NATIVE BEES IN THE PERMACULTURE GARDEN

Words and photos by Megan Halcroft

Bees are under threat worldwide. As we urbanise our environments we remove bees' natural habitat – we create flowerless landscapes when we substitute concrete and lawn for flowering trees and shrubs. And agricultural practices, such as monoculture, remove the variety of floral resources bees need for good health. Add to these the increasing use of pesticides in crop management and domestic landscapes, and the future for bees looks bleak.

Mention bees and people invariably think of honey bees. Humans have had an important relationship with honey bees for millennia, managing them for honey and pollination services. The social European honey bee *Apis mellifera* can be found in most parts of the world, and was introduced into Australia in 1822; however, this species is only one of 20 000 species of bees worldwide. Australia is home to almost 2000 species of native bees, and most of them are very important plant pollinators.

We can support native bee health and populations by improving our understanding of bee behaviour, and how that drives biodiversity. And understanding the importance of bees is about understanding pollination, which facilitates plant sexual reproduction, and the bees' role in it: biodiversity relies on mixing in the gene pool.

FLOWERING PLANTS AND BEES COEVOLVED

Around 100 million years ago, flowering plants (angiosperms) began to evolve. During this time, some wasps began to collect pollen as a protein source to rear their offspring (brood) instead of feeding them other insects; a complex coevolutionary system developed. Plants are immobile therefore unable to move about to find a mate, and this is where pollination vectors such as insects play an important role.

Plants have evolved ways of attracting pollinators to their flowers by enhancing the sugar concentration in their nectar, producing attractive scents and colours, and providing nectar guides to help insects find the food source. This, in turn, helps the plant to reproduce.

Pollination is the transfer of pollen from the anther (male flower structure) to the stigma (female flower structure). The stigmatic surface is highly nourishing and stimulates pollen germination. As the pollen tube grows, it carries the male gamete towards the female gamete, within the ovule. Gamete union is called fertilisation, which leads to seed set and results in the production of a plant hormone that stimulates fruit tissue development. So, good pollination produces good fruit quality and yield. Seed produced through good pollination has superior germination qualities.

SOLITARY BEES

Of the 2000 Australian bee species fewer than fifteen are highly social and colony-forming. Most species are solitary and do not make honey, but they are very important pollinators. Female bees are experts at collecting and transporting pollen and nectar back to their nests, to rear brood.

Most bees are covered with branched, electrostatic hairs, to which pollen grains are attracted. Females have specially adapted structures for transporting pollen, called scopa. Some species have stiff bristles under the abdomen where dry pollen grains are packed, while others – such as blue banded and teddy bear bees – have scopa on the outside of the hind leg, or on the inside of the hind legs and the abdomen. One of the most important aspects of these scopal hairs is that they carry millions of dry pollen grains. These are available for transfer from one flower to another as female bees move over the flowers.

Solitary bees live their lives independent of other bees in various nesting substrates. Once a female has mated, she finds a safe nesting place to rear her brood. She forages for floral resources, returns to the nest, unpacks the pollen from her scopa and regurgitates swallowed nectar. She combines these resources into 'bee bread', lays an egg on top, seals the brood cell and leaves the egg to develop alone. This process is repeated many times, until she dies. As she collects her precious cargo of pollen and nectar she performs pollination services.

NESTING BEHAVIOUR

Ground dwelling bees

Seventy per cent of bees nest in the ground and can dig burrows from five to fifty centimetres deep. Side branches are formed off the main burrow, and brood cells are created at the end of these branches. The number of brood cells can range from one to dozens, all created by a single female. Some species live in 'aggregations', where dozens to hundreds of individuals nest close to each other. Ground dwelling bees produce a water-repellent secretion which is painted onto the internal surfaces of the brood cell to protect developing brood. These secretions also help to 'mark' nest entrances, enabling individuals to find their home among the

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A bee hotel.

many others. Some species develop a semi-social behaviour as the brood rearing season progresses. Adult daughters remain in the maternal nest and share guard duties; however, they are capable of mating and producing their own brood.

CAVITY DWELLING BEES

The remaining thirty per cent of bee species nest in pre-existing cavities such as old wood-borer holes, hollow or pithy-centred plant stems, and other nooks and crannies. Many of the cavity dwelling species create brood cells successively, until the cavity is filled.

DIVERSITY

The world's bees are divided into seven families, five of which are found in Australia. Species are classified into families based on their mouth parts, how they carry pollen and nest construction. Species diversity is dictated by climate, natural vegetation, soil type and floral resources. The greatest diversity is seen in warm-temperate, dry regions; and it is estimated that such regions could support up to 300 native bee species.

Australia's bee populations are extremely diverse. Short-tongued species usually prefer to forage on open, shallow flowers. It is thought that the abundance of myrtaceous species, which have open flowers with cup-like containers of nectar, may have supported the evolution of such diversity. However, most native bees are generalist foragers, including the long-tongued species.

SOME NATIVE SPECIES

Not all native bees have a common name; however, there are some species that have been grouped together according to either their nesting behaviour or by distinguishing body markings.

- Reed bees are semi-social and generally nest in hollow or pithy-centred reeds or plant stems.
- Carpenter bees burrow into soft wood.
- Resin bees collect plant resin to seal the brood cells.
- Leafcutter bees cut discs from soft young leaves to make their nests.
- Masked bees have distinctive bright markings on their faces.
- Blue banded bees have iridescent hair-stripes (varying from white to dark blue) on their abdomen.
- Teddy bear bees have thick, orange hair.
- Parasitic cuckoo bees lay their eggs in the nests of other (host) bees. Their larvae may consume all of the host-larvae food provisions, or kill and eat the host larvae, or both. Because they do not rear their own brood, females do not need to collect pollen, so they have no scopa. They often have thick hard exoskeletons to protect them against attack from adult host bees.

BENEFITS OF NATIVE BEES AND HOW TO SUPPORT THEM

Use flowering plants

One of the best ways to support bees is to plant large numbers of flowering plants: ensuring access to food resources throughout the year supports their reproduction.

Conserve and create habitat

Conserving areas of natural habitat enables female bees to find safe nesting sites, and helps increase existing populations. Allowing plants to go to seed provides bees with much needed floral resources (and enables seed saving). Allowing plants, especially those with hollow or pithy stems, to break down in situ, or to slowly rot in piles in isolated corners of the garden, provides nesting sites for some masked bees and reed bees. Other ideas for bee habitat are provided on opposite page.

Don't use chemicals

Avoiding chemical pesticides in your garden is vital to the health of all bee populations, as well as many other beneficial invertebrates: not using pesticides allows nature to take its course. For example, beneficial insects – such as wasps, hoverflies, robber flies, predatory shield bugs and lady beetles – and spiders are then able to multiply. These help to control pest species – such as caterpillars, aphids, mites, grasshoppers and other herbivores – by eating them.

Native bees have a symbiotic relationship with a permaculture garden. Many of the non-interventionist techniques that we employ in permaculture support native bee populations. In return they support us by providing valuable pollination services, which produce high crop yield and good quality seed for future crop production.

Email Megan Halcroft at megan@beesbusiness.com.au *and find more information about her Bees Business at* www.beesbusiness.com.au

Online resources: a guide to some cavity-dwelling bees can be found at www.beesbusiness.com.au/articles/Halcroft_and_Batley_The_Bee_Hotel_ID_Guide.pdf; www.facebook.com/BeesBusiness; www.facebook.com/groups/beeawareofyournativebees

Clockwise: Lasioglossum species.
Amegilla -Blue banded bee.
Rammed earth block.
Megachile tasmanica Resin bee in natural cavity.
Wood block.

HOW TO CREATE NATIVE BEE HABITAT

It is easy to create habitat for bees in your garden, to attract cavity dwelling species such as resin, leafcutter, reed and masked bees.

Wood blocks

Mimic natural nesting substrate, such as old borer-holes, by drilling long burrows into hardwood blocks or dead tree stumps. Don't use treated wood. A good variety of hole diameters will attract a greater diversity of bee species: drill holes from three to eight millimetres in diameter to a depth of at least 100 millimetres. Larger holes attract larger-bodied bees, which need holes to a depth of around 150 millimetres.

Reed house

Other nesting substrates include hollow or pithy-centred stems. When pruning plants, check to see if any have these types of stems. Simply bundle them up with some wire (this can be tightened as the stems dry) and hang them in a tree (horizontally) or on a fence (vertically).

Bare earth

It is also desirable to leave some small areas of bare earth for ground dwelling bees to burrow. While some ground dwellers will nest in lawns, most prefer bare, slightly undulating soils that are not prone to waterlogging.

Rammed earth blocks

Blue banded bees will nest in rammed earth blocks but, because this species lives in aggregations of many nests, it is best to provide several blocks; more than three large blocks is desirable. Or fill hollow concrete blocks with a mix of damp (not wet) soil, and ram tight with a blunt tool. The mix should be a sandy loam that will hold its form when squeezed in the fist, but will break apart when poked. Imagine a tiny bee trying to burrow into the dried mud; it needs to be able to dig without the burrow collapsing.

These habitats are often placed together to create a 'bee hotel', and while these are ideal educational tools, recent research overseas has shown evidence of increased nest parasitism and disease levels in large nesting structures. So it is now recommended that a number of smaller habitats be placed throughout the garden, as would occur in nature.

EXAMPLE FLOWERING PLANTS TO SUPPORT BEES:

There's lots you can plant in your permaculture garden to help preserve native bee populations.

- **garden flowers** – flowers are an important part of the permaculture garden. The flowers attract the bees, the bees pollinate your vegetable and fruit trees and crop yields increase. There are many flowers that will attract bees; bog sage, dahlia, daisies, hebe, lavender, marigold, roses, salvia.
- **herbs** – leaving herbs to go to flower provides bees with an abundance of food. Here are a few that do well; basil, borage, mint, parsley, rosemary, sage, thyme.
- **native species** – with a range of native species you can provide pollen and nectar to your bees all year round: bottlebrush, eucalypts, geebungs, peas, tea-tree, grevillias.
- **vegetables** – some plants produce flowers to produce fruit: tomato, pumpkin, cucumber and others produce flowers after fruiting to create seed; brassicas, onion, lettuces.
- **fruit trees** – all flowering fruit trees: almonds, apricots, apples, citrus, peach.