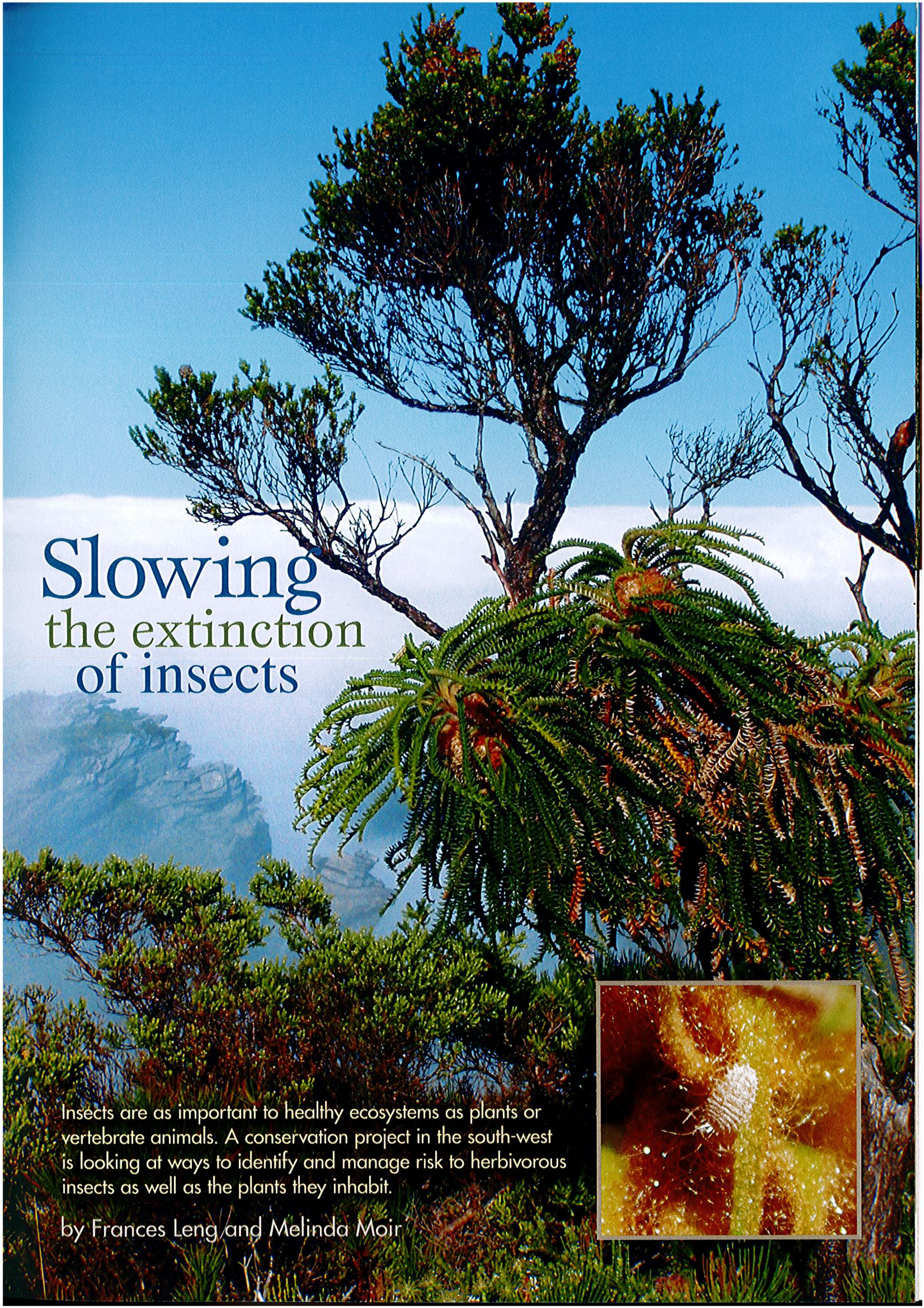


Slowing the extinction of insects

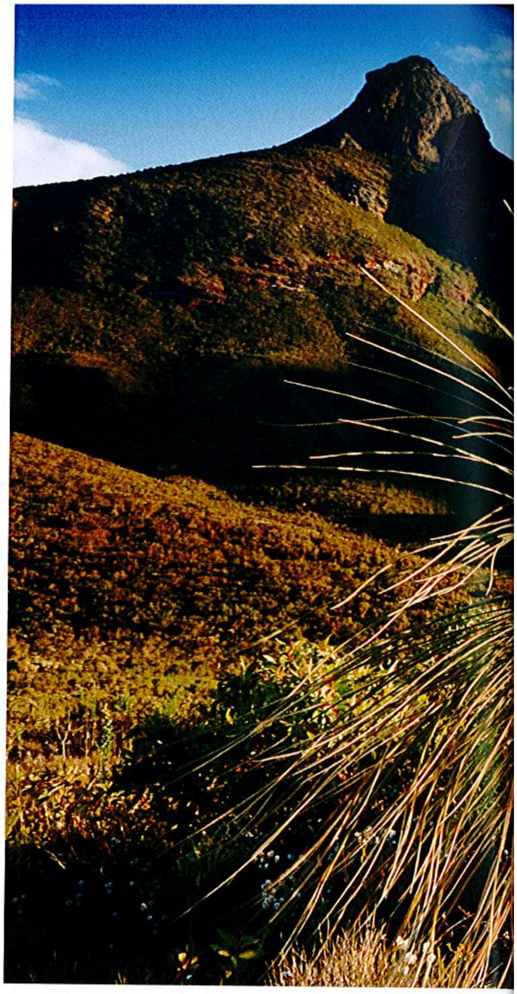
Insects are as important to healthy ecosystems as plants or vertebrate animals. A conservation project in the south-west is looking at ways to identify and manage risk to herbivorous insects as well as the plants they inhabit.

by Frances Leng and Melinda Moir

Australia's south-west region, one of the world's 34 recognised biodiversity hot spots, has a high rate of species endemism thanks to its geographic isolation. One threat to the unique diversity of the region is 'coextinction'; the process whereby a species goes extinct when the species it depends upon (a host) becomes extinct or there is a change in the host's population size. It is thought that as much as 40 per cent of the world's fauna are dependent species that are reliant upon one or more host species for survival. Lose the host and these dependent species are likely to go extinct as well. Loss of species through coextinction is contributing substantially to the current biodiversity crisis. Driving factors that can assist in the acceleration of coextinction rates include habitat loss, invasive species and climate change.

Invertebrates (such as insects, worms, snails and mites) are arguably the largest group to be threatened by coextinction. The importance of invertebrates as a component of biodiversity, and their role in ecosystem functioning, has been well documented. It has been conservatively estimated that invertebrates comprise more than 80 per cent of the world's biodiversity, in terms of number of species and biomass. Beetles alone could represent as much as a quarter of all species on Earth today. These overwhelming statistics are regarded as the major obstacle in effective invertebrate conservation. When so many species must be considered, how do we determine which invertebrate species are potentially threatened, why they are threatened and what to do about these threats?

In Australia it is estimated that there are about 300,000 species of invertebrates (excluding marine species), of which less than a third are described. What's more, of the nearly 100,000 species formally described, we still have little, or no, biological or ecological knowledge of them (with the exception of a few charismatic groups such as butterflies and dragonflies). This lack of knowledge on the distribution, habitat requirements, population size, life cycle and population biology has been termed the 'Wallacean Shortfall'. And such a shortfall makes it very difficult to formulate effective conservation plans for invertebrate fauna.



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Main The critically endangered *Banksia montana* in Stirling Range National Park is the only host plant for the *Banksia montana* mealybug.
Photo – Frances Leng
Inset *Banksia montana* mealybug.
Photo – Sonja Creese

Below Little is known about most insect species, except charismatic groups such as dragonflies.
Photo – Marie Lochman

Why worry about insects?

Insects play a fundamental role in maintaining healthy ecosystems. They are often the main food source for many other animals, such as insectivorous birds, spiders and skinks. Insects also form important mutualisms (beneficial partnerships between multiple species) with non-herbivores such as certain species of ant. However, the value of the roles of insects is difficult to discern. It is challenging to save a species when we have virtually no knowledge of it. The only certainty is that extinction is forever. And it is for this reason that the precautionary principle should be applied in efforts towards insect conservation.

The precautionary principle is the idea that a lack of full scientific certainty is not a reason to postpone action, if the postponement could cause extinction or other detrimental consequences. A world without insects

Above Ellen Peak in Stirling Range National Park.
Photo – Andrew Halsall

Right Insects often form mutually beneficial relationships with other species, such as these green tree ants tending aphids.
Photo – Jiri Lochman

would be ecologically devastating, with cascades of secondary extinctions and outbreaks of pest plants and animals. With so little information on insects available, and when the consequences of losing any single species on the ecosystem are unknown, it is far better to prevent these unidentified effects by applying the precautionary principle.

Despite difficulties associated with conserving insects, over the past decade there has been a steady gain in momentum in conservation projects in Australia. One such project focused on insect conservation is unfolding in the south-west of Western Australia. The project, funded by the National Climate Change Adaption Research Facility, aims to develop conservation strategies to identify which plant-dwelling insects are at greatest risk of coextinction induced by climate change, and to identify which management actions will be most cost-effective at reducing coextinction.

Saving south-west insects

The south-west is home to an estimated 8,000 plant species, most of which are endemic, with 1,909 identified as needing some form of conservation action. Translocations of more than 45 plant species have been occurring in this region during the past decade to save some of the most highly threatened plants from extinction. The main threats to plants here include dieback caused by the plant fungus *Phytophthora cinnamomi*, wildfire, habitat fragmentation and climate change.

While plant translocations have occurred in the south-west with the aim of preservation, very little work has occurred to save their associated dependent insects. It is estimated that this region contains between 14,200 and 27,500 insects species that are restricted in diet to just one host plant.

Left Vacuuming plants to remove predators before threatened insects are translocated.

Below left *Banksia montana* mealybug translocated onto its host plant.
Photos – Melinda Moir

However, the actual number of insects that are dependent upon all the plant species is unknown. What is known is that if these plants are threatened, then so too are the highly dependent insects reliant on them for survival.

A solution to conserve these threatened and highly dependent insects is to translocate them and their host plants. Ecologist-biologists Joern Fischer and David Lindenmayer described translocation in wildlife conservation as the "deliberate and mediated movement of wild individuals or populations from one part of their range to another", with the aims of increasing species' ranges, enhancing critical population numbers and establishing new populations, thereby decreasing species' extinction risks. Two main types of translocations occur frequently—introductions and reintroductions. Introductions (*ex situ*) establish species outside their recorded distribution, whereas reintroductions (*in situ*) establish species in an area where they once occurred historically, but where they have become locally extinct.

In what is believed to be a world first, the project has recently resulted in the translocation of three highly dependent insects onto rare or conservation-listed translocated plants in the south-west. To reduce the coextinction risk of these insect species, translocation trials are being conducted both *ex situ* and *in situ* in Stirling Range National Park. Two insects that have undergone *ex situ* translocations are the *Banksia brownii* plant-louse (*Trioza* sp. nov.) and *Banksia montana* mealybug (*Pseudococcus* sp. nov.). Vesk's plant-louse (*Acizzia veski*) has been translocated *in situ* onto two naturally occurring populations of its host plant, *Acacia veronica*, within Stirling Range National Park. These three insects have been the focus of

Above Sampling for *Banksia brownii* plant-louse in Stirling Range National Park.
Photo – Melinda Moir

the translocation trials because they occur on highly threatened plants and their diet is restricted to their one host plant species. The insects have been discovered only recently, with *Banksia brownii* plant-louse and *Banksia montana* mealybug yet to be formally named.

A mealybug and two plant-lice

The *Banksia montana* mealybug is extremely small—just one to three millimetres long. It has the typical oval shape characteristic of its family (Pseudococcidae) and is covered in a film of white fluff. It has only been found on several *B. montana* plants in the eastern mountains of the Stirling Range. The *Banksia brownii* plant-louse is also very small (about three millimetres long) with colouration varying from green to orange, with clear wings. It has been recorded from populations of *B. brownii* in the Stirling Range and three other natural populations occurring around Albany in the south. Both host plants of these two insects are listed as critically endangered nationally and have been the subject of translocation trials by the Department of Environment and Conservation (DEC) for the past decade.

The conservation status of *A. veronica* is 'priority 3', meaning it is in need of further study, while Vesk's plant-louse was recognised in 2012 as a co-threatened species and listed as vulnerable under the state government's *Wildlife Conservation Act 1950* (see 'Endangered', *LANDSCOPE*, Spring 2012).

On the move

These insects have restricted and predominantly localised dispersal. For example, the *Banksia montana* mealybug often remains on the host plant it emerged from. Therefore, its recolonisation to translocated threatened plants at alternative sites or *in situ* plant population sites greater than 10 kilometres away is highly unlikely without human intervention. Translocation of the three insects occurred last spring. Capturing insects for translocation occurred using 'hand collection', 'beating' and 'vacuuming' techniques (the latter with a weed-blower!). The insects were then transported in specially made containers. Once at the translocation site, the insects were caged on their respective host plants to help exclude predators and restrict the insects' movement in the hope of promoting successful attachment to their host plant.

The location where the *Banksia montana* mealybug and *Banksia brownii* plant-louse were translocated—an area on private property north of Albany—was reserved for conservation in 2003. The threatened plants were grown from seed or cuttings and transplanted as seedlings to a 2.8-square-kilometre area of remnant woodland. The *in situ* translocation sites for Vesk's plant-louse are located on the eastern side of the Stirling Range, more than 10 kilometres away from the natural population in the west of the park.

The host plants of the *Banksia montana* mealybug and *Banksia brownii* plant-louse at the *ex situ* translocation site are protected from threatening processes such as fire, grazing and

Above left *Bothriembryon glauerti* is a conservation-priority snail from the same mountains as the *Banksia montana* mealybug.
Photo – Sonja Creese

Above *Atelomastix tigrina* is a threatened invertebrate species from the same mountains as *Banksia montana* mealybug.
Photo – Frances Leng

Below Fieldworkers faced difficult weather conditions.
Photo – Karl Brennan

dieback disease. As the translocation site is located on private property, access to plants is controlled and DEC staff also safeguard the well-being of the plants with regular monitoring. Invertebrate predators and competition from herbivores was controlled by vacuuming the host plants before insects were translocated. However, based on samples collected from translocated plants in 2007, extremely low abundances of both predators and herbivores are expected.

It is highly unlikely that Vesk's plant-louse occurs on hosts other than *A. veronica*, and it therefore is unlikely the louse will switch hosts at the *in situ* sites. This is also true for *Banksia montana* mealybug and *Banksia brownii* plant-louse at the *ex situ* translocation site.

Gaining knowledge

It is hoped that successful translocation trials of these insects will contribute towards constructive plans for multi-species management for critically endangered insect taxa, in addition to *in situ* conservation. Such management plans will add value to existing translocations where more species could be conserved for very little extra resources. *In situ* conservation enables the preservation of natural genetic reservoirs, and *ex situ* translocation will hopefully safeguard these species. But whether successful or not, insect translocation trials will assist in closing the knowledge gap on the ecology of these rare insect species and the roles they play in ecological networks and food webs.

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