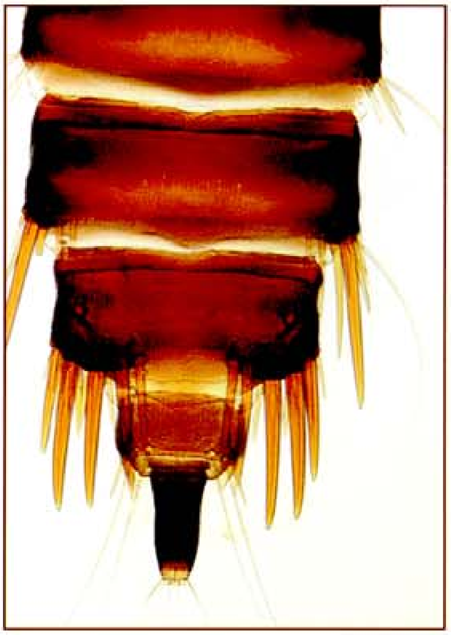

What makes **thri**

Mention the word thrips, and many of us would think of those pesky insects that play havoc with our flower beds and vegetable gardens.

This reputation is largely due to the destructive habits of the western flower thrips, a United States native that spread during the 1980s through most temperate areas of the world. In Australia, this pest is a limiting factor in the production of some crops near Adelaide, Sydney and Perth.

The antics of western flower thrips, and several other species such as the greenhouse thrips, have given these insects a bad name. But there's an international group of biologists that can't help being intrigued by them. In research funded in part by the Australian Research Council, they're investigating thrips for their social behaviour.

In charting the evolution of sociality in thrips, the biologists are seeking answers to fascinating questions. Why should one female surrender the right to produce children, and instead devote her life to protecting her sisters? What selection pressures have ensured that this altruistic behaviour is inherited, so that in certain species some individuals lay eggs and others defend them?

The Oxford don, Bill Hamilton, developed an elegant mathematical explanation based on the fact that in ants, bees and wasps – the majority of social insects – males have only half the number of chromosomes of their sisters, and do not have a father! As a result, sisters are more closely related to each other than a mother is to her own offspring. This means a female passes on more of her genes by raising her sisters than by reproducing herself.

According to Hamilton, altruism is driven by these genetic relationships. Thrips are the other major group of insects with this haplo-diploid genetic system, and theory suggests that sociality should have evolved in some members of this group.

During the 1980s, Bernie Crespi, a Chicago entomologist and student of Hamilton's began to look at patterns of behaviour in thrips. Crespi, who now works at Simon Fraser University in Vancouver, came to Australia because Laurence Mound, an honorary research fellow at CSIRO Entomology, had shown that some species of gall-inducing thrips on acacias exist as winged and wingless forms.

Crespi eventually demonstrated that the wingless forms are actually the first generation in such galls. When they become adult, these wingless forms act as 'soldiers' to defend their gall from attack by other insects, while their mother produces a further generation of mostly female winged adults that disperse to form new galls elsewhere. The soldiers are mostly females, and sacrifice their own reproductive potential to ensure that their sisters have a safe home. Such species are considered truly social.

But the great excitement about biology is that life does not always abide by our theories. Brenda Kranz, a PhD student working with Mike Schwarz at Flinders University in Adelaide has demonstrated that in one species of gall thrips the soldiers do not sacrifice their breeding potential.

The soldiers, not the original female, are responsible for laying the eggs that give rise to the next generation of winged

A thrips gallery.

Left: The yellow soldier female has a broader chest and shorter antennae than the brown long winged gall foundress (far left).

Centre left: The tail end of this thrips species is used like that of a porcupine to drive off its rivals.

Top right: This female thrips glues two *Acacia* leaves across each other to form a home, within which she defends her developing young.

Lower right: Two pest species: the sculptured greenhouse thrips and the spiny western flower thrips (bottom right).

Below: Tom Chapman of Simon Fraser University in Vancouver and David Morris from Flinders University becoming acquainted with the *Acacia* thrips of Central Australia.

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adults. So in this species, which in body structure seems to be ancestral to the other species with soldiers, gall defence rather than consanguinity appears to have driven the evolution of a division of labour, and hence sociality.

Work on thrips under this council grant is not limited to gall-inducing species, because *Acacia* trees in central Australia support a remarkable diversity of thrips. The harsh environment has driven these small insects to develop various ways of sheltering from the sun within domiciles of their own choosing, in which they raise their young.

Some do this by fixing two leaves together with a circle of glue, and then breeding inside the circular space. Others produce a more silk-like product that they use to hold a group of leaves together. Yet others create a structure like a silken purse within which to breed. And many species adopt small holes, often abandoned wasp galls, and have curious adaptations to deter invaders.

But antisocial behaviour seems universal, and a wide range of thrips species has developed the habit of usurping these domiciles, so carefully constructed by their more social relatives. Some of these warring thrips have sharp-pointed claws to stab and kill their rivals. Others have a bizarre arrangement of stout spines at their rear end, which they use to drive off their rivals, as a porcupine uses its tail. Some even produce strong chemicals from their rear end, presumably to repel invading ants.

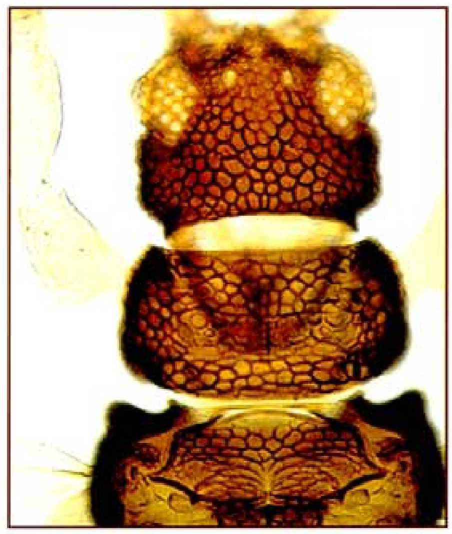
Acacia trees in the Australia's centre may appear peaceful, but look more closely and they shelter a dynamic suite of populations of minute insects. And these insects compete with each other for 'lebensraum', and for life without desiccation.

This complex suite of thrips on *Acacia* trees in Australia is providing opportunities for examining several questions of a more general importance. For example, has each of these interesting behaviours arisen only once: the sociality, the habit of gluing two leaves together, or the use of the tail end of the abdomen as a defensive weapon? Or is the evolution of complex behaviour patterns driven by the environment, with each arising several times?

David Morris, another PhD student with Michael Schwarz, is using molecular biological techniques to examine relatedness between many of the species involved. With Laurence Mound, he is formally describing the many new species and constructing phylogenies. Together with Bernie Crespi, they hope to trace the evolution of these different traits.

It is not just on *Acacia* trees, however, that complex behaviour patterns are being observed in thrips. Darryl Jackman, a PhD student at the Waite Campus, is also working with Laurence Mound. They have noted that males of the pest thrips on citrus in South Australia form aggregations to which individual females are attracted for mating. In birds, such male aggregations are called leks, but they have not previously been noted among thrips.

Social, and antisocial, interactions among the many species of these minute insects are probably not determined primarily by visual cues. Thrips probably communicate with chemical messages. Through developing our understanding of thrips evolution, behaviour and communication, the scientists hope, ultimately, to find novel methods of population control of the noxious pests, including those western flower thrips on your capsicums and chrysanthemums.



Laurence Mound, who until his retirement was Keeper of Entomology at London's Natural History Museum, is a world authority on thrips. He is interested in the public appreciation of science and has written for young people books about the insect world. His current project at CSIRO involves producing on CD-ROM an illustrated information system about thrips pests of the world.