The ant, the butterfly, the leafhopper and the bulldozer

by **Tim Gamblin, Matthew Williams** and **Andrew Williams**

The delicate complexities of a symbiotic relationship between a butterfly once thought to be extinct, a sugar ant and a sap-sucking leafhopper are only just being discovered.

Exclamations of 'wow' and 'incredible' are typical responses from even the most seasoned naturalist upon hearing of the extraordinary relationship between a sugar ant, a threatened butterfly and a leafhopper living together in subterranean galleries close to the Wheatbelt town of Mukinbudin. This is the stuff that reinvigorates a passion for biology or sparks it in those so far untouched. The life history of the critically endangered arid bronze azure butterfly (*Ogyris subterrestris petrina*) is not only a wonderful example of the interrelatedness of life but is also a fine illustration of a threatened species being managed to provide an agreeable outcome for all stakeholders.

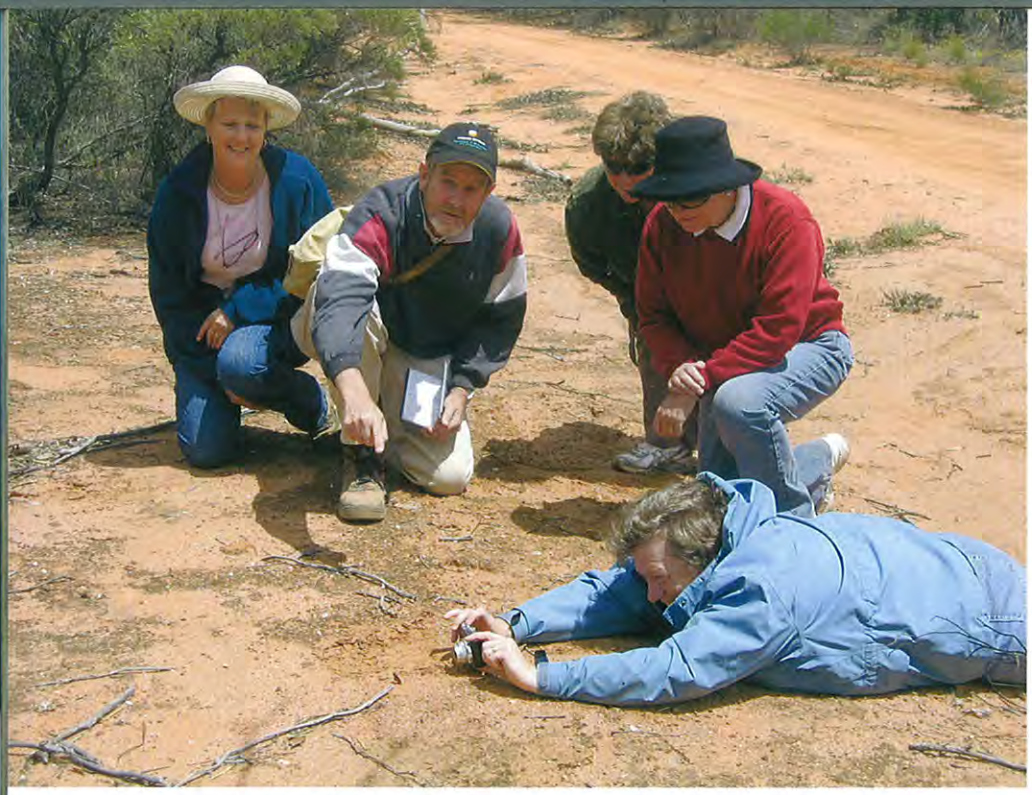
This butterfly, which had not been seen for almost 14 years, was recently rediscovered in the northern Wheatbelt. Concerningly, imminent roadworks threatened to destroy its habitat less than six months after it was found. This is the story of how the Mukinbudin Shire, the Mukinbudin Conservation Group, the Department of Environment and Conservation (DEC) and volunteers worked together to help this rare butterfly and its host ant keep their habitat from being bulldozed for a new road.

The arid bronze azure butterfly is a medium-sized, fast-flying butterfly endemic to Western Australia. It is predominantly dark brown to black, with iridescent bronze or purple-bronze flashes on the upper sides of the wings. Like most species of azure butterfly (members of the genus *Ogyris*) it is both rare and highly localised in occurrence. Azure butterflies are members of the lycaenid family, a group of butterflies with coppery or blue wings.

The butterfly was discovered near Lake Douglas, 12 kilometres south-west of Kalgoorlie in the early 1980s. It was known from just this one site and searches of surrounding areas over several years failed to locate any other populations. Then, around 1993, the population at Lake Douglas disappeared. DEC staff and butterfly enthusiasts continued to search unsuccessfully for the arid bronze azure. Fearing the butterfly may be extinct, a *LANDSCOPE* article was published appealing to the public to report any possible sightings (see 'Endangered or extinct? Kalgoorlie's arid bronze azure', *LANDSCOPE*, Summer 2005-06).

Above A female arid bronze azure butterfly (*Ogyris subterrestris petrina*).
Photo – Geoff Walker

Above right Matthew Williams and Andrew Williams 'pooting' ants—sucking them into test tubes for collection as voucher specimens.
Photo – Tim Gamblin



Above Members of the Mukinbudin Conservation Group help with research. *Photo – Clare Smith*

The rediscovery

In 2006, a keen butterfly enthusiast and photographer, Geoff Walker, planned to visit WA, including the Lake Douglas site, with the faint hope of locating the arid bronze azure. In late October, having failed to find the butterfly, he headed west towards the coast.

The rediscovery happened by chance. Geoff was driving through a small remnant of woodland close to Mukinbudin. He described seeing a large, dark butterfly darting across the road. He knew it had to be an *Ogyris*. He slammed on the brakes, forgetting for a moment that he was towing a two-tonne caravan!

Geoff managed to photograph several of the butterflies at the site and reported these to DEC's Science Division in Perth. DEC senior technical officer Andrew Williams immediately visited the site and obtained a series of specimens which were provisionally identified as the 'long-lost' arid bronze azure butterfly. Specimens subsequently sent to Dan Schmidt at Griffith University for genetic analysis confirmed this identification.

The new locality was in a small patch of remnant bushland, only about one hectare in size, sandwiched between a road and a railway line. The area was a road and rail reserve embedded in, but not actually a part of, a nature reserve. Andrew revisited the site in November and established transects, both in the site where the butterfly had been seen and on the adjacent nature reserve, to map the occurrence of the butterfly. He found that the core of the population was centred on the small patch of bushland in the road and rail reserve and that relatively few butterflies were found outside this area.

Word of the discovery spread rapidly through the butterfly community. Local DEC nature conservation officer David Jolliffe was advised of the possible threat from butterfly collectors visiting the site. Although the arid bronze azure had been proposed for listing as an endangered species more than 10 years earlier, at that time the Threatened Species Scientific Committee felt there were insufficient survey data to be sure the species was endangered. So, like all of the butterflies outside conservation reserves, the new population had no formal protection.

The ant and the butterfly

In order to reproduce, the arid bronze azure butterfly has a close association, or symbiotic relationship, with the 'pale coloured' or 'Goldfields' form of a sugar ant (*Camponotus terebrans*). The butterfly larvae (caterpillars) feed on, or are fed by, the ants. They live entirely within the ant's subterranean nest during their development. The ants protect the butterfly larvae from predators and the ants, it is thought, are rewarded with secretions produced by the larvae.

The butterfly larvae also emit chemical signals that mimic those of the ants and produce sounds to convince the ants that not only do they pose no danger, but should be given the best hospitality. In similar ant–butterfly species relationships, the ants will care for the caterpillar as well as, if not even better than, the ant queen. When fully developed, the larva pupates inside the ants' nest. When the adult butterfly emerges, it must make a hasty exit towards the light as, unlike the larva, they do not emit signals of immunity and the ants will attack them.

Large numbers of sugar ants are required to support a colony of the butterflies—it is thought about 500 ants for each larva. This means the butterfly's survival depends not only on the presence of the ants, but on massive colonies of them. This was confirmed when surveys found high densities of ant nests within the main butterfly breeding area.

Due to the ant–butterfly relationship, any threat to the ant colonies is also a threat to the butterfly. In order to effectively preserve and manage the butterfly one must protect the ant colonies. Therefore, one of the critical recovery actions for the conservation of the butterfly species is the establishment of a monitoring program to detect signs of decline of the ant colonies and to better understand the environmental variables or habitat required for their persistence.

An important question to ask is: what do the ants require from the environment to establish strong colonies? This will take more time to answer completely but initial results are very interesting. A sample of ant colonies was mapped throughout the area and habitat data for each ant nest gave an indication of some of the environmental variables required for the presence of the ant. It was found that proximity to disturbance (such as nearby tracks or other cleared areas) and the presence of eucalypt trees were critical to the presence of sugar ant nests.

Given that many areas close to the site with similar habitat have no ant nests and no butterflies, it is believed that there are other subtle requirements

Left A pre-pupal larvae of the arid bronze azure butterfly with attendant sugar ant (*Camponotus terebrans*).

Below left Habitat of the 'pale coloured' or 'Goldfields' form of the sugar ant—smooth-barked eucalypt species in open woodland with light disturbance.

Below right A sugar ant feeds from a leafhopper *(Pogonoscopus myrmex)* while others keep guard.
Photos – Tim Gamblin

for the presence of ant colonies which are as yet unknown. More than 100 sites in the Wheatbelt and Goldfields superficially appear to be good potential habitat for the ants, but have been searched without positive results.

Ants farming leafhoppers

As well as hosting the larvae of the butterfly, it was found that the ants also host leafhoppers within their nests. Leafhoppers are sap-sucking insects with piercing mouthparts to puncture the bark of plants so they can feed on the nutritious sap. When the ant nest was disturbed, ants were seen carrying leafhopper adults and nymphs in their jaws to safety undercover. Leafhoppers were also observed in other nearby ant nests, indicating that this was an organised symbiotic relationship.

As most sugar ants are nocturnal, the site was visited in the evening. On the trunks of many trees the ants were observed 'shepherding' their leafhoppers to 'pasture' to feed on the tree sap. Unlike many herbivorous insect species that are 'farmed' by ants in the tree canopy, most of the leafhoppers were located between one and three metres above the ground on the tree trunk. Each leafhopper was closely attended by several ants, giving them protection from predators. Ants were observed feeding on the excess sap excreted by the leafhoppers. Some of the leafhoppers disturbed by the intrusion were promptly marched back down the trunk and into the ants' nest and it is assumed that the entire 'herd' would be shepherded below ground to safety before sunrise.

The leafhopper species was collected and identified as *Pogonoscopus myrmex* and had not been recorded from nests of the 'pale coloured' form of this species of sugar ant before. This leafhopper species is small and streamlined compared with those that live above ground—probably an adaptation to their mainly subterranean life within the ant galleries.

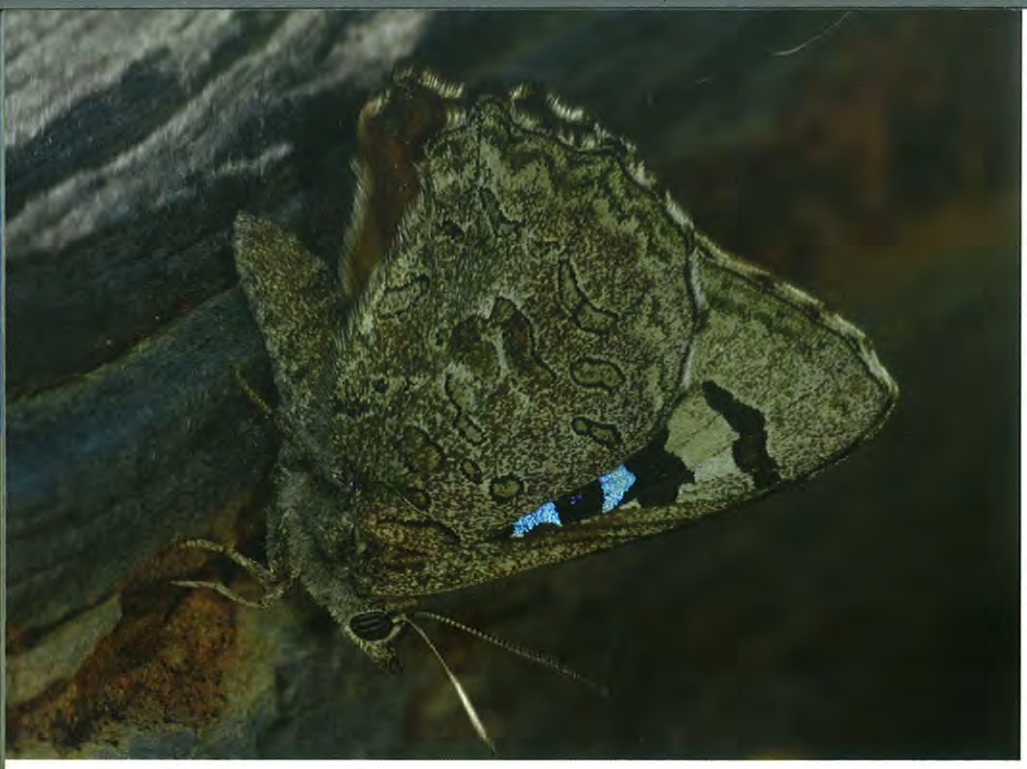
It is little known that certain species of leafhoppers were found to cohabit below ground with ants. While it is not new to science that lycaenid butterflies often associate with ants, it is far less common that their caterpillars develop entirely below ground and even less well known that leafhoppers also share the ant galleries. For both caterpillar and leafhopper to occur together in a single ant nest is quite remarkable and possibly unique.

What is not known is how much the ants rely on the leafhoppers for food. If they depend heavily on the leafhoppers to maintain strong colonies then the original question should also include the leafhoppers: what do the ants and the leafhoppers require from their environment to promote strong colonies?

Aside from the protection the ants provide, the answer is likely to be related to the sap they obtain from the eucalypts: its quality and quantity. This may explain why ant nests are found with particular species of eucalypt, particularly those that are smooth-barked such as gimlet (*Eucalyptus salubris*) and the Lake Grace gum (*Eucalyptus loxophleba* sp. *gratiae*).

The bulldozer

Although the news of a new population of the arid bronze azure was widely known, the exact locality was kept confidential. In February 2007, local butterfly enthusiast Daniel King asked for details of the site so



Left A male arid bronze azure butterfly. *Photo – Geoff Walker*

he could see the butterfly and perhaps locate additional populations. The news he brought on his return to Perth was a blow: a major road-widening project was threatening the site.

DEC's local conservation officer immediately contacted the local shire and discovered that the road adjacent to the butterfly population was a 'black spot'—a common car crash location—and that a project to re-align the road was already in progress. A permit to clear the remnant vegetation between the road and railway line, the core habitat of the butterfly, was in the process of being submitted to DEC.

With this imminent and major threat to the habitat of the only known population of arid bronze azure butterflies, the rare species was again nominated to the Threatened Species Scientific Committee for formal listing. This was possible because many more surveys had been conducted in the region since the previous application. Due to the level of threat posed to the butterfly, it was assessed as critically endangered and gazetted as schedule one (rare or likely to become extinct). The listing halted the roadworks and also prevented collectors from taking specimens. It also provided the incentive for the then Avon Catchment Council (now Wheatbelt Natural Resource Management) to fund a baselining program of the arid bronze azure's habitat as part of a monitoring project for the catchment.

Additional surveys of the site by DEC staff from Merredin and Perth confirmed that the area under application for clearing was a major part of the breeding area of the arid bronze azure. Mukinbudin Shire's plan to clear this area to eliminate the black spot had been made before the discovery of the butterfly and, once the shire was alerted to the significance of the area, it was keen to assist in reducing the threat to the butterfly. However, all parties agreed that eliminating the black spot for the safety of road users was also crucial. Some compromise solution needed to be found.

The compromise and the future

The Mukinbudin Shire modified its road realignment plan so the new road would be closer to the railway line, passing through land that had already been cleared. The shire also plans to rehabilitate the old road area with local plants, providing additional habitat for the ants, the butterflies and the leafhoppers. This will also provide connectivity between the butterflies' core breeding area and the adjacent nature reserve. Thus the new road will not only resolve the black spot issue but preserve the area of dense ant colonies. Despite the delay in road construction and an increase in the cost of the roadworks, the compromise meets the objectives of all stakeholders and offers the best opportunity for the long-term survival of the butterfly.

Planned future actions at the site include continued monitoring of the butterfly and ant populations, searching for more populations of the arid bronze azure in surrounding areas, and, if the need arises, translocations of the butterflies to other sites with suitable habitat. An interpretive shelter is planned near the butterfly site where visitors can learn more about the ecology of the arid bronze azure, the threats it faces and how the public can contribute towards the conservation of this species.

Tim Gamblin is a technical officer at the Department of Environment and Conservation's (DEC's) Kensington Research Centre. He can be contacted on (08) 9334 0188 or by email (tim.gamblin@dec.wa.gov.au).

Matthew Williams is a DEC senior research scientist at based in Walpole. He can be contacted on (08) 9334 0399 or by email (matthew.williams@dec.wa.gov.au).

Andrew Williams is a senior technical officer at DEC's Woodvale Research Centre. He can be contacted on (08) 9405 5117 or by email (andy.williams@dec.wa.gov.au).

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Scientific/technical advice
Kevin Thiele, Paul Jones, Keith Morris.
Design and production Gooitzen van der Meer, Peter Nicholas and Natalie Jolakoski.
Illustration Gooitzen van der Meer.
Cartography Promaco Geodraft.
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Phone (08) 9334 0296 *Fax* (08) 9334 0432.
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