Behaviour of Australian Stingless Bees

Third Edition — PDF eBook

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Behaviour of Australian Stingless Bees

3rd Edition (PDF ebook) 2017

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Native Bees of Australia Series
Booklet 3

An Australian Native Bee Research Centre Publication

All photographs and drawings are by the author, except where otherwise acknowledged in the text.

FRONT COVER
An Australian *Tetragonula* Stingless Bee worker removing rubbish from her nest.
Photograph by Peter O.

Published by:
AUSTRALIAN NATIVE BEE RESEARCH CENTRE
PO Box 74, North Richmond NSW 2754
Visit our website: https://www.aussiebee.com.au
First edition, 1996 (paperback).
Second edition, 2010 (paperback).
Third edition, 2017 (paperback)
This revised third edition (ebook) published in 2017.

ISBN (2017 ebook edition) 978-1-876307-26-4

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The Amazing Private Lives of Our Australian Stingless Bees

Our Australian stingless bees (genera *Tetragonula* and *Austroplebeia*) are tiny, black and intriguing. Their elaborate nests, concealed inside hollow trees, are rarely seen.

In some ways these native bees resemble the better known commercial honeybees (*Apis mellifera*): they live in large social colonies with a queen, workers and males, and they make honey. However, in many other ways their behaviour is entirely different. Let's take a look into the fascinating private lives of our Australian stingless bees…

A Tetragonula carbonaria worker in her resinous nest

The Family Members

There are three castes or types of bees in an Australian stingless bee nest — the queen, the workers and the males.

The Queen

The queen bee normally lays all the eggs for the nest. She is a fertile female. After mating, her abdomen (or tail section) becomes so large and swollen with eggs that she cannot fly.

So, once she is mature, the queen never leaves the nest. If she dies or becomes too old, she is replaced by a new virgin queen from her own nest. The queen bee spends most of her time in the brood chamber and is a central figure in the life of the nest.

The Workers

There are hundreds or even thousands of sterile female bees in each nest. These bees are called workers. In stingless bees that have been studied overseas, most workers live for a maximum of two to three months. However, Megan Halcroft discovered[1] that our *A. australis* workers can live for more than five months. They perform different tasks at different stages of their lives. They care for the immature bees in the brood, help build the nest structures and guard the nest entrance.

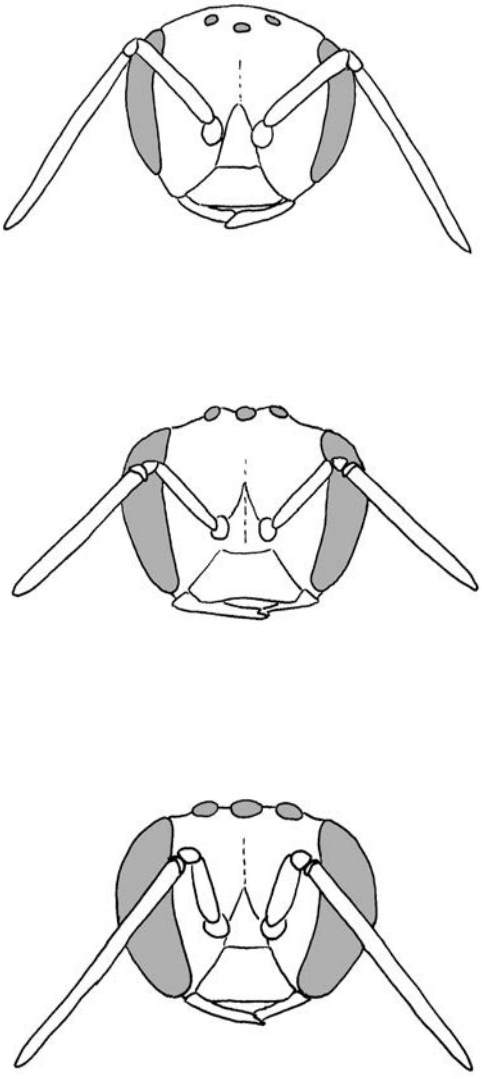
In the final weeks of their lives, worker bees forage on the flowers. They have special curved surfaces called *pollen baskets* on their back legs for carrying balls of pollen or resin back to the nest.

The Males

All male stingless bees are fertile. Their main role in life is mating with a new queen. The males have very large eyes and long antennae. They do not collect honey or pollen for the nest, so they do not have specially-shaped back legs as the workers do. In European honeybee colonies (*Apis*), the male bees are called drones.

Occasionally large swarms of males are seen outside nests of stingless bees. These are mating swarms where males gather in the hope of joining a virgin queen bee on her mating flight.

More information on the three different castes of stingless bees can be found in another ebook in this series: *How to Recognise the Different Types of Australian Stingless Bees* — details page 14.



The family photo album: top, queen; middle, worker; bottom, male.

Choosing the Sex of the Offspring

Stingless bees (as well as commercial honeybees) have a very unusual method of producing male and female offspring. It is called *haplodiploidy*. In humans, both girls and boys develop from eggs which have been fertilised with sperm. In bees, however, female bees develop from fertilised eggs, whilst male bees develop from unfertilised eggs.

When a new queen bee mates, she stores up the sperm inside her body. When she wants to produce female young, she lets some of the stored sperm fertilise the eggs that she lays. However, when she wants to produce males (or drones), she just lays unfertilised eggs. Many human families, I am sure, would like to arrange the sex of their children as easily as the bees can!

The hundreds of sterile workers in a bee nest normally do not lay eggs of their own, but spend their whole lives helping the queen raise their younger sisters and brothers. The reason for this can be traced back to this special way that bees produce male and female young. Worker bees are actually more closely related genetically to their sisters than they would be to their own daughters. So a worker bee can pass on her genes better by raising her siblings than by having her own family.

From this strange situation arose the marvellous social behaviour that occurs inside a stingless bee nest. Now let's take a look at the life story of the bees in the nest…

A mature queen bee, with her huge abdomen swollen by eggs, with the much smaller workers in an Austroplebeia cincta stingless bee nest

Growing Up

The life of a stingless bee starts with a tiny egg. Worker bees build a small brood cell to hold the egg. In *Tetragonula* nests the brood cells are oval shaped, whilst in *Austroplebeia* nests the brood cells are spherical. The brood cells are made from a building material called *cerumen* (see page 4).

The worker bees stock each brood cell with a mixture of honey, pollen and some secretions. The queen bee then lays an egg in the cell and the cell is sealed.

Newly built brood cells in a T. hockingsi nest

The Larva

Inside the brood cell, the soft bee egg splits open or dissolves away to reveal a tiny white larva or grub which looks nothing like an adult bee. In order to grow, it just needs to eat the food in its cell and regularly shed its skin. So the larva has a simple smooth body with no wings, legs, eyes or antennae. When fully grown the larva is plump and shiny. It curls up in a U-shape, completely filling the small brood cell.

The first stage of development: the shiny white larva

As mentioned above, if an egg is fertilised it will develop into a female bee. However, both queens and workers are females. So what makes a fertilised egg develop into a queen bee instead of a worker?

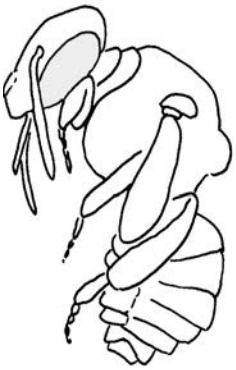
In commercial honeybees, queen larvae are fed a special rich food called royal jelly, whilst worker larvae are reared on poorer quality food. The larvae of stingless bee queens, in contrast, are not fed a special diet. Instead, an egg destined to become a queen bee is simply given a larger amount of food. In *T. carbonaria* nests, a queen larva normally develops inside a large sealed queen cell, full of provisions. In *A. australis* nests (and in queenless nests of *T. carbonaria*), a queen larva will eat the provisions in its own cell. Then it will break into an adjoining brood cell and eat those provisions too! In both cases, the larva develops into a queen simply because it has consumed a larger quantity of food.[2]

Two large queen cocoons (see arrows) along side smaller worker cocoons in a T. carbonaria nest. Photograph by Tim Heard.

Experiments in an overseas species showed that if one egg was given food from four worker cells, it became a queen. Smaller supplies of food resulted in workers that looked like miniature queens. Queen cells in *T. carbonaria* nests are up to 7 mm long, while worker cells and male cells are only 4 mm long. Queen cells, due to their large size, are usually located on the edge of the brood comb.

The Pupa

Once the larva has grown to full size, it spins a silken cocoon around itself inside its brood cell. Then it turns into a soft white pupa. In this remarkable stage, the bee transforms its body material into wings, legs and other adult body parts. Gradually the different parts of its body become darker in colour.



The second stage of development: the pupa with a soft white body and partially developed wings and legs

Side view of the brood comb in a T. carbonaria nest showing the darker cerumen cells above the paler cocoons

Other worker bees in the nest strip off the cerumen material from the outside of the silken cocoon. The silken cocoons containing the pupae are a pale cream colour while the cerumen cells containing the larvae are a darker brown colour. So you can tell which cells in a brood contain pupae and which contain larvae by looking at the cell colours.

Finally the pupa develops into an adult bee and climbs out of its cocoon. Tarlton Rayment, in his studies of *T. carbonaria* and *A. australis*, reported that the time to develop from egg to adult varied between 50 and 70 days. He also said that an *A. australis* queen bee developed from a young larva to an adult in two months. This is much longer than the development times recorded for commercial honeybees which are 21 days and 16 days for the worker and queen respectively.

The new worker bee is the same size and shape as other adult bees and she never grows any larger. However, some parts of her body are still white or brown, and they may not become black for two to three weeks. A young bee with this pale colouring is called a *callow*. She stumbles around the comb for some time, stretching out her cramped legs and her crumpled wings. Older bees feed her a first meal: a clear droplet of honey. Before long she joins in the work of building the nest.

A young callow stingless bee with a white thorax

Nest Construction

One of the first jobs of the new bees is to help build the complex structures inside the nest. Most of the structures in the nest are built from a brown material called *cerumen* made by the worker bees.

Cerumen is a mixture of wax and resin:

— White flakes of wax secreted by young worker bees from glands on the top of their abdomens (or tail sections)

— Resin collected by older forager bees from damaged trees and other similar sources.

Cerumen: the building material of the stingless bees

The young worker bees use cerumen to sculpt the tiny brood cells in their characteristic arrangements: the elegant spiral comb of *T. carbonaria*, the tiny interconnected brood combs of *T. hockingsi* and the cluster brood of *A. australis*. They also construct the intricate involucrum sheath that surrounds the brood, and the delicate honey and pollen pots. It is a marvel how these young bees manage to instinctively build such elaborate structures in total darkness.

The Nursery Staff

Young worker bees also form the major work force in the brood or nursery, caring for the next generation of bees in the nest. They crowd around each new brood cell that is being built, taking turns to add new fragments of cerumen, or to disappear head first into the cell to smooth and work the inside surface.

Once a new brood cell has been built, the queen bee arrives and the worker bees in the brood comb partially fill the cell with larval food, a mixture of nectar, pollen and some secretions. One by one, the worker bees climb head first into the cell and, with strenuous contractions of the abdomen, deposit a droplet of fluid food. In *T. carbonaria* nests,[3] about 4 to 6 droplets are put in each cell, whilst in *A. australis* nests,[4] about 16 droplets are added. The queen bee then lays an egg in the cell.

Finally, a worker bee closes up the top of the cell. She inserts her abdomen into the cell and rotates her body as she closes the top of the cell with her jaws and legs.

Worker bees tending the brood cells in an A. cassiae nest

How Our Australian Stingless Bee Queens Lay their Eggs

Researchers[3, 4] have discovered a fascinating difference between our two different genera of Australian stingless bees (*Tetragonula* and *Austroplebeia*) in the way they lay their eggs in the brood cells:

In *T. carbonaria*, an exciting frenzy of egg laying occurs about four times a day. The worker bees build up to 90 new brood cells all together in a batch. It takes about five hours to finish building all the cells. Then the queen arrives and the worker bees suddenly start rapidly provisioning all the cells in the batch. The queen bee races excitedly around the batch laying an egg in each cell, and the workers seal up all of the cells. It takes only 10 to 15 minutes from the time the food is added to the first cell in the batch to the time the last cell is sealed. The queen then does not do any more egg laying for another five hours.

A batch of brood cells being built at the same time in a T. carbonaria nest

In contrast, in *A. australis* and *A. cassiae*, egg laying is done in a much more gradual pace throughout the day. The worker bees start building brood cells one at a time. Some cells may be built in about two hours whilst others take over six hours to build. So at any one time there are new cells in many different stages of construction. The queen visits the brood at irregular intervals. If one or more cells are ready, the worker bees quickly provision them then the queen lays an egg in each cell. During one visit she might lay an egg in just one cell or perhaps in five or six cells. On average the queen lays one egg about every half an hour throughout the day.

Individual brood cells at different stages of construction in an Austroplebeia nest

The Nest Air-Conditioning Engineers

Another important job for the young worker bees is controlling the temperature inside their nest. We recorded the temperature of a *T. carbonaria* brood comb while the outside temperature varied from 10° C to 30° C. They managed to keep the brood temperature between 26° C and 28.5° C! How does a cold-blooded insect achieve such a feat?

Temperature control is helped by the insulating properties of a nest structure called the *involucrum*. This is a sheath of cerumen which surrounds the brood.

Multiple layers of involucrum wrapped around a brood in a T. carbonaria nest

In warm northern parts of Australia, some species only build a single layered involucrum that may not entirely cover the brood. However, in *T. hockingsi* and particularly in the southern species, *T. carbonaria*, the involucrum is a remarkable multi-layered structure of air passageways, interlinked by tiny slots.

Inside this insulating involucrum, the bees warm the brood by clustering their bodies on the comb. Some stingless bee species can generate extra heat by vibrating the flight muscles of their thorax or middle segment.

In hot weather, the bees fan the nest to keep it cool. In some nests in hollow trees, the bees leave tiny holes in the *batumen plates* (or sealing layers) at the top and bottom of the nest. Cool air can be fanned in these holes from the tree cavity and warm air fanned out the entrance to cool the nest.

Tetragonula bees fanning to cool their overheated hive on an extremely hot day. Photograph by Keith Paull.

Unfortunately nests kept in boxes can overheat in hot weather as the insulation provided by a wooden box is not nearly as as good as a tree's insulation. It is vital to keep boxed nests out of direct afternoon sun in the summer. If a hive overheats, long rows of bees may be seen fanning air through the hive entrance (see photograph on page 6). If you see this behaviour, you should try to cool the hive as soon as possible, by hosing it down or draping it with wet towels.

The Garbage Disposal Squad

In a nest crowded with hundreds of bees, cleaning up is a vital job to control disease. Worker bees regularly carry droppings and dead bees out of the nest and drop them at some distance from the entrance. If the weather is too cold for flying, however, the bees store this material in a little rubbish dump, not far from the nest entrance, until it can be removed.

Bacteria and mould must also be controlled in the nest. The honey of stingless bees contains an antibiotic substance to control bacteria, and the bees also thicken the honey by evaporating water from it to inhibit bacterial growth. The tree resins used as building materials in the nests also often have antibiotic properties. These resins, used in the honey and pollen storage pots and to bury the bodies of dead beetles or other nest invaders, help control bacteria and mould growth in the nest.

A stunning photograph by Peter O. of a stingless bee carrying rubbish out of a hive. Visit the Aussie Bee website to see more beautiful native bee photographs by Peter O.

The Defence Forces

As the worker bees get older, they take on the important job of guard duty. Stingless bees actually do have stings but the stings are so tiny that they do not work. So the bees must defend the nest by sealing up all unnecessary openings to their nest. *Austroplebeia* bees have an additional method for keeping out intruders. At night and during cold weather, they close up their nest entrance with a fine, lacy curtain of resin droplets. This material is torn down each warm morning and stored inside the nest entrance for use on the following evening.

Fortunately our Australian stingless bees do not have to cope with the large predators, such as armadillos, skunks, honey badgers, bears and chimpanzees, that confront stingless bee species overseas. Nevertheless, Australian species such as *T. hockingsi* and *T. carbonaria* have developed an efficient method of discouraging humans who break open their nest. They crawl all over them, getting into their eyes, ears and hair, and giving tiny nips, like pin-pricks, with their mandibles or jaws. In such a situation, they appear to release an alarm pheromone chemical which calls other worker bees to join in the attack too.

The bees also have to defend their nest from other insects trying to come in the entrance hole. Large insects, such as commercial honeybees, may be attacked by groups of guard bees. This defence is quite effective as long as the nest is intact, so that the single intruder is faced by many guard bees at a tiny entrance hole. Should an intruder such as a beetle succeed in getting into the nest, the bees inside will daub it with many tiny drops of resin until it is entombed forever!

Top: the entrance tunnel of an Austroplebeia nest covered over at dusk with a curtain of resin droplets. Above: a large beetle that has been buried in resin inside a Tetragonula nest.

Stingless bees also have to contend with Phorid flies, Syrphid flies and more recently, introduced South African hive beetles, which try to lay their eggs in the food stores of the nest. Guard bees must kill these invaders and remove their eggs and larvae to protect their nest from being eaten! Great care should be taken, if boxing or splitting a nest, to completely seal the nest up as quickly as possible after the work is done, to help keep these pests out of the nest (see our ebook *Keeping Australian Stingless Bees in a Log or Box* for more information – details page 14).

Finally, a *Tetragonula* nest may even be attacked by stingless bees coming from another nest of the same or a closely related species.[5] Occasionally workers from a strong nest will stage an invasion and try to take over a weak nest. Guard bees are able to recognise bees from their own nest by their smell and may attack a stingless bee from a different nest and fight to the death.

Sometimes huge *fighting swarms* form outside *T. hockingsi* or *T. carbonaria* nests, with clouds of worker bees weaving around near the nest entrance. In such swarms, large numbers of bees may attack one another and wrestle to the death.

Ros Gloag[6] used genetic techniques to study eight fighting swarms in *T. carbonaria* and found that there were always bees from two or more nests in each swarm, even if there was no other known nest nearby. Fighting swarms could be caused by as few as 100 bees attacking or trying to enter another nest. Fortunately, despite the bee losses, nests nearly always recover from these fighting swarms. If a nest is invaded by a powerful nest, it may even end up stronger after the fight!

See Aussie Bee Online Article 13 — The Mysterious Fighting Swarms: www.aussiebee.com.au/abol–current.html

Above: a severe infestation of Phorid fly larvae in a T. carbonaria nest. Photograph by Cec Heather. Right: a huge swarm of T. hockingsi worker bees.

The Supermarket Shoppers

The job of the oldest workers in the nest is to forage for nest supplies: nectar, pollen and resin. Nectar or honey is the bee's carbohydrate food, pollen is their protein food and resin is used in nest construction.

Stingless bees are tropical and the foragers generally do not fly until the temperature reaches 18°C. This is one reason why stingless bees do not survive in cooler areas of Australia. For many months, the days are not warm enough for the foragers to fly and collect the resin and food needed for the colony.

When new forager bees first leave their nest, they make an orientation flight. They fly round and round near the nest whilst facing towards the nest entrance, learning the details of the nest's position.

Most Australian stingless bees prefer to forage within about 500 m from the nest for food supplies.[7] They can thrive on both native and exotic flowering plants. In fact *T. carbonaria* bees do particularly well in urban gardens.[8]

Commercial honeybees use complex dances inside the hive to tell other forager bees the location of good nectar and pollen sources that they have found. Stingless bees have a quite different method of communicating this information. Instead of performing specialised dances, they often use scent marks to guide other foragers to their discoveries. The scent marks may be placed on the food source and/or laid as a scent trail between the nest and the food source.

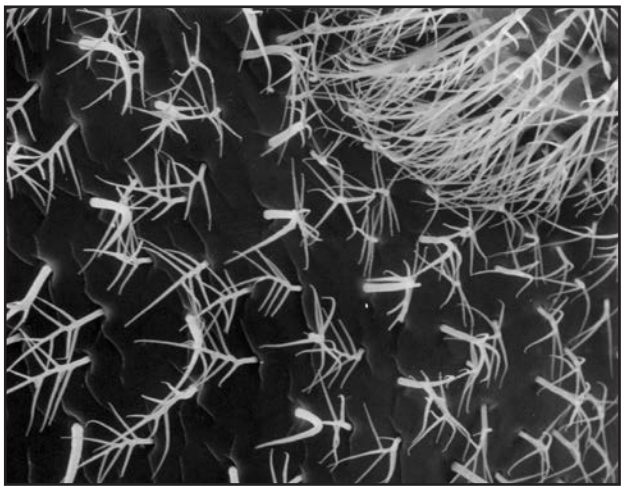
Austroplebeia stingless bees, visiting this tray containing sponges soaked in sugary water, heavily marked the edge of the tray with yellow scent marks

Tad Bartareau[9] studied the foraging behaviour of *T. carbonaria* bees by offering them feeders placed between 20 and 50 m from their nest. The feeders held sponges soaked in solutions containing 0%, 10%, 20% or 40% sugar. He showed that these bees could detect how much sugar there was in each solution. After the scout bees located a food source they marked it with scent droplets to help other forager bees find it. The scouts put the most marks on the richest feeders that were closest to their nest.

The nectar produced by flowers contains up to 90% water. If the bees stored dilute nectar like this in their nests, it would soon ferment. So the bees convert the nectar into honey by evaporating much of its water content. The bees cluster in a warm place in the nest and work drops of the nectar back and forth repeatedly with their tongues. The finished honey contains only about 20 – 30% water. This honey is still thinner than commercial bee honey, however, which usually contains only 18% water. Our stingless bees store their honey in clusters of oval cerumen pots in the nest.

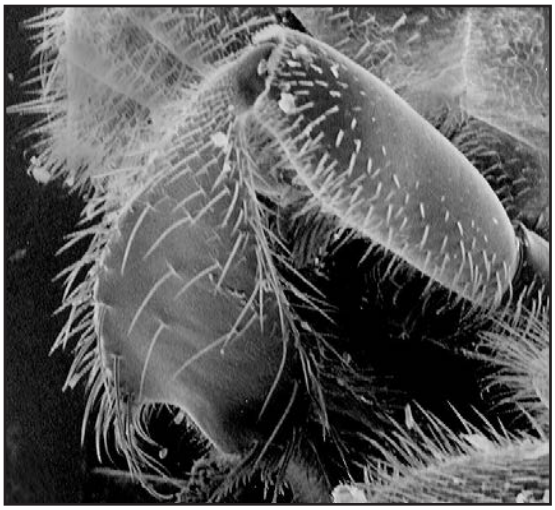
Delicate clusters of honey pots in an Austroplebeia nest

When a forager bee visits a pollen bearing flower, grains of pollen cling to her fur all over her body. Bees have special feather-shaped hairs on their bodies (see photographs) that help to trap the grains of pollen. The stingless bee forager combs the pollen off with her legs, moistens it with nectar and packs it in round balls onto special smooth plates on her hind legs. Each plate, known as a *pollen basket*, has a shiny concave surface studded with a few thick bristles, and a rim of stiff hairs along one edge.



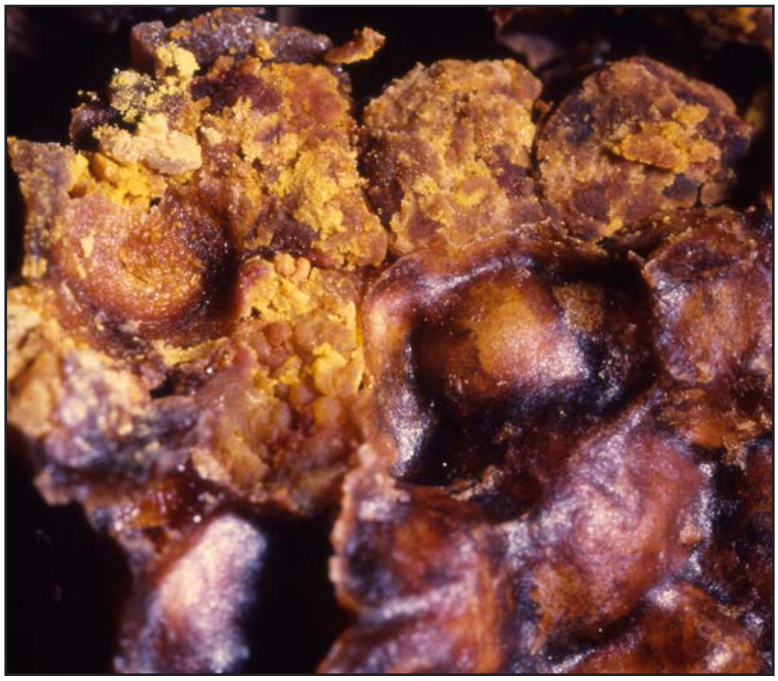
Scanning electron microscope photographs by John Vaughan. Above left: the side of the thorax of a Tetragonula bee showing the thick hairs that help the bee collect pollen from flowers. Above right, magnified view of the hairs on the thorax showing their special feather-like structure that traps the grains of pollen.

Left: photograph by Peter O. of a bee covered in pollen grains after visiting a Portulaca blossom.
Below left: this bee has combed the pollen grains from her body and packed them onto the pollen baskets on her hind legs. Photograph by Peter O.
Below right: scanning electon microscope photograph by John Vaughan of a pollen basket on the hind leg of a Tetragonula bee.



Some *T. carbonaria* workers we studied were carrying 20% of their weight in pollen, or 0.8 mg per bee. The pollen is also stored in clusters of cerumen pots in the nest, usually close to the brood.

To be an ideal plant pollinator, a bee should only visit flowers from one plant species on a particular day. Then as she flies from flower to flower she carries just one type of pollen and is sure to pollinate every flower with the correct type of pollen. Daniel White[10] studied five hives of *T. carbonaria* bees that had access to 61 species of plants in a garden. The bees visited six different flower species in the garden during the study. However, 88% of the bees were visiting only one plant species per day and were bringing in pure loads of pollen from that plant. This study shows that our Australian *T. carbonaria* bees can provide high quality pollination services.



Pollen from the hind legs of forager bees stored in resin pollen pots inside a Tetragonula nest

Tree resins, used for nest construction and defence, are also collected and carried back to the nest as translucent shiny jewels of red or yellow, on the worker's pollen baskets. The smooth polished surfaces of these plates on the workers' hind legs would assist the bees in handling this extremely sticky material.

The resin is often stored in dumps near the nest entrance prior to use. Other materials that some species collect for nest construction include termite dirt and fresh paint.

Above left: a Tetragonula stingless bee collecting wax from a red Christmas candle. Photograph by Peter O. Above right: these stingless bees met an unfortunate sticky end after attempting to collect adhesive from discarded tape on a construction site. Photograph by Janet Cavanaugh.

Building a New House

When a nest grows strong, the time may come to build a daughter nest. For stingless bees this is quite a slow process that can last some months. A new nest site is selected and building materials are carried in from the mother nest to seal and line the new cavity. Provisions are also brought from the mother nest to the daughter nest. So worker bees leaving a nest carrying nest materials on their hind legs may be a sign that this process is occurring.

Stingless bees always raise a new queen bee to start a daughter nest. The old mature queen bee stays in the original nest. She is too heavy to fly because her abdomen is so swollen with eggs and her wings have become tattered and short. So a colony that is building a daughter nest will construct some queen cells in the brood and raise some new virgin queen bees. As discussed previously (page 3), new queen bees are raised in cells that are larger than the cells of the worker bees and males. Multiple queen cells are often found in the broods of the Australian stingless bees during the warm months.

Overseas, there is great variability in the way that stingless bees raise virgin queens and in the early life of these virgin queens after they emerge from their queen cells:

— One nest of *Trigona crassipes* in Brazil had 132 queen cells in its brood; whilst in other species queen cells are rarely seen.

— In some overseas species, new virgin queens blend in with the other young bees when they first emerge from their cells. They move freely around the brood for quite some time.

— In other overseas species, new virgin queens emit special scents or pheromones when they emerge. These scents excite the worker bees and change the behaviour within the nest. Most newly emerged queens of this type are soon killed by the worker bees. In some species the virgin queens that survive spend their following days, or even months, enclosed inside cerumen chambers. Whilst it looks as if the virgin queen has been imprisoned by the workers, in fact the virgin queen can open or close her chamber at will and maintains a sort of protected territory inside her chamber. Worker bees enter and leave the chamber through a small hole, feeding the enclosed virgin queen. In other species the virgin queens are continuously surrounded by a ring of worker bees that form a living barrier between the virgin queen and the mature queen bee of the colony.

In the Australian stingless bees, little is known about the early life of the virgin queens. In the process of boxing nests in the field, we have found up to seven virgin queens walking freely inside *Austroplebeia* nests along with a mature queen. These virgin queens often had the pale colouring of very young bees. However, we do not know if *Austroplebeia* virgin queens normally walk freely around the nest, or if the process of boxing these nests had released these virgin queens from some form of confinement. Perhaps you can add to Australia's knowledge by your observations!

Eventually the time comes for a new virgin queen to begin her lifetime of egg laying. If the colony is building a daughter nest, the virgin queen flies off to the new nest site accompanied by a swarm of workers. Sometimes, however, if the dominant queen bee of a colony has become old and weak, one of the virgin queens may stay in the original nest and replace the old queen bee.

T. hockingsi males sleeping out at night on a dry stem.
Photograph by Tom Carter.

Then there is a mating swarm. The virgin queen flies out of the nest, pursued by a swarm of males, and mating occurs. In a stingless bee species studied in Thailand,[11] the males leave their own nest and join large congregations with males from many other nests to wait for a chance to mate. In Queensland, dozens of *T. hockingsi* males have been observed roosting at night out in the open, clinging side by side along a bare twig.

A commercial honeybee queen mates with about seven to ten males during her mating flight. However, in the Australian stingless bee, *T. carbonaria*, genetic studies[12] have shown that each queen bee mates with only one male. So very few of the stingless bee males ever get the chance to pass on their genes to the next generation.

In commercial honeybees, a new daughter nest may be built several kilometres from the original mother nest site. Commercial honeybees can fly long distances and the establishment of a new nest is abrupt. Large numbers of worker bees swarm out of the nest along with the old mature queen of the colony. They settle in a large cluster, hanging from a tree branch or other support, whilst scout bees select a final nest site. Then the swarm flies into the new nest site and begins to construct the waxy combs.

In contrast, in the stingless bees, new daughter nests are always built fairly close to the mother nest because there is a lengthy connection between the new and the old nests. Workers may fly back and forth for weeks or months between the two nests as the new nest is constructed. Even after the mating swarm, the daughter nest may continue to be supported by the mother nest for some time with extra provisions.

Conclusion

We have taken a look at the private lives of our Australian stingless bees — from the time they struggled damp and crumpled from their cocoons, to their days in the flowers and sunshine. The habits of our Australian species are still far from well understood. Perhaps you can add to our knowledge with your stories and observations.

Glossary

Abdomen — A bee's body has three segments, the head, the thorax and the abdomen. The abdomen is the third or tail segment of a bee.

Batumen Plates — Thick hard walls of resin and other materials used to seal off sections of a cavity that are not being used by the nest.

Brood Cell — A small cell where an egg is laid and an immature bee is raised. Brood cells may be loosely arranged in a cluster or more regularly joined together into combs.

Callow — A pale coloured bee that has recently emerged from its brood cell.

Cerumen — A mixture of wax and tree resin used by stingless bees for nest construction.

Cocoon — The silky capsule that a fully grown larva spins around itself inside its brood cell, before it develops into a pupa.

Drone — In a social bee nest there are three types of bees: a queen, workers and males. In European honeybees (*Apis*), the male bees are called drones.

Fighting Swarm — A large number of worker bees flying around and wrestling with one another outside a nest or hive. This behaviour can be triggered by bees from one hive trying to enter another hive.

Halodiploidy — The unusual form of reproduction seen in social bees where fertilised eggs develop into females and unfertilised eggs develop into males.

Involucrum — A protective and insulating sheath that surrounds the brood, consisting of one or more layers of cerumen.

Larva — The grub-like first stage of a stingless bee's development after it emerges from its egg.

Pheromone — A chemical scent secreted by a bee that gives a signal to other bees. For instance, a pheromone may be used to attract other bees to a food source or to send out an alarm signal to other bees in the colony.

Pollen Basket — A smooth polished plate on the hind leg of a stingless bee that is used for carrying pollen and resin. Also known as a *corbicula*.

Pupa — The second stage of a stingless bee's development before it becomes an adult bee.

Queen — In a social bee nest there are three types of bees: a queen, workers and males. The queen is the fertile female bee that normally lays all the eggs in a nest.

Queen Cell — A larger brood cell in which an immature queen bee is raised.

Thorax — A bee's body has three segments, the head, the thorax and the abdomen. The thorax is second segment corresponding with the chest.

Worker — In a social bee nest there are three types of bees: a queen, workers and males. The workers are the sterile female bees that do most of the work in the nest.

Further Reading

Other eBooks in the *Native Bees of Australia Series*:
— *Introduction to Australian Native Bees*
— *Nests of Australian Stingless Bees*
— *How to Recognise the Different Types of Australian Stingless Bees*
— *Keeping Australian Stingless Bees in a Log or Box*
— *Boxing and Splitting Hives: A Complete Do-It-Yourself Guide*
The above ebooks are available from the Aussie Bee website: **www.aussiebee.com.au/abshop.html**

The Australian Native Bee Book by Tim Heard (2016). Available from: **nativebeebook.com.au**

The Social Behaviour of the Bees by Charles Michener (1974). The Belknap Press of Harvard University Press, Cambridge, Massachusetts.

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Notes on Australian species name changes:
— The *Trigona* stingless bees in Australia are now called *Tetragonula*.
See: www.aussiebee.com.au/tetragonula–name–change.html
— The *Austroplebeia symei* stingless bees are now called *Austroplebeia cassiae*.
See Aussie Bee Online Article 25, Meet the *Austroplebeia* species: www.aussiebee.com.au/abol–current.html

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