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The Mysterious Fighting Swarms

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THOUSANDS of bees may die in battles to the death in fighting swarms of Australian stingless bees. In a groundbreaking new study, Ros Gloag of the University of Sydney has discovered the cause of this puzzling behaviour.

What is a Fighting Swarm?

A huge swarm of *Trigona* stingless bees sometimes gathers in front of their nest or hive. Pairs of flying bees will grasp one another with their jaws and fall to the ground, wrestling to the death. In a major fighting swarm, the result can be a carpet of thousands of dead and dying bees on the ground, locked in mortal combat.

Back in 1982, Les Dollin and I wrote the first report on this behaviour in an article in *The Australasian Beekeeper*[1]. We initially wondered whether worker bees might be expelling drones from a hive. However, microscopic examination of fighting swarm samples soon revealed that all the bees involved were workers.

What triggers this destructive behaviour? Why do the bees attack one another? Do all the bees come from just one hive or are multiple hives involved?

The Research Begins

In 2006 Ros Gloag, in Professor Ben Oldroyd's Beelab at the University of Sydney, set out to answer these questions using modern DNA techniques. Ros needed samples of bees from fighting swarms. So she asked for the help of hive owners through our *Aussie Bee Email Updates* and the ANBees Yahoo! Group.

A number of hive owners sent Ros bee samples from eight naturally-occurring *Trigona carbonaria* fighting swarms between September 2006 and January 2007. They also sent in samples of bees collected from every hive within ten metres of the swarm.

Back in the lab, Ros extracted DNA from the sampled bees and was able to work out the origin of the bees in each swarm.

Invading Bees Cause Fighting Swarms

Ros' results showed that these eight fighting swarms were all caused by bees from one hive attacking or trying to enter another hive.

In each fighting swarm about half of the bees came from the hive closest to the swarm. This was the hive being attacked or the 'defending hive'. It was never more than two metres from the swarm.

The other half of the bees in each swarm came from other hives. Most of these bees came from just one other hive. This was the attacking or 'aggressor hive' (see graphs on page 2).

Left: A carpet of bees that have fought to the death, after a fighting swarm. Right: Ros Gloag of the University of Sydney studies a Trigona carbonaria fighting swarm during her research.

Where is the Aggressor Hive?

One of the puzzling things about fighting swarms was that they sometimes form in front of single isolated hives where there do not seem to be any other hives in the area. Where are the attacking bees coming from?

Interestingly the attacking bees did *not* come from a neighbouring hive (within ten metres of the swarm) in five of the eight swarms that Ros studied. In two of these cases there were no other known hives within ten metres of the swarm. In the other three cases, the aggressor hive was not any of the neighbouring hives.

So fighting swarms can be the result of attacking bees that have come from an unknown hive quite some distance away.

Alarm Pheromones

In six of Ros' swarms, worker bees from more than two hives were caught up in the fight (see graphs on right). In two cases, bees from seven different hives were involved!

Number of Swarms	Source of Bees in Swarm
Two	Two Hives
Two	Three Hives
Two	Four Hives
Two	Seven Hives

Stingless bees may produce alarm pheromones during a fighting swarm. These special scents, produced from glands in the bees' heads, may attract other bees from neighbouring hives to join in the fight.

Recognising Friend or Foe

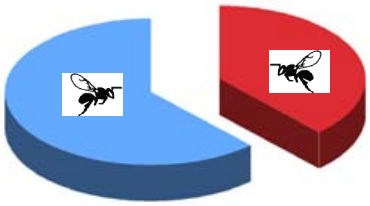
Stingless bees can recognise their own hive-mates by scent. Ros noticed that when a pair of fighting bees falls to the ground in a fighting swarm, the bees sometimes release one another almost immediately and fly back to enter the swarm. At other times, the two fighters remain locked together until they die. Ros concluded that the fighters were not able to identify one another until they landed on the ground.

The hive owners sent Ros 212 pairs of dead bees that were still locked together in battle after the fighting swarms. Ros studied the DNA of these 424 individual bees. In 81% of the pairs, bees from two different hives were locked in combat. However, in 19% of the pairs, a worker from the defending hive had killed one of her own hive-mates. Sadly in the heat of the battle, many defending worker bees had been unable to recognise their hive-mates and had ended up wrestling with them to the death.

Identifying the Bees in Each Swarm

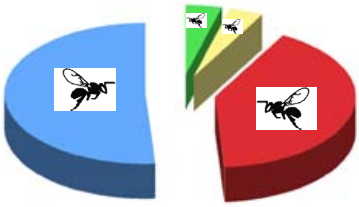
There were up to seven hives involved in each of the naturally-occurring fighting swarms in Ros' research. The following pie graphs show the percentage of bees that came from each hive involved in that swarm. The bees from the defending hive are shown in blue.

Defending Bees **Attacking Bees**

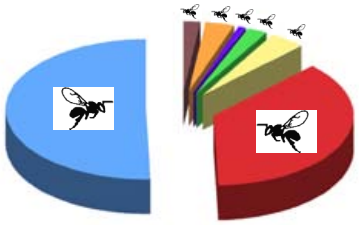


A Swarm Involving Two Hives

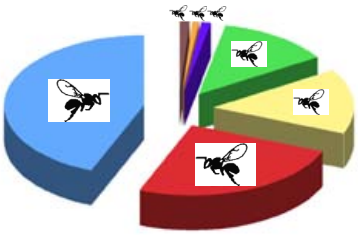
A Swarm Involving Three Hives



A Swarm Involving Four Hives



A Swarm Involving Seven Hives



Another Swarm Involving Seven Hives

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Two Experiments to Find Out More

Ros did two experiments to find out how many invading bees are needed to cause a fighting swarm.

Experiment 1

Two pairs of hives were set up at equal heights and orientations. At midday, after a morning of busy foraging, the two hives in each pair were exchanged. Foraging bees kept returning home to their hive's original location. Before long, large numbers of foragers were trying to enter hives that were not their own. For the guard bees of each hive, this would have seemed like a major invasion of foreign bees, even though these foragers were often carrying pollen or nectar.

Large fighting swarms (see video 1) soon formed in front of all four hives. Wrestling pairs of bees fought on the ground (see video 2). Ros noticed that worker bees were also dragging wrestling bees out of the hive entrances, suggesting that fighting was also occurring inside the hives. In two of the hives, the swarming continued for seven days although after the first day the there were no more wrestles to the death.

Experiment 2

Six well established hives were chosen from Dr Tim Heard's collection in Brisbane. The entrances of these six hives were closed then the hives were moved a short distance away. Six new hives were brought in and set up where the old hives used to be. On the next morning, bees from the new hives were allowed to orientate and forage for seven to eight hours.

Ros Gloag examines a fighting swarm during one of her experiments

Ros released 100 bees at 1pm from each of the old hives. These 100 bees flew away to forage and then returned to their old hive locations, now occupied by the new hives. For the guard bees of each new hive, this would have looked like an invasion of about 100 foreign bees.

Swarms formed in front of five of the six new hives in this experiment. However, there was little actual fighting, probably because there were only about 100 bees 'invading' each hive in this experiment. The swarms continued for three to five hours but did not resume on following days.

These two experiments confirmed that a fighting swarm can be caused by as few as 100 bees trying to enter the wrong nest in less than an hour. With higher numbers of invading bees, the fighting was more intense and the swarming behaviour lasted much longer.

The High Cost of Hive Defence

Fighting swarms are an effective way of defending a hive from invasion. However, the cost of this defence is very high. Thousands of bees from both the attacking and the defending hive may die in the combat. To make matters worse for the defending hive, many of their casualties may come from hive-mates attacking one another by mistake. The swarms may also last for many days, preventing workers from carrying out normal foraging.

What to Do About Fighting Swarms

Ros Gloag's research showed that even 100 bees trying to enter the wrong hive can cause a fighting swarm. Ros suggests that helping the bees to recognise their own hive may prevent them getting lost and improve this situation.

Bees would rarely get lost in the wild, where the bees build a nest in a tree and the nest location and surroundings remain unchanged for many years. However, with boxed hives, many bees may become lost when hives are moved into new surroundings.

This problem may be particularly severe if hives are taken into an orchard or crop for pollination work. The hives may need to be set up close together in a very uniform landscape with few orientation clues.

Ros suggests that marking hives with individual symbols and setting up hives at different heights and facing in different directions may help the bees find their own hives and prevent a fighting swarm.

Dr Tim Heard says that recent research by Dr Paul Cunningham at the University of Queensland suggests that most fighting swarms are caused by one hive trying to take over another hive. Tim says that there is not a great deal that can be done to prevent this.

Dr Tim Heard adds[2] that fortunately, despite the bee losses, the colonies nearly always recover from these fighting swarms. Sometimes the attacked hive may even end up stronger if it has been invaded by a more vigorous hive.

Ros Gloag's research at the University of Sydney has solved a major mystery in stingless beekeeping. With her DNA studies, Ros has shown that bees trying to enter or attack another hive can cause fighting swarms, even in cases where there do not seem to be any other hives in the area. Ros Gloag's important discoveries should help beekeepers better understand and manage fighting swarms in our Australian stingless bees.

Ros would like to warmly thank all the beekeepers who offered assistance with her study. In particular she wishes to thank Tim Heard, John Klumpp, the ANBees Yahoo! Group and all the beekeepers who so kindly sent in bee samples for her research.

This article is based on the following scientific paper describing Ros Gloag's research:

R. Gloag, TA Heard, M Beekman and BP Oldroyd (2008). Nest defence in a stingless bee: What causes fighting swarms in *Trigona carbonaria* (Hymenoptera, Meliponini)? *Insectes Sociaux* 55(4): 387-391.

References

1. Anne Wagner and Leslie Dollin (1982). Swarming in Australian native bees - Help solve the mystery! *The Australasian Beekeeper* 84: 34-38.

2. Tim Heard (1996). Stingless bees. *Nature Australia* Spring: 50-55.