Gumleaf skeletoniser (*Uraba lugens*) is native to Australia and recognised as a serious defoliator of many eucalypts. The moth species occurs in all states and territories except the Northern Territory and is now one of Australia's less popular exports to New Zealand, where it was found in 1992 emerging as a pest on amenity and plantation trees. While a natural pest in Australia, outbreaks of gumleaf skeletoniser may pose a real risk to forest health. Defoliation caused by the larvae reduces food sources for animals and can impact on the growth of trees. Its effect can be particularly severe when combined with other stressors such as drought. What's more, leaf litter build up caused by the gumleaf skeletoniser poses an increased risk of fire. So what do we know about these creatures and the destruction they may wreak on our forests?

What is a gumleaf skeletoniser?

Gumleaf skeletoniser caterpillars, or larvae, feed on a wide range of eucalypts and related species within the family Myrtaceae. There are two recognised biological forms: one 'coastal/inland' form that produces two generations a year, an average of 11 larval instars (stages between moults) and eggs laid in parallel rows spaced one egg diameter apart; and a 'highland form' which has one generation a year, an average of 13 instars and eggs laid in less organised clumps with no intervening spaces.

In the southern jarrah forests of Western Australia, gumleaf skeletoniser populations are a variant of the 'coastal/inland' form, with predominantly one generation a year. However, there are populations that are thought to produce two generations on the northern and southern coastal margins of its distribution, brought on by warm, dry winters.

High-hats and itchy hairs

The eggs and larvae of this species are very distinctive. Newly laid eggs look like green circular discs with a crimped pattern around the upper edge. As the embryo develops the egg turns yellow to brown, and the developing larva can be progressively seen through the top of the egg as a red–brown spot which develops into a dark black spot, gradually filling the entire egg case.

The tiny newly hatched larvae are initially gregarious, connected to each other by silk threads. They feed close to their eggs by consuming leaf tissue between the leaf veins and avoiding oil cells. Larvae grow through successive moults, moving out from their initial

Gumleaf skeletoniser

a defoliator of jarrah

During the past two summers the jarrah forest from Greenbushes to Quinninup and Nannup to Rocky Gully experienced severe defoliation as though badly scorched by fire. Extensive areas of brown tree canopies and trees with near-complete defoliation alarmed local communities who feared their forests were dying. The cause was the larvae of a moth called *Uraba lugens*, more commonly referred to as gumleaf skeletoniser.

by Janet Farr

Left A gumleaf skeletoniser with its distinctive head-dress on a skeletonised leaf.

Background above A gumleaf skeletoniser egg raft infected with fungus. *Photos – Janet Farr/DEC*

feeding site as they systematically skeletonise the leaf. It is this feeding pattern which gives them their common name.

At about the fourth to fifth moult, or instar, their gregarious habit starts to break down, and the larvae become more solitary. Feeding progressively changes to leaf munching and they start to retain their head capsule from the previous moult by stacking it on top, creating a distinctive 'head-dress'. The larvae also have prominent hairs that, when touched, can cause irritation and skin rashes in some people. The hairs and distinctive head-dress are thought to help deter bird predation.

Another weapon in the gumleaf skeletoniser's arsenal of survival strategies is its ability to abseil using silk threads. This enables larvae to disperse to different branches and trees during feeding, increasing the likelihood of survival when food reserves are depleted from the branch on which their eggs were laid.

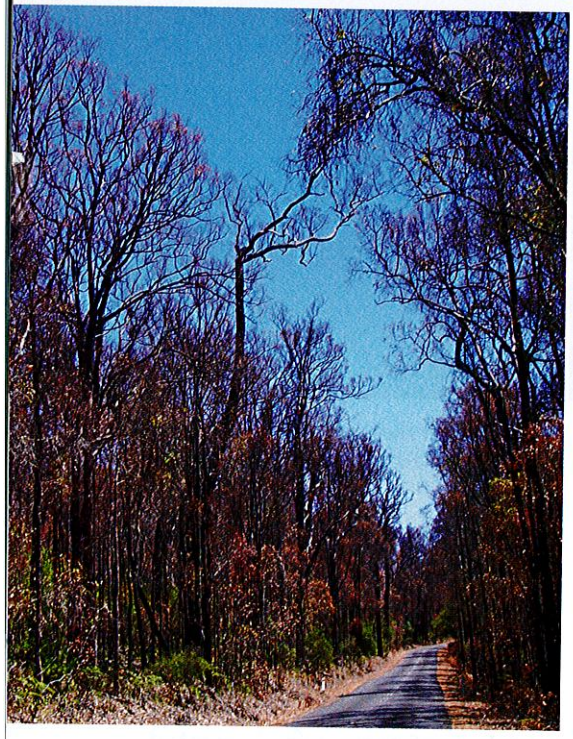
In its adult phase the gumleaf skeletoniser becomes a small grey moth. Some insect taxonomists place the species in the moth family Nolidae and others in Noctuidae.

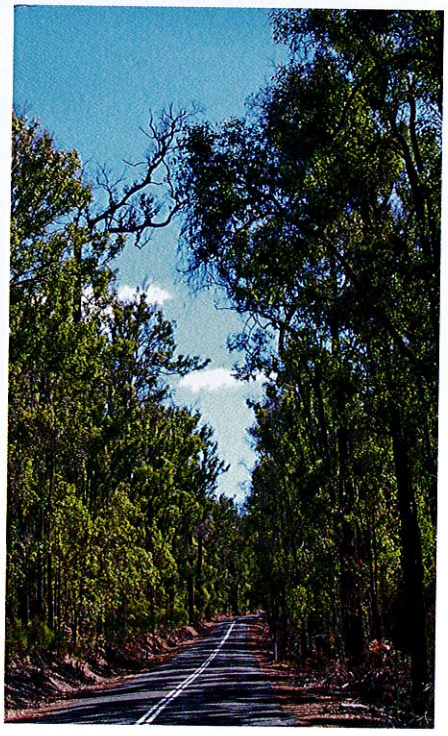
Natural enemies

As with all biological organisms, the gumleaf skeletoniser has a range of natural enemies. There are 22 known primary parasitoids, which attack mainly larvae and pupae, and six invertebrate predators known to eat gumleaf skeletoniser.

In WA four species of wasp have been found in the southern jarrah forest in gumleaf skeletoniser populations: *Cotesia urabae*, *Casinaria micra*, *Euplectrus* sp. and *Trichogramma* sp.. High levels of *Euplectrus* sp., together with an unidentified pathological agent, helped significantly reduce gumleaf skeletoniser numbers and bring an end to the massive outbreak in the Western Australian jarrah forest during the 1980s. However, incidences of this wasp are usually very low. *Euplectrus* wasps infest and feed on their prey by attaching to the outside of their host on the underside of larvae between the forelegs, and are often overlooked by the casual observer.

By contrast, the wasp *Cotesia urabae* is a more readily observed enemy, burrowing into its host. Wasp grubs feed off the host from the inside, but





Above Taking samples of gumleaf skeletoniser from the forest canopy.
Photo – Kerry Ironside

Far left Wheatley Coast Road during the outbreak in January 2011.

Left Wheatley Coast Road in April 2011, after leaves have resprouted.
Photos – Steve Collings/DEC

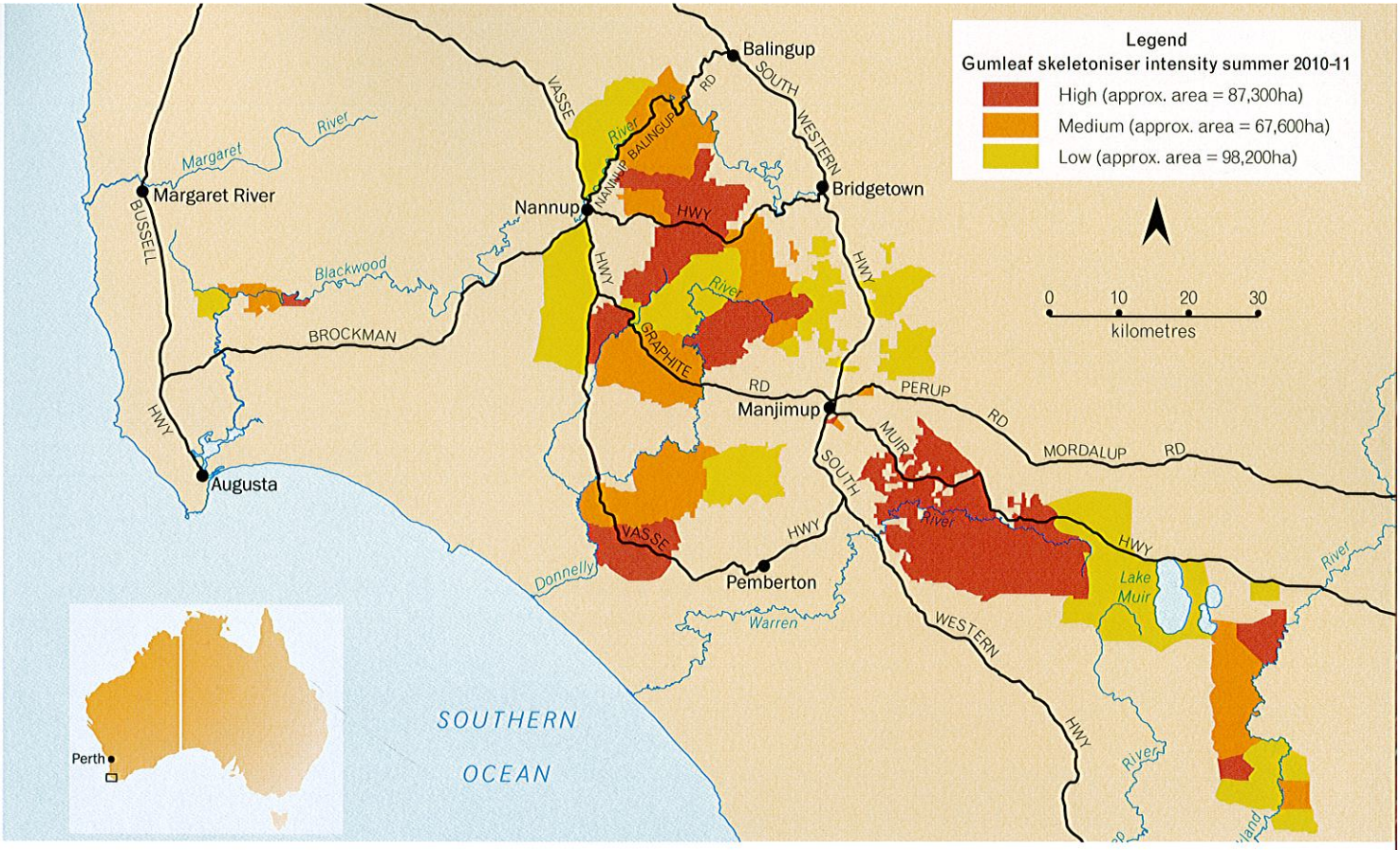
just before pupation the parasitoid larva emerges from its host, leaving a distinctive wound. Pupation occurs alongside the gumleaf skeletoniser larva after spinning a distinctive yellow-white cocoon. New Zealand has imported this species for potential biological control of gumleaf skeletoniser. Other agents which increase gumleaf skeletoniser mortality are fungi such as *Beauvaria bassiana* (Moniliaceae), *Aspergillus* spp. (Eurotiaceae) and *Chaetomium* sp. (Melanosporaceae).

Outbreaks

The earliest record of gumleaf skeletoniser as a significant defoliator was in 1900. Since then it has caused occasional to severe damage in New South Wales, Victoria, Queensland, South Australia and Tasmania. The first recognised outbreak of gumleaf skeletoniser in WA was between 1983 and 1992 when, at its peak, 90,000 hectares of jarrah forest were defoliated.

After 1992 gumleaf skeletoniser declined to very low levels in the forest; so low that it was not often encountered. However, since 2001, the Department of Environment and Conservation's (DEC's) Science Division has been recording the occurrence of gumleaf skeletoniser as part of a project called FORESTCHECK (see 'Keeping our forests in check', *LANDSCOPE*, Autumn 2004). In November 2007, the project found that incidences of gumleaf skeletoniser had started to increase in the southern jarrah forest.

Isolated patches of moderate defoliation were detected in summer 2009–10 near Wheatley–Donnelly and Quininup, very close to the original 1980s outbreak. Severe defoliation followed in 2010 to 2012, such that in February 2011 more than 250,000 hectares of jarrah forest suffered near-complete canopy loss—an area slightly larger than the Australian Capital Territory. Gumleaf skeletoniser populations during this period were more than 10 times higher than



Below A leaf completely skeletonised by gumleaf skeletoniser. Only the veins and oil glands remain.
Photo - Janet Farr/DEC

recorded for the post-1980 outbreak period and 1.7 times the recorded peak in 1987.

Population monitoring and future directions

DEC research into the gumleaf skeletoniser has revealed that the larvae appear to be more prevalent in areas that have experienced a long time since fire, indicating prescribed burning as a possible management measure. However, DEC seeks to gain more information on the larvae before putting such measures in place. As such, departmental scientists have been monitoring population numbers.

During the initial outbreak, population levels were monitored quantitatively. This was done using an elevated work platform to collect foliage samples from jarrah trees in forests near Manjimup. The branch clipping method in the upper forest canopy involved physically counting larval numbers in the laboratory and relating the numbers to the amount of leaves consumed. Since 2011, populations have again been monitored using this technique, at both the original locations and in new monitoring sites. Using this method enables useful information to be gathered on both population levels and larval mortality due to pathological agents including parasitoids and fungi. However, this form of sampling is expensive, time-consuming and hazardous.

Over the past two years DEC's Science Division has successfully trialled a pheromone specific to gumleaf skeletoniser developed in New Zealand. The pheromone, known as Desire®, mimics the chemical attractant released by female moths to lure sexual partners. Using this lure will enable DEC researchers to regularly monitor the forest for gumleaf skeletoniser levels both in outbreak and non-outbreak periods, and determine populations relative to the quantitative levels initially monitored using the branch clipping method.

In addition, researchers will use a digital camera to develop a 'leaf area index' which will enable the level of canopy loss to be more accurately determined. They will then investigate relationships between forest defoliation levels and gumleaf skeletoniser populations, together with geographic information systems and satellite imagery. Integration of these technologies will enable a more consistent evaluation of population fluctuations of gumleaf skeletoniser and help us understand more fully its outbreak dynamics.

Janet Farr is a research scientist specialising in forest entomology with the Department of Environment and Conservation's Science Division based in Manjimup. She can be contacted on (08) 9771 7996 or by email (janet.farr@dec.wa.gov.au).

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Executive editor Madeleine Clews.

Editors Samille Mitchell, Joanna Moore.

Scientific/technical advice Kevin Thiele, Lachie McCaw, Keith Morris, Chris Simpson.

Design and production Lynne Whittle, Gooitzen van der Meer, Natalie Jolakoski, Peter Nicholas.

Illustration Gooitzen van der Meer.

Cartography Promaco Geodraft.

Marketing Cathy Birch.
Phone (08) 9334 0296 or *fax* (08) 9334 0432.

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