest management practices may aid the spread of insect pests, but in the case of one, the jarrah leafminer, detailed studies have shown that timber harvesting and spring burning are unlikely to have caused the outbreaks. This research has also thrown up possibilities for control of the jarrah leafminer.

The jarrah leafminer (*Perthida glyphopa*) became a pest in jarrah forest east of Manjimup around 1960, when feeding by the larvae caused extensive damage to the crowns of jarrah trees. This infestation has gradually extended west, south and north, and at present occurs as far north as Collie. At the peak of an outbreak of jarrah leafminer in 1980, more than half a million hectares of State forest were moderately to severely affected. In 1992, 196 000 hectares were affected, as the outbreak around Manjimup had receded. What has caused this outbreak, and what can we do to control it?

## LIFE CYCLE

The female jarrah leafminer moth deposits her eggs into the lower surface of jarrah leaves in April or May, preferring leaves that are about six months old. A tiny caterpillar (or larva) hatches out of each egg and feeds for about five months during the winter. The process is rather like mining coal underground in that the caterpillar in its 'mine' consumes leaf tissue from within the leaf. The rate at which it grows is largely dependent on the temperature; during a mild winter, the caterpillars grow more quickly. When the caterpillar is mature, around September or October, it cuts a neat circular hole (cutout) in the leaf and falls to the ground within a protective capsule of leaf tissue. It then burrows a couple of centimetres into the soil, where it remains inactive until about the end of February, when pupation begins. The pupal stage, during which the caterpillar metamorphoses into an adult moth, lasts for about another month. When the adults emerge, they probably have only a few days to mate successfully and and for the females to lay their eggs (adult moths live for only about 10 days in the laboratory).

If you walked through a forest infested with jarrah leafminer, you might notice the crowns of the jarrah trees appear brownish, where the feeding caterpillars are destroying the leaves. In severely affected stands, so-called 'outbreak zones', 60 per cent or more of all foliage turns brown and is unable to photosynthesise. Consequently, the foliage becomes less dense and dies back

*Previous page*
*Top left:* New seasons's growth of jarrah leaves, not yet infested by jarrah leafminer.
Photo – Dennis Sarson/Lochman Transparencies
*Top right:* Magnified detail of a jarrah leaf showing several completed mines (evidenced by cutouts).
Photo – Steve Curry

*Previous page*
*Bottom left:* Flower buds, fruits and flowers of jarrah.
*Bottom right:* Close-up of jarrah bark.
Photos – Babs & Bert Wells/CALM

*Above:* Crowns of jarrah infested (brown) and uninfested (green), seen from Kepal fire tower in 1966.
Photo – Steve Curry

*Below:* Progressive deterioration (1967, 1975, 1987) in the condition of a jarrah tree crown due to jarrah leafminer infestation.
Photos – Zan Mazanec and Ian Abbott

from the branch tips, permanently damaging the crown of the tree. Although this does not usually kill the tree, it affects the overall health and vigour of the forest. As a result, the balance of the forest could change as marri (*Eucalyptus calophylla*), which is not affected by the jarrah leafminer, thrives. It could also affect other organisms that depend on jarrah foliage, such as leaf-eating beetles. The loss of leaves will mean that affected trees use less water, which could have an effect on the levels of water tables locally. Also, in places where jarrah is harvested for timber, the sparsely leaved jarrah crowns will have an economic effect. It is estimated that jarrah leafminer currently causes a reduction in the growth of approximately 50 000 cubic metres of wood per year, because infested trees grow more slowly.

*Above:* Comparison of leaves from jarrah susceptible (left) or resistant to infestation by jarrah leafminer. Note that although many eggs are laid within the resistant leaf, none develop to any notable extent.
Photo – Babs & Bert Wells/CALM

*Below:* By December, the flush of new jarrah foliage constrasts markedly in colour with foliage damaged a few months earlier by jarrah leafminer.
Photo – Ian Abbott

*Above:* In leaves from jarrah susceptible to infestation, much of the tissue is consumed and the individual mines appear to coalesce. Note cutouts and capsules (left) containing jarrah leafminer larvae.
Photo – Steve Curry

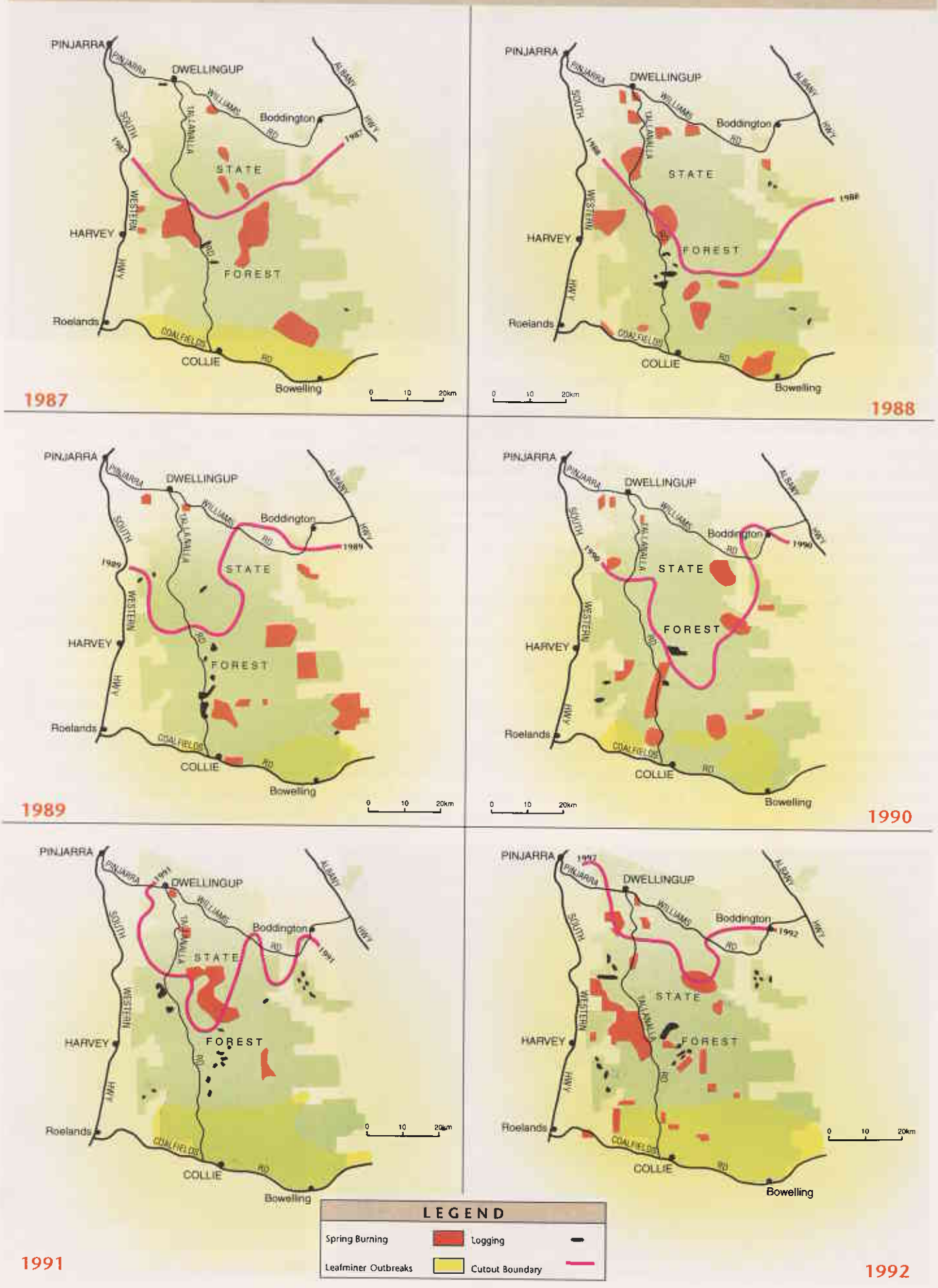
Many people believe the emergence of the jarrah leafminer in pest proportions in State forests over the past 30 years might be partly due to forest management methods, such as timber harvesting and spring burning. Because both of these result in regeneration of the forest and a burst of new leaf growth, burned or thinned stands of jarrah should provide ideal egg-laying sites for the female leafminer moths. It was, therefore, thought these areas might be infested with leafminer caterpillars the following winter, from where the moths would disperse into the surrounding forest the next autumn. For the Department of Conservation and Land Management (CALM) to control the spread of this pest, it was important to establish whether timber harvesting and spring burning have any effect on the distribution or abundance of the leafminer.

## COUNTING CUTOUTS

It was decided to use the number of larval cutouts at sites throughout the affected areas as a measure of the abundance of the leafminer. Once the abundance and distribution of the pest had been established, this could be correlated with the logging and burning records for the areas. The number of cutouts per leaf indicates how many larvae have gained maturity; it is therefore a useful measure of the severity of infestation. (Note that it is not a measure of the total number of larvae as some die before the cutout stage, but these generally do less damage to the foliage than the larvae that grow to maturity.)

In 1984 and 1987, 40 experimental plots were established by CALM scientists in State forest in the Manjimup and Collie

## EXTENT OF JARRAH LEAFMINER OUTBREAKS 1987-92



districts. These were carefully chosen to cover a representative range of rainfall, fire history, logging history and vegetation type. In each plot, six young jarrah saplings were randomly selected for detailed study and each spring, for between four and seven years, several new leaves on each plant were tagged. The following spring, the number of larval cutouts on each of the 600 leaves tagged in each district was counted. The total area burnt in the previous spring in each district, and the total area logged in the previous year in each district, were extracted from CALM records and compared with these figures for the average number of leafminer cutouts (i.e. mature larvae) per leaf.

The area of forest logged or burned in the Manjimup and Collie districts varies markedly from year to year, sometimes by a factor as great as five. If these practices contributed to the spread of the leafminer, you would expect that the greater the area of forest logged or burned in any year, the more abundant would be the leafminer larval cutouts in the following spring. In fact, although the abundance of the leafminer in the experimental plots went up and down from year to year by as much as a factor of three, the increases in abundance did not necessarily follow years in which the areas logged or burned had increased.

Further investigations, directly comparing experimental plots that were either burned or not burned, showed no significant difference between the burned and unburned plots in the number of larval cutouts per leaf the following spring.

## MONITORING THE SPREAD

To keep tabs on the spread of the jarrah leafminer, 300 000 hectares of jarrah forest, north of the main outbreak zone near Collie, were inspected annually for the presence of leafminer mines and cutouts. When the annual results are plotted on a map, there is a clear boundary in the distribution, termed the 'cutout boundary'. To the north of the cutout boundary, no leafminer larvae successfully complete the feeding part of their life cycle in the jarrah leaf; all larvae die in their mines—perhaps because of cold or lack of nutrients. To the south of the cutout boundary, larvae are able to finish feeding and then drop from the leaf to complete the next stage of their life cycle in the soil.

A stand of jarrah trees burnt in autumn. Note the green foliage and lack of infestation by jarrah leafminer.
Photo – Dennis Sarson/Lochman Transparencies

The cutout boundary is not fixed; it shows quite marked fluctuations in position from year to year. If logging and/or burning aid the spread of the leafminer, the cutout boundary should follow closely the location of recently burned or logged stands of jarrah. In fact, the detailed set of maps over six consecutive years from 1987 until 1992 show that the annual fluctuations in the position of the cutout boundary do not relate to the location of spring fires or logging in the previous year (see opposite). Substantial areas of forest burned in spring were not colonised successfully by jarrah leafminer in the following year. For example, Hakea forest block was burned in spring 1985, but remained to the north of the cutout boundary until 1989. A notable retreat of the boundary southwards occurred in 1988, even though extensive tracts of forest to the north had been burned in springs of preceding years.

## CONTROL OPTIONS

So how can we control outbreaks of jarrah leafminer? One possibility is to disrupt the life cycle of the leafminer. An experiment and a survey carried out in Collie district show that burning forest in autumn under hot dry conditions scorches all or part of the forest canopy and reduces the density of leafminer for 18 months. The scorched leaves are quickly shed, but are not replaced until spring. This means that female leafminer moths find fewer suitable leaves in which to lay their eggs. In addition, if done early enough in autumn, fire can kill leafminer pupae in the topsoil, so that fewer moths emerge.

At present, less than five per cent of State forest in Collie district is burned in autumn; most is burned in spring under cool damp conditions. Spring fires rarely result in leaf scorch exceeding six metres above the ground and tend to burn the ground vegetation in patches. Some judicious autumn burning, to scorch crowns of affected jarrah forest, could be an effective way of subduing outbreaks of the jarrah leafminer.

Interestingly, about 10 per cent of all jarrah trees seem to be resistant to attack by the larvae of the jarrah leafminer. Although the leaves of these resistant trees carry similar numbers of larvae to the susceptible trees, most of the larvae die in their mines before they have damaged a significant part of the leaf. Although the chemical basis for this resistance has not yet been discovered, criteria for detecting resistant trees have been established. Increasing the proportion of resistant trees in the jarrah forest would effectively limit the spread of the jarrah leafminer. This could be achieved by ensuring resistant trees are left behind when timber is harvested from affected jarrah stands, so that in time the forest will naturally contain a greater proportion of resistant trees. A simple change such as this could have a dramatic effect on the vigour and growth of the jarrah forest around Collie and Manjimup, as well as protecting against future outbreaks.

Ian Abbott is Science Adviser and Head of CALM's Science Services Group. He can be contacted on (09) 442 0300.

Paul Van Heurck, Tom Burbidge and Allan Wills are technical officers with CALM's Science and Information Division. Tom and Allan are based at Como Research Centre and can be contacted on (09) 334 0305. Paul is based at Woodvale Research Centre and can be contacted on (09) 405 5100.

# LANDSCOPE

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*The threatened Wyalkatchem foxglove is being given a helping hand by scientists from CALM and Kings Park and Botanic Garden (see page 17).*

*This nesting pair of splendid fairy-wrens is one of the many 'Birds of the Stirling Range' (see page 36).*

*WA Goldfields timbers are fast becoming recognised as prime materials for producing world-class musical instruments. See 'Musical Timbers' on page 48.*

*A new CALM book,* Dive & Snorkel Sites in Western Australia, *will encourage novice divers and snorkellers to explore the rich and diverse coastline of WA. See 'Secrets of the Sea' on page 10.*

*The common rock-rat, photographed here in the Kimberley, has recently been recorded in the Kennedy Range National Park. See page 28 for a profile of this wonderful wilderness area.*

## FEATURES



## REGULARS



## COVER

The brilliant purple flowers of the twining fringed lily (*Thysanotus patersonii*) entwined around the burnt stem of a slender banksia (*B. attenuata*). See 'After the Burn' on page 21.

*Illustration by Philippa Nikulinsky*


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**Illustrations:** Gooitzen van der Meer, Philippa Nikulinsky
**Cartography:** Promaco Geodraft
**Marketing:** Estelle de San Miguel ☎ (09) 334 0296 Fax: 334 0489
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