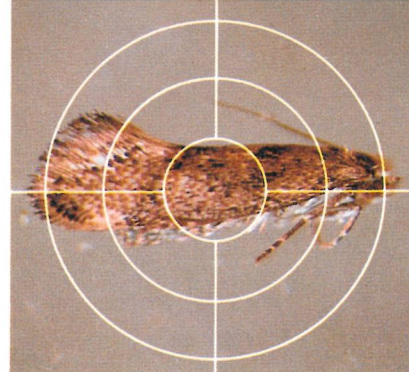


The jarrah leaf miner and its natural enemies

■ Jarrah forest damaged by the miner. Note dead branches.



■ The leaf miner moth.

by Z. Mazanec*

The larva of the small native moth, the jarrah leaf miner, *Perthida glyphopa* Common, is the most important insect pest of jarrah, *Eucalyptus marginata*, in the south west of Western Australia. Large-scale damage to jarrah leaves, resembling scorching by fire and occurring during September-October of each year was first noted near coastal settlements and townships in the early 1920s.

In the 1950s, outbreaks of the leaf miner appeared in the inland forest between the townships of Mount Barker and Manjimup, from whence they spread rapidly farther to the north and west. At present the area of forest and partly-cleared land on which jarrah is being damaged annually is approximately 19,000 square kilometres. The most severe infestation occurs along forest edges, in clearings, in forests of thin canopy and in partly cleared land.

The leaf miner has natural enemies, but the prospects of making better use of them are not encouraging to date.

Distribution and damage

Jarrah is the principal host tree, but in addition, a leaf miner similar to *P. glyphopa* also occurs in other eucalypts. Of these the coastal blackbutt, *E. todtiana*, a tree restricted to the northern region of the jarrah forest, and the more widely distributed flooded gum *E. rudis*, occurring in riverine environments, are the most heavily attacked. The distribution range of the flooded gum and of its leaf miner extends north to the Murchison River, where the tree resembles the river red gum *E. camaldulensis*. In the south it extends to Albany and some eastern areas. However, in situations where jarrah and flooded gum grow together, it is often only the flooded gum which harbours the leaf miner. While no morphological differences could be established between the moths from jarrah and the flooded gum, it is uncertain whether the leaf miner attacking *E. rudis* is *P. glyphopa*, or

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■ Typical leaf damage from miner attack.

a different species. This article therefore is concerned with the leaf miner found in jarrah.

The leaf miner does not kill jarrah trees. When an infestation is heavy, many of the mined leaves die off in late September-October, and are shed soon after. Those damaged to a lesser degree are retained until December-February, the time of leaf flush, then dropped and replaced by new ones. However the tree does not always replace all the damaged leaves, especially in the years preceded by a drought. Many of the leaf-bearing branchlets remain bare and die, leaving permanent damage in the crown. This now may be observed in the outbreak areas. The less obvious effect of the attacks is the reduction of wood increment.

Life cycle

The leaf miner has a single generation per year. Its life cycle consists of an egg, four larval instars (growth phases), prepupa, pupa and adult. Moths emerge in April-May and are active on fine, sunny days. The females deposit their eggs singly under the lower epidermis of the leaves, and the larvae begin to feed from late May till September or October, each excavating a blotch mine.

When feeding is completed, each larva constructs an elliptical cell by cutting out the upper and lower portions of the mine, and fastening them together with silk. The cell is released from the mine at night, when the larva snips off the yet unfastened ends, leaving a hole in the leaf.

Encased in the cell on the ground, the larva protrudes from one of the cell's ends, and burrows 2 to 3 cm deep in the soil, dragging the cell behind. It then withdraws into the cell, seals both ends with silk and remains quiescent in an upright position until the end of February, when it pupates. In April-May the pupa pushes out of the cell to the surface of the soil, where the moth emerges.

Natural enemies

The long periods of feeding in the leaves and the transfer to the soil, expose the larvae to numerous natural enemies. They are the parasites, birds and predacious insects. The parasites are small wasps which attack the larvae in both leaves and soil. Altogether there are seven important species, as yet undescribed.

Females of the internal parasites insert their egg(s) inside the larva of

the leaf miner (host). In two of the parasite species mentioned above, the larvae feed within the living host, killing it only after they have completed their own development approximately 4 and 9 months after hatching, respectively. In contrast, the female wasp of the third species kills the host at oviposition time, and its larva then feeds on the dead tissue within, completing the life cycle in 3 to 4 weeks. Only one of the three species is specific to the jarrah leaf miner.

The female wasps of the four external parasites paralyse the hosts by stabbing them before depositing their eggs into the mines. The parasitic larvae then feed on the surface of the paralyzed host, and later pupate within the mines from which the adults emerge by chewing escape holes. The duration of the life cycle is 3 to 4 weeks, and is strongly influenced by temperature. None of the external parasites are specific to the jarrah leaf miner, and require an alternate host.

As the leaf miner larvae approach maturity, they may be eaten by birds. Surveys showed that the gizzards of

■ A parasitic wasp attacks the adult pest.





■ Leaf miner larva under attack.

seven species of small birds contained remains of leaf miner larvae: the silveryeye, two species of pardelotes, three of thornbills, a honeyeater and the twenty eight parrot. The red wattle bird also feeds on the leaf miner larvae in leaves.

When the mature larvae in their cell fall to the ground, but fail to bury during darkness, they are collected and eaten in the daylight by predacious insects, especially the ants. Some ants carry and store the cells in the galleries of their nests, and eat the larvae later. Ants, carabid beetles and their larvae, earwigs and other litter-dwelling arthropods continue to chew up any partially-buried cells containing larvae, throughout the period of the leaf miner's quiescence in the soil. In addition, an external, non-specific parasitic wasp seeks out and parasitises such cells.

The ability of natural enemies to influence the abundance of the jarrah leaf miner varies with climatic conditions. At the warmer, northern end of the Darling scarp, where the leaf miner has never reached outbreak densities, many of the feeding larvae which have been parasitised internally, also are parasitised externally and eaten by birds, because neither the external

parasites nor the birds discriminate between internally parasitised and healthy prey. The intense competition between the three groups ensures a very low survival rate of the feeding larvae each year.

The rate of parasitism declines in the cooler, southern region of the Darling Range and beyond. Here the internal parasites often are absent altogether, so the external species and the birds are the principal enemies of the feeding leaf miner.

The external parasites often account for a higher degree of mortality, because they attack the smaller-sized host, are active longer and leave fewer prey for the birds. This situation is reversed in cooler years, when the external parasites develop more slowly, and are less abundant. The proportions of feeding larvae taken by the external parasites and birds therefore fluctuate according to the weather conditions, but the final reduction in leaf miner numbers is always high enough to prevent an outbreak.

When the population density of the leaf miner increases as a result of a high oviposition by female moths, there is usually no proportional increase in parasitism and predation. This is due to the general scarcity of the specific, internal parasite, because of its low survival and problems of synchrony with the host. Similarly the external non-specific species are unable to cope with the increased numbers of leaf miners, because having existed on the scarce alternate hosts during the previous nine months of summer and winter, their density is very low. Often they cannot increase fast enough, because of the cool weather conditions in August-October. Parasitism therefore remains at a relatively low level, and fluctuates according to the weather.

Predation by birds, on the other hand, does not fluctuate at high population densities. Here the birds do not have to compete for their prey with external parasites, so their consumption may even increase. However, the increase is usually only small, because it soon reaches the

ceiling at the point of their satiation. Since the birds live mostly locally their numbers change little, and their consumption of the leaf miner remains fairly constant from year to year.

Similarly, natural enemies active at the soil surface have only a limited opportunity to attack the mature larvae in the cells. The larvae transfer from leaves to the ground at night, bury before daybreak, and thus escape the predators which are active only in daylight. The low mortality rate of those in the soil indicates that once buried, they are inaccessible to their enemies.

Control prospects

The prospects of restraining outbreaks of jarrah leaf miner through its own natural enemies therefore are not promising. The geographic distribution of the parasites, together with their dependence on weather and alternate hosts, allows them to attain only relatively low population densities.

Likewise, the predators cannot respond numerically to the seasonal nature of the leaf miner's availability as food.

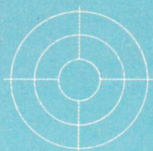
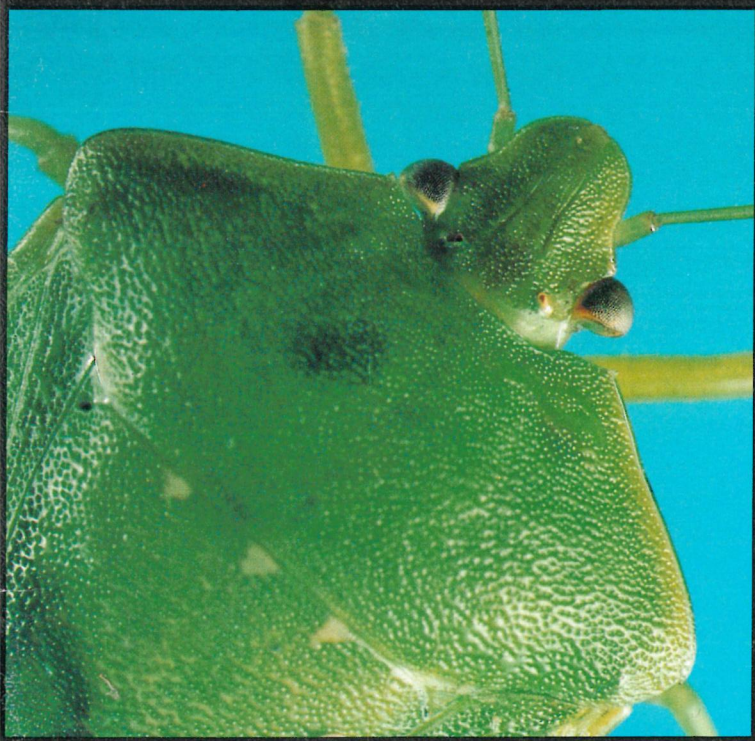
These restrictions are not relaxed when numbers of leaf miner larvae reach high levels as a result of increased egg laying by moths.

The density of leaf miner eggs in a forest often may rise gradually over several generations. This can be caused by increased egg laying activity of local moths, but more often by females which have immigrated from the neighbourhood. In such situations the density is limited only by the fecundity and natality of the moths. These two factors are influenced by the condition of the host tree. Young leaves produced in the most recent growth flush, stimulate egg laying.

The jarrah tree's ability to recover from damage and provide the leaf miner with new leaves, even after repeated attacks, favours the continuation of outbreaks.

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