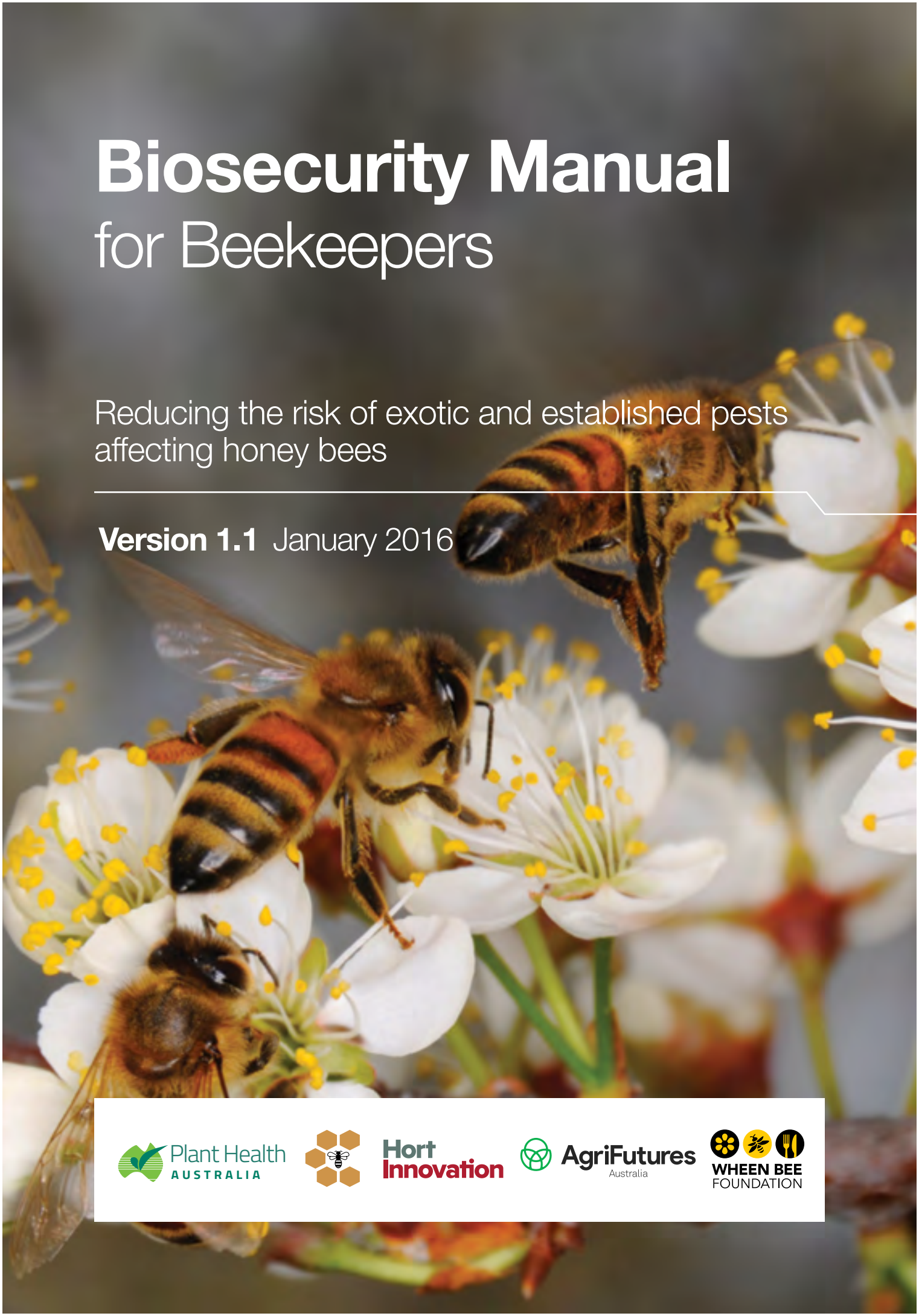

Biosecurity Manual for Beekeepers

Reducing the risk of exotic and established pests affecting honey bees

Version 1.1 January 2016

Plant Health AUSTRALIA

Hort Innovation

AgriFutures Australia

WHEEN BEE FOUNDATION

Plant Health Australia (PHA) is the national coordinator of the government-industry partnership for plant biosecurity in Australia. As a not-for-profit company, PHA services the needs of Members and independently advocates on behalf of the national plant biosecurity system. PHA's efforts help minimise plant pest impacts, enhance Australia's plant health status, assist trade, safeguard the livelihood of producers, support the sustainability and profitability of plant industries and the communities that rely upon them, and preserve environmental health and amenity **www.phau.com.au.**

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An electronic copy of this manual is available from the website listed above.

The Australian Honey Bee Industry Council (AHBIC) is the peak honey bee industry body that represents the interests of its member state beekeeper organisations and apiarists from around Australia **www.honeybee.org.au.**

Horticulture Innovation Australia (HIA) is the industry owned rural research and development corporation for the Australian horticulture sector **www.horticulture.com.au.**

The vision of AgriFutures Australia is to grow the long-term prosperity of Australian agriculture through research and development, knowledge and understanding that fosters innovative, adaptive and valuable rural industries **www.agrifutures.com.au.**

The Wheen Bee Foundation supports research and education aimed at keeping Australia's honey bees healthy. The foundation advocates for the betterment of beekeeping in Australia and efficient pollination of our food crops **www.wheenbeefoundation.org.au.**

The Biosecurity Manual for Beekeepers is available to download for free from **beeaware.org.au** or by contacting Plant Health Australia at **biosecurity@phau.com.au**

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Six easy ways to protect your honey bees

2 **Beekeepers have an important role to play in protecting honey bees and the entire honey bee industry from biosecurity threats.**

Here are six easy ways to reduce the threat of exotic and established pests affecting your livelihood. Each of these practices should be embedded in the everyday management of an apiary as it makes good business sense to reduce the risk of spreading pests. Don't put your livelihood and the honey bee industry at risk by neglecting honey bee biosecurity.

1. Be aware of biosecurity threats

You and your workers should be familiar with the most important exotic and established honey bee pest threats. Conduct a biosecurity induction session with staff to explain required hygiene practices for people, equipment and vehicles in an apiary.

2. Use pest-free honey bee stock and apiary equipment

Ensure all queen bees, packaged bees and apiary equipment are from trusted sources, pest-free and preferably certified. Keep good records of apiary inputs.

3. Keep it clean

Practicing good sanitation and hygiene will help prevent the entry, establishment and movement of pests within and between apiaries. Workers, visitors, vehicles and equipment can spread pests, so make sure they are clean before entering and leaving the apiary.

4. Check your apiary

Monitor your hives and the health of honey bee brood frequently. Report any new or unusual events and pests. Keep written and photographic records of all unusual observations. Constant vigilance is vital for the early detection of any exotic pest threat.

5. Abide by the law

Respect and be aware of laws and regulations established to protect the honey bee industry, Australian agriculture and the local region.

6. Report anything unusual

If you suspect a new pest – **report it immediately to the Exotic Plant Pest Hotline**.

EXOTIC PLANT PEST HOTLINE
1800 084 881

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Biosecurity overview

4

This manual is designed to provide information to anyone who keeps honey bees in Australia. All beekeepers, from commercial operators, to backyard enthusiasts, to people starting up their first hive, form part of the honey bee industry. Each and every beekeeper has a role to play in protecting honey bees from established and exotic pests.

Incorporating these recommended biosecurity processes into day-to-day operations is the best way to protect individual beekeepers, regional biosecurity and the Australian honey bee industry as a whole.

What is biosecurity?

Biosecurity is the protection of livelihoods, lifestyles and the natural environment, all of which could be harmed by the introduction of new pests, or through the impact of pests already established in Australia.

Biosecurity is a national priority, implemented off-shore, at the border or in an apiary. Biosecurity is essential for a successful beekeeping business.

Australia's geographic isolation has meant that we have relatively few of the pests that affect honey bee industries overseas.

Freedom from these exotic pests is a vital part of the future profitability and sustainability of Australia's honey bee industry. Biosecurity preserves existing trade opportunities and supports new market negotiations.

The definition of a **pest** used in this manual covers all insects, mites and pathogens (diseases) that may harm honey bees. **Exotic** pests are those not currently present in Australia. **Established** (or **endemic**) pests are those present within Australia.

What is honey bee biosecurity?

Honey bee biosecurity is a set of measures designed to protect your honey bees from the entry and spread of pests. Honey bee biosecurity is the responsibility of every beekeeper and every person visiting or working in an apiary.

Implementing honey bee biosecurity is essential for your business. If an exotic or endemic pest establishes in an apiary, business costs will increase (for monitoring, hive management, additional chemical use and labour), productivity will decrease (yield and/or colony performance) and markets may be lost. The health of the honey bee industry also ensures the continued success of many other plant industries that rely on honey bees for pollination.

Early detection and immediate reporting increases the chance of an effective and efficient eradication.

Regional biosecurity

The biosecurity measures of an individual beekeeper can be enhanced by collaborating with others in a particular region. Through this collaborative approach, biosecurity threats to all apiaries in a region can be minimised.

Promotion of honey bee biosecurity at the regional level can be enhanced through the engagement of the community and by understanding the area's vulnerability, and the potential source and nature of threats. Neighbouring apiaries (managed or abandoned), feral colonies and/or unregistered hives are examples of potential biosecurity threats.

Regional biosecurity efforts are strengthened by identifying what resources and expertise are available, and by having a commitment from stakeholders to implement biosecurity measures and surveillance programs.

Implementation of honey bee biosecurity strategies underpins regional biosecurity, which in turn underpins national biosecurity.

Marion Weatherhead

Pests

High priority exotic pests

The following are some key exotic pests that will have serious consequences for honey bees and the Australian honey bee industry should they enter and become established in Australia. Additional information on these pests is included in the fact sheets at the back of this manual.

For information about other exotic pests of the honey bee industry, visit the BeeAware website for detailed pest information and images **beeaware.org.au/pests**

Varroa mites (*Varroa destructor* and *V. jacobsoni*)

OVERALL RISK – HIGH

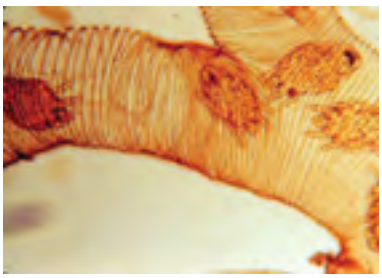
- External parasitic mites that feed on the haemolymph (blood) of both drone and worker bee larvae and pupae, and adult bees
- Detection possible by close examination of brood or testing of adult bees (p. 16-17)
- Symptoms include deformed pupae and adults (stunting, damaged wings, legs, abdomens), parasitic mite syndrome (PMS) and colony decline
- Varroa mites can also spread viruses, further affecting the colony's health and disease susceptibility

Stephen Ausmus, USDA Agricultural Research Service, www.Bugwood.org

Tracheal mite (*Acarapis woodi*)

OVERALL RISK – HIGH

- Internal parasite of the honey bee respiratory system
- Affects the honey bee's capacity to breathe, resulting in weakened and sick honey bees which have a reduced lifespan
- Symptoms include population drop, bees crawling on the ground and bees holding their wings at odd angles (K wing)
- Accurate identification requires dissection and microscopic examination of the bee's trachea



USDA

Tropilaelaps mites (*Tropilaelaps clareae* and *T. mercedesae*)

OVERALL RISK – HIGH

- External parasitic mites that feed on the haemolymph of both drone and worker bee larvae and pupae, and adult bees
- Detection possible by close examination of brood or testing of adult bees (p. 16-17)
- Symptoms include deformed pupae and adults (stunting, damaged wings/legs/abdomens), parasitic mite syndrome (PMS) and colony decline
- Tropilaelaps mites can also spread viruses, further affecting the colony's health and disease susceptibility

Denis Anderson

Priority established pests

Pests in this category are established in Australia. Some are present in every state and territory and others have a localised distribution. They are expensive and/or difficult to manage and force you to specifically monitor hives, as they affect the strength and productivity of the honey bee colony. Additional information on these pests is included in the fact sheets at the back of this manual.

For more information on each of these pests, visit the BeeAware website **beeaware.org.au/pests**

American foulbrood (*Paenibacillus larvae*)

- Brood disease caused by a bacterium that is ingested by bee larvae (less than 3 days old) and results in the larvae dying of starvation after cell capping
- Symptoms include sunken and discoloured, sometimes greasy, cell cappings with perforations and an irregular brood pattern
- Decaying infected larvae may be roped to a distance of 25 mm or more
- Infection weakens the hive making it susceptible to robbing, and spread to other bee colonies will be fatal in most cases
- Bacterium is very infectious, remains dormant for over 50 years and can occur on components of infected hives

Food and Environment Research Agency (Fera), Crown Copyright

Asian honey bee (*Apis cerana* Java genotype)

- Invasive and adaptive strain of Asian honey bee (AHB)
- Similar appearance to the European honey bee, although is slightly smaller, has more pronounced stripes on its abdomen and has an erratic flying pattern
- AHB cannot be managed for honey production or pollination, due to its frequent swarming and tendency to abscond
- Robs European honey bees of their honey stores and competes for floral resources

CSIRO

Black queen cell virus (*Black queen cell virus* (*Cripavirus*))

- Virus that causes mortality in queen bee larvae or pre-pupae
- Queen bee larvae or pre-pupae die after capping. The dead larvae or pre-pupae and the queen bee cell wall turn brown-black
- Symptoms reflect the appearance of worker bee larvae killed by sacbrood virus
- Black queen cell virus may be transmitted by *Nosema apis*

Rob Snyder, www.beeinformed.org

Braula fly (*Braula coeca*)

- The braula fly lives in honey bee colonies and attaches itself to honey bee mouth parts where it feeds on nectar and pollen
- Has a preference for attaching itself to queen bees which can decrease the efficiency and egg laying capability of queen bees
- Braula larvae tunnel under honey cappings which give honey comb cappings a fractured appearance

Simon Hinkley and Ken Walker
Museum Victoria, PADIL

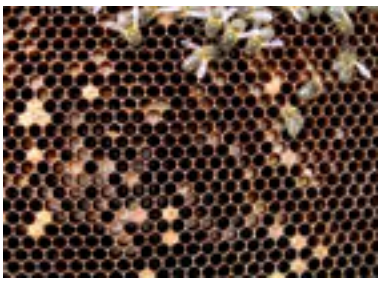
Chalkbrood disease (*Ascosphaera apis*)

- A fungus that is ingested by bee larvae causing death by starvation
- Symptoms include scattered brood with perforated cappings
- Larvae die after the cell is capped and become covered by the white/grey fungus, causing the diagnostic 'mummies'
- Incidence is usually greater when the colony is under stress due to cool weather or poor nutrition

Food and Environment Research Agency (Fera), Crown Copyright

European foulbrood (*Melissococcus plutonius*)

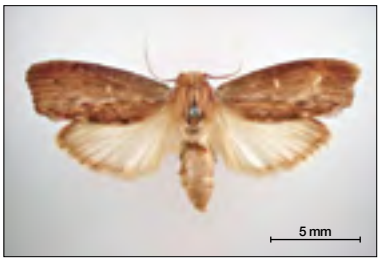
- A brood disease caused by a bacterium that is ingested by honey bee larvae and results in the larvae dying of starvation
- Symptoms include spotted brood pattern intermingled with healthy brood, sunken and dark cappings and a foul smell
- Infected larvae die before their cells are capped in a twisted position and become yellow-brown
- Incidence is usually greater when the colony is under stress due to cool weather or poor nutrition



Food and Environment Research Agency (Fera), Crown Copyright

Greater wax moth (*Galleria mellonella*) and Lesser wax moth (*Achroia grisella*)

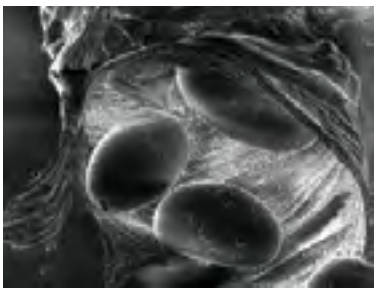
- Pests of weak and stressed colonies and combs in storage
- Both moths are a similar grey colour and tend to coexist in the same location (greater wax moth pictured right)
- Both species prefer brood combs and eat wax, pollen and remains of larval honey bees, leaving behind silk webbing and silk lined tunnels
- Larvae chew canoe-like cavities on wooden frames and hive boxes in which they spin their white silk cocoon.



Simon Hinkley and Ken Walker
Museum Victoria, PADIL

Nosemosis (*Nosema apis* and *N. ceranae*)

- Disease caused by two species of microsporidian parasites which can infect drones, workers and queen bees
- Spores germinate in the adult bee gut causing a shortened life-span, a sometimes rapid reduction in the number of adult bees, poor honey production, reduced brood production and dysentery in and around the hive
- Infected bees show no specific disease symptoms
- Heavy losses of bees and colonies may occur in autumn, winter and spring



Food and Environment Research Agency (Fera), Crown Copyright

Sacbrood virus (*Sacbrood virus* (*Iflavirus*))

- A virus that affects bee larvae after consuming contaminated brood food, water, pollen or nectar
- Symptoms include scattered dead brood with discoloured, sunken or perforated cappings
- The larvae die with their head characteristically raised in a banana shape toward the top of the cell
- Infected larvae die shortly after capping and have a yellowish appearance as they become a fluid filled sac. The skin of dead larvae changes into a tough plastic-like sac

Food and Environment Research Agency (Fera), Crown Copyright

Small hive beetle (*Aethina tumida*)

- Larvae of this brown-black beetle consume honey bee eggs, brood, pollen and honey
- The larvae chew through the combs causing the honey to ferment and the hive to become 'slimed out'
- Larvae can also consume combs of honey removed from the hive for extraction
- Large numbers of small hive beetle can result in the death of the colony or the colony absconding

James D Ellis University of Florida www.bugwood.org

Pests that are established in regions of Australia may still be reportable in states or territories in which they are present, as well as those from which they are currently absent. Know which of these established pests are reportable for your region and consult your local department of agriculture if you detect them.

If you detect an exotic pest in your hive, contact your local department of agriculture immediately or call the Exotic Plant Pest Hotline on 1800 084 881.

Code of Practice and National Bee Biosecurity Program

10 The Code

In an effort to improve the management of established pests and diseases, as well as increase the preparedness and surveillance for exotic pest threats, the Australian honey bee industry, through the Australian Honey Bee Industry Council (AHBIC), has developed a national Biosecurity Code of Practice (the Code). The Code has been developed in consultation with beekeepers and governments to provide a clear framework for Australian beekeepers to engage in best-practice biosecurity. The objectives of the Code are to:

- Increase productivity in the Australian honey bee industry by improving the general level of pest and disease control by Australian beekeepers.
- Assist beekeepers to recognise exotic pests and diseases of bees and prepare for an exotic or emerging disease response.
- Ensure beekeepers conduct regular surveillance for the presence of notifiable exotic and established pests and diseases.
- Assist in the management of significant established diseases of bees, particularly American foulbrood.
- Facilitate the cross-border movement of bees and products in certain zones through adoption of a single national code for biosecurity practices.
- To ensure the future viability and sustainability of the Australian honey bee industry.

Norfolk Island Quarantine Survey

Regular inspection of colonies forms a large component of the Code

The Code has been developed to incorporate fundamental biosecurity principles into the practices of all Australian beekeepers. It describes the outcomes you need to achieve for good pest and disease prevention and control. It is not a manual on how to keep bees: the Code tells you what you need to achieve but how you achieve it will be up to you and will be influenced by your situation.

The standards set in the Code are not onerous – they are simply standards that all beekeepers should be doing to minimise the impact of pests and diseases on their hives and those of their fellow beekeepers. If you are already in a quality assurance (QA) program, then QA programs will be slightly modified to allow you to conform to the Code.

To download the Code and learn how you can incorporate these practices into your hobby or business, visit the BeeAware website **beeaware.org.au**

National Bee Biosecurity Program

As part of the Code, the National Bee Biosecurity Program will commence in 2016. This program is a national partnership between the Australian honey bee industry, Plant Health Australia (PHA) and state governments that promotes best management practices for beekeepers in Australia.

NATIONAL BEE BIOSECURITY PROGRAM

To ensure that Australian beekeepers are following appropriate biosecurity practices, the Program aims to have a Bee Biosecurity Officer (BBO) in each state. These positions will be within each state department of primary industry (DPI), funded by a combination of beekeeper levies and state government contributions.

The role of a BBO is to provide extension services for industry, training and education for beekeepers and to monitor industry's compliance with the Code. The work plans and milestones of the BBO would be determined in consultation between state beekeeping association representatives, PHA and state DPI's. This ensures that industry helps drive the Program and have some ownership of what the Program is aiming to achieve.

In the event of an incursion of an exotic pest (such as Varroa mite) a BBO will be on hand to provide expert support to industry, help to design and implement response measures, and provide training and education for beekeepers.

For more information about the National Bee Biosecurity Program, and to access resources to help beekeepers comply with the Code (such as online training and record keeping templates) visit the BeeAware site **beeaware.org.au**

Sam Maltroy

BBO's will be on-hand to work with beekeepers to deliver greater education, training and inspection services

Keeping honey bees healthy

12 Controlling pests and diseases

Many beekeepers in Australia move their hives for pollination contracts and to follow honey flows. This movement of hives, as well as the drifting and robbing habits of honey bees means that the spread of pests and diseases can be difficult to prevent or contain. However, the adoption of the following biosecurity measures in day-to-day management practices will help minimise the risk of pest and disease transmission between honey bee colonies and apiaries.

Purchase clean hives and equipment

- Only purchase second hand hives and equipment from beekeepers who regularly check for established and exotic pests and diseases.
- If possible, examine the colony and hive parts before purchase to ensure they meet the required standard and are pest and disease free.
- Isolate newly purchased hives for up to 6-12 months until you are satisfied of their health status.
- Sterilise or irradiate second hand beekeeping equipment before use in your apiary.

Sam Malfroy

A clean, well managed apiary

Clean apiary equipment regularly

- Clean smokers, hive tools and other apiary equipment of any accumulations of wax, propolis or honey before commencing work at each new apiary, particularly if any pest or disease is suspected.
- Always clean extracting machines, drums or containers before and after use.
- Ensure honey containers are cleaned inside and out and dried and sealed before use.

Dispose of waste material effectively

- Make sure that honey spills, exposed combs and wax are destroyed or covered to prevent robbing by honey bees.
- Maintain good hygiene practices around the apiary and remove beeswax scraps, old combs and dead-out hives, which can attract and harbour pests and diseases.

Implement a health program

- Obtain sound information and understand the pest and disease risks for each apiary.
- Develop appropriate measures for pest and disease control and record all treatment details.
- Implement a barrier management system to reduce the risk of spreading pests and diseases within and between apiaries.
- Control swarming in colonies by providing extra space for the colony during build up, and remove queen cells to keep the colony population strong and healthy.
- Regular comb replacement can lead to improvement in the health of your honey bees. Brood combs should be replaced with new foundation at least once every three years.
- Requeen colonies every two years with a young and healthy queen bee from a reputable breeder.
- Inspect brood combs on a regular basis throughout spring, summer and autumn.

All pest and disease (exotic and established) surveillance activities on the property or apiary should be recorded. These records can be used in the response to an incursion to inform management practices as well as provide support to industry surveillance activities.

14 Inspecting hives

It is critical to inspect all hives on a regular basis, especially the brood. This is an important management practice to determine the presence or absence of many established pests and diseases within Australia. It is also an important precautionary measure for beekeepers to identify any exotic pests that may be in their hives, such as the exotic Varroa mite. The following are guidelines for inspecting hives.

NSW DPI

Preparing the hive for inspection

Getting started

- Try to examine the brood and colony at least several times a year in spring, summer and autumn.
- Make sure that the circumstances are suitable to inspect the colony. For instance, do not start your inspection if the weather is likely to turn wet or cold, or if there are people or animals in the vicinity.
- Make an assessment of the level of activity at the entrance of the hive. Observe whether honey bees are flying, if there are dead honey bees at the entrance, or if honey bees are bringing in pollen.
- Keep records of your inspections and write down any occurrence, or suspicion, of disease. If anything suspicious is observed report it immediately to the Exotic Plant Pest Hotline 1800 084 881.
- Always be calm and methodical when inspecting hives and try to avoid any sudden or sharp actions.

NSW DPI

Opening up the hive

Opening the hive

- Apply smoke into the hive entrance
- Remove the hive lid and any supers and place them to the side of the hive.
- Use your smoker sparingly to control the bees – too much smoke may excite or distress the bees.
- If the hive has a queen excluder, carefully remove it with the aid of a hive tool.
- Clean up any brace/burr comb or propolis from the queen excluder on the top of frames and place in a sealed container that can be taken away with you. Do not discard this on site as honey bees could rob this material which could spread pests and diseases.
- Remove an end frame, and if the queen is not present, place on the side of the hive to give more space to remove the centre frames without damaging the honey bees.

NSW DPI

Removing a brood frame

Inspecting the hive

- Remove a brood frame (without the queen bee) and shake most of the honey bees back into the hive or at the hive entrance, leaving the brood comb clear for inspection.
- Hold the frame by the top and inspect the brood thoroughly.
- Look for symptoms associated with established pests and diseases of honey bee colonies.
- Look for any queen bee cells on the comb surface and bottom side of the comb, and if present, remove to reduce swarming potential.
- Repeat this for all brood frames.
- Place combs back in the same sequence and orientation as they were at the start of the inspection, unless you have planned to manipulate the combs for a management reason.
- Make sure that the frames are tightly pushed together to provide the correct bee space.
- Record what you observe and note any pests and diseases that you have identified. Look at possible control or management options.

NSW DPI

Inspecting brood comb

Sam Malfroy

16 Early detection of exotic mites

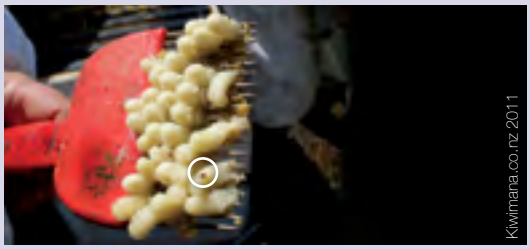
When inspecting any hives, it is important to always be aware of the possibility that they could contain exotic pests. Exotic pests, such as Varroa mites, pose a constant threat to Australia's honey bee industry and beekeepers are in the front line for early detection. Early detection and reporting greatly improves the chances of containing and eradicating any new pests.

You should include checks for external parasites in routine inspections of hives. The two methods listed below are simple procedures that should form part of a comprehensive health and surveillance program for every apiary.

For detailed fact sheets and instructional videos about how to conduct these methods, as well as other surveillance methods for exotic pests, visit the BeeAware website **beeaware.org.au/surveillance-for-exotic-pests**

Uncapping drone brood

Up to 85% of Varroa mites in a honey bee colony are in capped brood cells. Since Varroa mites prefer reproducing on drone brood, uncap ~100 drone brood and remove drone pupae (right). **Please note** that this will kill the drone brood.



Examine each pupa for reddish-brown mites, which can be clearly seen against the healthy pearly white bodies of the drone pupa (left and above). Once the drone pupae are removed, check the bottom of the drone brood cells for any mites that may not have been attached to the removed drone pupae (below).

It is recommended that every beekeeper conduct this method as it is fast and can be easily carried out as part of a routine inspection. Uncap drone brood on at least three brood frames from randomly selected hives from each apiary. This should be conducted in early spring and at other times of the year when drone brood is present.

Sugar shaking honey bees

Sugar shaking honey bees is a quick and easy method to detect external parasites such as Varroa mites. It does not kill the honey bees and removes 70-90% of external Varroa mites present. The sugar shaking method works because the sugar particles, and the grooming behaviour that it stimulates in honey bees, helps dislodge any Varroa mites for detection.

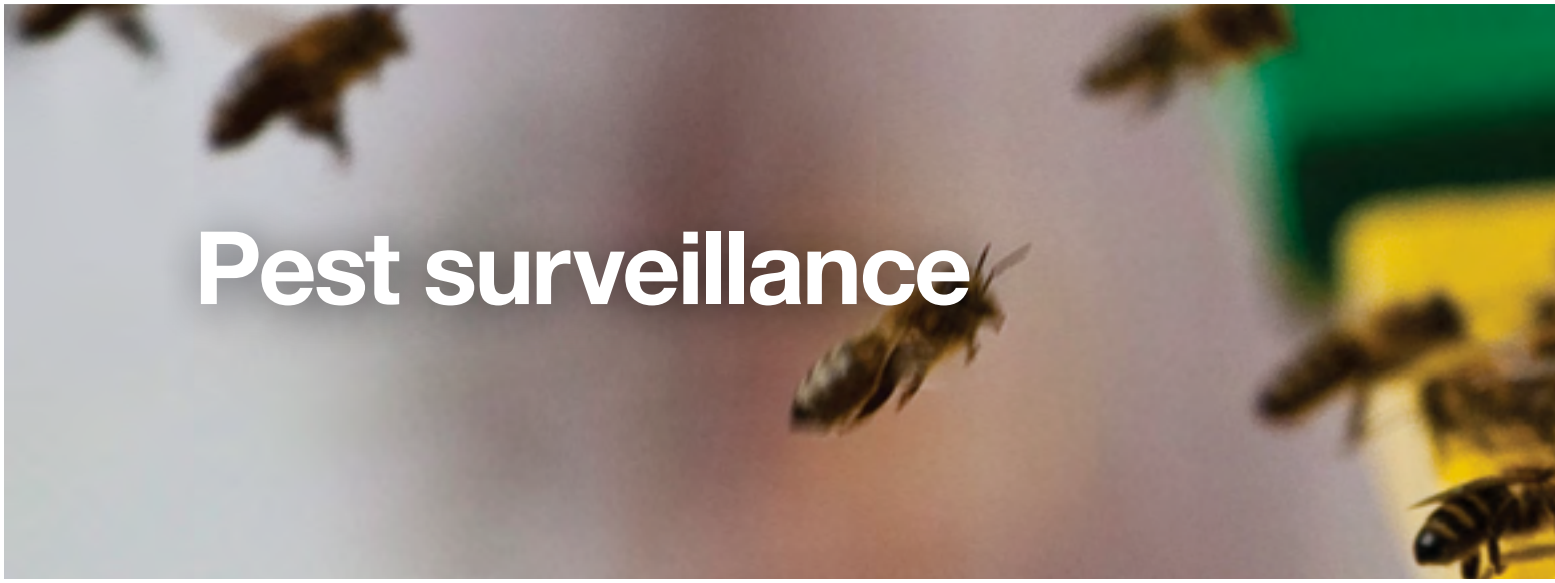
To sugar shake honey bees, add 1 tablespoon of icing sugar mixture and approximately 300 honey bees (1/2 a cup) into a container that has 1/8 gauze wire mesh for a lid (left). Roll and gently shake the honey bees for 2-3 minutes, ensuring the bees are covered in sugar. Leave for 2-3 minutes and then roll and shake again for 2-3 minutes.

Shake the sugar out of the container through the wire mesh onto a white piece of paper or cardboard and look for any Varroa mites (right). The sugar and any Varroa mites (if present) will pass through the mesh, leaving the honey bees in the container.

Once completed, return the honey bees coated in icing sugar back to the hive (left). Inspect the empty jar thoroughly for any possible Varroa mites. This method should be conducted on at least 5% of hives in an apiary.

If any mites are found using either of these methods, or if you see anything unusual, call the Exotic Plant Pest Hotline on 1800 084 881.

EXOTIC PLANT PEST HOTLINE
1800 084 881



Pest surveillance

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Importance of pest surveillance

Apiary monitoring and surveillance involves looking for and recording the presence, absence and population levels of pests. Regular monitoring is a fundamental part of honey bee management practices and gives the best chance of spotting exotic or established pests soon after they arrive.

Pest surveillance is necessary because of:

- **Market access:** Export destinations for honey bees can require 'evidence of absence' data for exotic and some established pests that are of concern. The Australian honey bee industry, in collaboration with governments, must prove through surveillance that exotic and/or established pests have been looked for and shown to be absent.
- **Exotic pest eradication:** Early detection of exotic pests improves the chance of eradication or containment within a region. However, if eradication or containment is not feasible, early detection, in conjunction with contingency planning and preparedness by government and industry bodies (e.g. preparing emergency chemical registrations, awareness material and training in pest diagnostics) assists with more rapid and effective response management.

Report suspect pests or symptoms

Early detection and reporting of any suspect pests or symptoms may prevent or minimise long-term damage to the honey bee industry and reduce any quarantine period that an apiary, or apiaries, are placed under.

When inspecting hives, look for unusual symptoms such as poorly formed honey bees with deformed wings (below), thoraces and/or abdomens as well as general colony symptoms of rapid population decline, or a low bee to comb to brood ratio. Also be aware of any mites that are observed on the honey bees or in the brood.

CSIRO

Worker European honey bee with wing deformities as a result of varroa infestation

If you observe any unusual symptoms or detect any mites on your honey bees or in the brood report it immediately via the Exotic Plant Pest Hotline on 1800 084 881.

Calls to the Exotic Plant Pest Hotline will be forwarded to an experienced person in the state or territory government, who will ask some questions about what you have seen and may arrange to collect a sample.

Do not send samples without first speaking to someone from the state or territory department of agriculture, who can discuss the correct type of sample, its packaging, handling and transport to the laboratory assigned for diagnosis.

In some states and territories, the Exotic Plant Pest Hotline operates only during business hours. Outside these hours, leave your full contact information and a brief description of the issue and your call will be followed up as soon as possible. Every report will be taken seriously and treated confidentially.

If you suspect you have an exotic pest, the following general precautions should be taken immediately to contain the pest and protect your apiary:

- Mark the hive or area where the pest was found. Limit access of people and equipment to the apiary and surrounding area.
- Wash hands, clothes, apiary equipment and vehicles that have been in contact with the suspect hive/s or apiary. Make sure sick or infested honey bees are not removed from the apiary.
- Stop beekeeping operations immediately while waiting for the identification of the suspected exotic pest.

If a suspected or confirmed honey bee Emergency Plant Pest (EPP) is identified, you should follow the simple guidelines listed below:

- Always follow the relevant state or territory regulatory requirements and the directions given by the state or territory apiary inspectors.
- Do not move, or attempt to move any hives, machinery, or equipment from the premises or apiary site.
- Always adhere to any movement restrictions that apply to hives, honey bee products, machinery or equipment within the Control and Restricted Areas.
- If requested, provide the relevant state or territory apiary inspector with a list of known beekeepers who own hives within the Control and Restricted Areas or Quarantine Zone.
- It is important to work with state or territory apiary inspectors. Emergency containment and preserving the ability to eradicate the EPP is the first priority for everyone involved.

Following these guidelines provides the best protection for every beekeeper and the entire honey bee industry.

If you see anything unusual, call the Exotic Plant Pest Hotline.

EXOTIC PLANT PEST HOTLINE
1800 084 881

20 Emergency responses

In Australia, both industry and governments have a role to play in managing and funding emergency responses aimed at eradicating exotic pests and diseases.

Incursions by pests and diseases that are deemed to be Emergency Plant Pests (EPPs) are dealt with under the terms of the Emergency Plant Pest Response Deed (EPPRD).

The Australian Government, all state and territory governments and the major plant industry bodies have signed the EPPRD, along with Plant Health Australia, the custodian of the agreement.

Under the EPPRD all decisions are made by committees that include government and industry representatives. The decisions of the Consultative Committee on Emergency Plant Pests (CCEPP) relate to the technical feasibility of eradication of the pest in question. Decisions of the National Management Group (NMG) are made on technical advice from the CCEPP and financial considerations.

The EPPRD sets out arrangements that automatically activate when a suspected EPP is detected in Australia, allowing swift and effective action. The fast response time is required to provide an opportunity to eradicate the pest or disease.

What happens if an exotic pest or disease is confirmed

Within 24 hours of the initial identification of an exotic pest or disease, the relevant state agency, through the State Chief Plant Health Manager, will inform the Australian Chief Plant Protection Office who will notify all state agencies, relevant industry representatives and Plant Health Australia.

The relevant state or territory agriculture agency will seek a confirmatory diagnosis from another laboratory, usually within a different jurisdiction.

If the pest or disease is considered potentially serious and/or suspected to be an Emergency Plant Pest (EPP), the relevant state/territory agriculture department will usually adopt precautionary emergency containment measures. These measures, depending on the pest, may include:

- restricted access to the area
- a hive standstill
- restriction of operations in the area
- withdrawal of people, vehicles and machinery from the area
- control or containment measures.

If an EPP is confirmed, technical and economic considerations are reviewed, and a decision made whether to:

1. Attempt to eradicate, which would be managed under the Emergency Plant Pest Response Deed (EPPRD) and a Response Plan
2. Take another course of action, such as to contain or do nothing and accept potential long-term management of the pest.

The Australian Honey Bee Industry Council (AHBIC) has signed the EPPRD, giving the industry a seat at the decision making table in the event of an incursion that affects the honey bee industry.

Since the industry benefits from a response to eradicate new pests or diseases that would compromise production, AHBIC covers a proportion of the costs of an approved Response Plan by having appropriate biosecurity levy arrangements in place.

Also, under the conditions of the EPPRD, the honey bee industry (including members of AHBIC) has a responsibility to report suspect pests or diseases.

For more information on the EPPRD and emergency responses, go to **planthealthaustralia.com.au/epprd**

Norfolk Island Quarantine Survey

Sampling honey bees for viruses

Owner Reimbursement Costs

Without early reporting, eradication efforts can be futile as the pest or disease is too widespread and established in the environment. In these cases, beekeepers then have to manage the pest or disease as endemic, leading to permanent increases in production costs.

To encourage early reporting and improve the chance of successful eradication, the EPPRD allows for payments to beekeepers who can demonstrate financial losses or costs incurred as a result of an effort to eradicate an EPP. Owner Reimbursement Costs (ORCs) may cover costs associated with Response Plan actions, such as the destruction of hives, honey and additional chemical treatments. Their purpose is to reduce the financial impact of the eradication response on the beekeeper.

ORCs apply only to approved Response Plans aimed at eradication, and only to industries that are signatories to the EPPRD, like the honey bee industry.

ORC Evidence Frameworks are developed for each agricultural sector to provide extra guidance and a hierarchy of evidence is used to determine specific ORC valuations. The honey bee industry has already developed their evidence framework for ORC's. It is available from **planthealthaustralia.com.au/orc**

Product management

22 Queen bees and packaged bees

Use healthy queen bees and packaged bees (i.e. tested with no pest or disease detections) from reputable breeders. This assists in managing biosecurity risk as it is hard to visually assess the health of purchased queen bees or packaged bees. Viruses, bacteria and mites may be present but not induce symptoms under some circumstances.

To minimise the risk of introducing pests or diseases into an apiary:

- Obtain queen bees and packaged bees only from a business that takes biosecurity, hygiene, health testing and record keeping seriously.
- Check packaged bees and queen bees and the brood that is produced thoroughly within one month of arrival.
- Maintain a register of the apiary's purchased queen bees and packaged bees, including their source (with contact details), breed/strain, locations, what was bought and the receival date.

Sam Malfroy

Queen cell cages

Pollination

Every beekeeper should aim to use best industry practices to provide a high standard of pollination service. When placing hives for pollination, many beekeepers and growers prefer to use a pollination agreement that specifies the responsibilities of both parties. Agreements are useful to clarify what a grower is hiring and what the beekeeper needs to supply.

Some of the issues raised in an agreement should include:

- hive stocking rates
- strength of hives
- dates of hive introduction and removal
- placement of hives
- payment of fees
- protection from spray damage.

Visit the BeeAware website for more information **beeaware.org.au**

Doug Somerville, NSW DPI

Hives pollinating almonds

Honey and specialist products

Honey, comb honey, wax, pollen, royal jelly and propolis are all specialist products that are produced by beekeeping operations in Australia. In order to produce honey and specialist products of the highest standards, follow industry best management practice guidelines which are outlined in quality assurance schemes (see page 24).

To minimise the environmental impacts of beekeeping, you should follow the guidelines that are published in the *National Best Management Practice for Beekeeping in the Australian Environment* which was published by AHBIC, Australian Government and NSW DPI in 2007. This report is available at **honeybee.org.au**

Tim Malfroy

Frame of honey comb

Record keeping

Good record keeping is an important part of any hobby or business and complete records should be kept of all biosecurity actions and observations. Hives or groups of hives should be clearly identified and accurate records of movements kept for traceability. Accurate records are also critical if a beekeeper becomes affected directly, or indirectly, by the incursion of an exotic pest and a subsequent Response Plan.

A variety of record templates are available from the BeeAware website **beeaware.org.au** for download.

Doug Somerville, NSW DPI

Recording observations and inspections in an apiary

Biosecurity and quality assurance

24 Barrier systems

A major method of disease spread within an apiary or between apiaries is through the transfer of infected material between hives prior to disease symptoms being detected. A well-managed barrier system will contain potential spread to within defined units, and enable you to trace both the source and spread of a disease, which will help with management and eradication efforts.

A barrier system is a method of dividing apiaries into smaller sub-units to ensure there is no transfer of potentially infected materials between the sub-units. The overall purpose is that hives and hive components in one sub-unit are not interchanged with those from another sub-unit, however, how the barrier system is implemented will depend on the individual circumstances of the enterprise. Good record keeping and forward planning is essential, and all people working with the hives must understand how the system works for it to be effective.

The adoption of a barrier system will enhance traceability, biosecurity and quality assurance aspects of the beekeeping enterprise, as well as build upon best practice principles.

Barrier management systems alone are not a replacement for good beekeeping and good pest monitoring and management.

Quality assurance programs

Auditable quality assurance (QA) programs can be valuable to commercial beekeepers with benefits to biosecurity, market access, meeting specifications, customer expectations and food safety. There are a variety of private QA programs that can be adopted, as well as the industry owned QA program, B-Qual. If an apiary business is accredited with a QA program it is likely that some fundamental techniques of biosecurity best practice are already being applied.

QA programs are underpinned by best beekeeping and processing practices, which have been backed by research into hygiene, quality and chemical residues. Quality standards have been developed for apiary operations, extracting and packing plants, biosecurity procedures, organic production and other specialised activities.

Biosecurity signs

Well-designed signage informs visitors that biosecurity management of honey bees within an apiary is important, and that there is a shared responsibility for maintaining it. The signs serve to alert people that they should register their presence before entering the apiary, as well as demonstrating a beekeeper's commitment to apiary hygiene and safety.

Biosecurity signs at entrances to a property or apiary should provide your name along with a contact phone number. In cases where hives are transported to different sites, signs should accompany hives and be placed at the new apiary site.

Biosecurity signs are also important when the apiary is situated on another property, providing contact details in case of chemical spraying, a biosecurity incident (such as an exotic pest detection) or in the event of an emergency such as bushfires or flooding.

One template is for a 600 x 900 mm corflute panel with four eyelets to be placed on gates to properties or apiaries. The second is for an A4 corflute sign that can be staked at each apiary or moved around with each load of hives.

Trevor Monson, Australian Pollination Services

For more information about barrier management systems, QA progams or to download free templates for biosecurity signs, visit the BeeAware website **beeaware.org.au**

Movement of hives, honey bee products and equipment

26 Movement of hives

The movement of hives for a honey flow or pollination contract can easily spread pests and diseases to other regions or apiary sites. Adopt the following management measures to reduce this risk.

- Minimise hive movements where feasible, and understand the stress that is placed on honey bee colonies that are regularly moved.
- Ensure that hives, honey and apiary equipment are secured and covered to prevent robbing by honey bees.
- When moving hives to a new location, assess any disease threat posed by possible abandoned or poorly managed hives nearby.
- Always obtain a health certificate which has been signed by an apiary inspector from the state or territory of origin before moving hives interstate.
- Find out which established pests are reportable for the region you are moving from, and to. If detected, contact the local department of agriculture (see contacts on page 32).

Movement of honey bee products

Each state and territory has different restrictions on the interstate movement of honey and honey bee products such as wax, propolis and pollen. Before moving any of these products interstate, always contact the local department of agriculture for advice on any specific health certification requirements (see contacts on page 32).

Ian Zadow

Moving hives to a new apiary

Keep accurate records of hive movements so that in the event of an incursion of an exotic pest or disease, trace back information about hive movements can be provided to identify possible risk areas for targeted surveillance.

Movement of vehicles, machinery and equipment

Vehicles and all apiary equipment, including forklifts, trucks, hand tools and bee boxes can carry pests and diseases in adhering honey and wax. Pests and diseases can then spread, or be introduced to a previously clean apiary.

Take the following measures to reduce the risk of pest and disease entry on equipment and vehicles:

- Clean and wash down vehicle trays of honey, wax and associated colony debris, especially after visiting other apiaries.
- Limit the movement of vehicles within the apiary.
- Always make sure that borrowed and second-hand apiary equipment and machinery is cleaned and sterilised before moving into the apiary.
- Regularly clean and sterilise all tools and equipment, including hive tools, gloves, pallets, boxes and any other equipment used in the apiary.

While inspecting and cleaning machinery can seem onerous, remember that it is easier and cheaper than dealing with a new pest or disease.

Movement of vehicles and apiary equipment between properties

As well as ensuring good honey bee hygiene, beekeepers who travel to farms or properties need to consider farm biosecurity for other primary producers or to the natural environment.

Pests, diseases and weeds carried in soil, apiary equipment, on vehicles, clothing and boots can introduce pests that are very damaging for other agricultural industries or to native vegetation.

- Always consider farm biosecurity when entering a property.
- Be aware of other industries' biosecurity risks and requirements.
- Adopt a ‘come clean, go clean’ policy wherever possible.
- Talk to the landholder about areas that have been visited or any specific biosecurity concerns that apply to their property.

For more information on farm biosecurity go to **farmbiosecurity.com.au**

BeeAware

28

BeeAware is a hub of online information for beekeepers and growers about honey bee biosecurity and pollination of agricultural and horticultural crops. The BeeAware website contains detailed information on established and exotic honey bee pests and diseases, the symptoms they cause and how to control them. It also has pollination information and advice on how growers and beekeepers can work together to get maximum benefit from honey bee pollination.

BeeAware contains the latest information for both hobby and commercial beekeepers about how to implement biosecurity best practice in the apiary, information on education and training resources, beekeeping associations and downloadable documents, such as this biosecurity manual.

The BeeAware website is funded by the Australian honey bee industry, pollinator-reliant industries, Plant Health Australia, governments and R&D agencies.

The BeeAware website is constantly being updated so become a frequent visitor to the site and see what is new as well as sign up to the BeeAware e-newsletter.

Honey bee pests and diseases

The BeeAware website contains extensive information and images about established pests in Australia as well as exotic pests that affect honey bee populations elsewhere in the world. Pest pages include:

Established pests	Exotic pests
American foulbrood	Varroa mites
Small hive beetle	Tropilaelaps mites
Asian honey bee	Tracheal mite
European foulbrood	Asian hornet
Wax moth	Africanised honey bee
Nosema	Cape honey bee
Sacbrood virus	Large hive beetle
Braula fly	Dwarf honey bee
Chalkbrood disease	Giant honey bee
Black queen cell virus	

Beekeepers need to be familiar not only with established pests, their symptoms and how to control them, but also to know how to monitor for exotic pests.

The life cycle and biology of each pest is described, as well as signs and symptoms to look for, guidance on how to check for them and how to manage the pests most commonly found in Australia. This includes links to other useful websites, fact sheets from Australia and around the world and instructional videos.

Pollination

As honey bees forage for nectar and pollen they pollinate plants, resulting in benefits for many types of crops. The benefits vary from crop to crop, and include increased seed or fruit set, improved storage qualities and shape of some fruit, and a more synchronised maturation of some fruits or nuts.

The BeeAware website contains extensive information about the pollination requirements and the management practices that can be put in place to achieve optimal pollination for the following crops.

Pollinator reliant crops	
Almonds	Macadamias
Apples and pears	Melons
Avocados	Onions (for seed)
Berries	Papaya
Blueberries	Passionfruit
Cherries	Strawberries
Cotton	Summerfruit
Legumes and oilseeds	Vegetables
Lychees	

To assist farmers and beekeepers, BeeAware has details about how pollination works, checklists that beekeepers and growers should follow, and extensive information on the following topics:

- **Pollination agreements** – agreements help clarify what a grower thinks they are hiring and what a beekeeper thinks they need to supply.
- **Pesticides** – contains information about pesticides that are harmful to bees, how to avoid being exposed to pesticides and how to report a bee kill incident.
- **Preparing for Varroa** – summarises the impact that Varroa will have on pollination markets in Australia and how plant industries can prepare for an incursion.
- **Native bees** – outlines the role of native bees in Australia as pollinators and how these native populations can be promoted on-farm.

Newsletter

Stay up-to-date with the latest news and information about beekeeping and pollination by subscribing to the free BeeAware monthly e-newsletter. Each newsletter contains information on:

- Bee news and events from Australia and around the world
- Honey bee pests and diseases
- The latest research into pollination, pests and diseases
- Pollinators and pesticides in agriculture
- Alerts of new pest detections and incursions affecting honey bees
- Updates made to the BeeAware website.

The newsletter is a great way to keep connected and have the latest information for your hobby or business. To subscribe, go to **beeaware.org.au/subscribe-to-newsletter**

Biosecurity best practice checklist

Sam Malfroy

This list of recommended biosecurity practices allows you to assess your honey bee management. While all practices may not be applicable, working through the list will highlight the strengths and weaknesses of an apiary. This ensures the apiary has the best protection against the introduction and spread of new pests and diseases.

Once identified, a few simple and practical procedures can be implemented to strengthen areas of greatest risk. While changing everyday practices can take more effort in the short term, these will become second nature with time and are easier and cheaper than dealing with the introduction of a new pest.

Neil Bingley

Date of biosecurity check: _____

RECOMMENDED PRACTICES	YES	NO	COMMENTS
Pests			
You and your staff are familiar with common established pests and the high priority exotic pests of honey bees			
Hives are regularly inspected for pests			
Sugar shaking and/or uncapping drone brood forms part of a routine health surveillance program to detect any potential exotic mites			
You and your staff know how and where to report pests			
Pest surveillance activities and results are recorded even when nothing is found			
A science and evidence based health program to monitor and manage pests is implemented			
You and your staff undertake biosecurity training to update knowledge			
Apiary and product management			
Purchased queen bees and packaged bees are 'certified' or have a defined and documented health status			
Records of purchased queen bees and packaged bees, second hand hives with bees, used hive components and other used beekeeping equipment and their sources are maintained			
You and your staff are aware of symptoms of honey bee pests spread with queen bees, packaged bees, second hand hives with bees, used hive components and other used beekeeping equipment			
Brood and bees in purchased second hand working hives and used hive components are thoroughly checked within one month of arrival and for up to 12 months afterwards			
Honey and other products are loaded and unloaded on a paved or sealed pad away from production areas			
Waste material is disposed of away from production areas (preferably buried or burnt to keep it from foraging bees)			
Biosecurity and quality assurance schemes such as B-Qual or a barrier system are adopted			
Industry best management practices are adopted in the production of queen bees and packaged bees, honey and specialist products and in pollination services			
Equipment and vehicles			
No honey, wax and colony debris is left on vehicles and apiary equipment in order to prevent robbing			
Wash down facilities are provided to clean vehicle trays of honey, wax and associated colony debris, especially after visiting other apiaries			
All tools and equipment, including hive tools, gloves, pallets, boxes and any other equipment used in the apiary are regularly cleaned and sterilised			
Discussions are regularly held with landholders about where you have travelled and the risk of spreading pests and/or disease onto their property that are significant for them or their industry			
Borrowed and second-hand machinery and equipment is cleaned and sterilised before use			

Further information

Contact the organisations and agencies below for more information on biosecurity, apiary hygiene, pests and diseases and the Australian honey bee industry.

Contact details	
Australian Honey Bee Industry Council	**Phone:** 07 5467 2265 **Email:** ahbic@honeybee.org.au **Website:** www.honeybee.org.au
Plant Health Australia	**Phone**: 02 6215 7700 **Email**: biosecurity@phau.com.au **Website**: www.phau.com.au
BeeAware	**Phone:** 02 6215 7700 **Website:** www.beeaware.org.au
Farm Biosecurity	**Phone**: 02 6215 7700 **Email**: info@farmbiosecurity.com.au **Website**: www.farmbiosecurity.com.au
GOVERNMENT	
Australian – Department of Agriculture and Water Resources	**Phone:** 02 6272 3933 **Website:** www.agriculture.gov.au
New South Wales – Department of Primary Industries	**Phone:** 02 6391 3282 **Website:** www.dpi.nsw.gov.au
Northern Territory – Department of Primary Industry and Resources	**Phone:** 08 8999 2006 **Website:** www.nt.gov.au
Queensland – Department of Agriculture and Fisheries	**Phone:** 07 3404 6999 **Website:** www.daf.qld.gov.au
South Australia – Department of Primary Industries and Regions	**Phone**: 08 8226 0222 **Website**: www.pir.sa.gov.au
Tasmania – Department of Primary Industries, Parks, Water and Environment	**Phone:** 1300 368 550 **Website:** www.dpiwe.tas.gov.au
Victoria – Department of Economic Development, Jobs, Transport and Resources	**Phone**: 13 61 86 **Website**: www.economicdevelopment.vic.gov.au
Western Australia – Department of Primary Industries and Regional Development	**Phone**: 08 9368 3333 **Website**: www.dpird.wa.gov.au

If you see anything unusual, call the Exotic Plant Pest Hotline.

EXOTIC PLANT PEST HOTLINE
1800 084 881

Carly Housley

EXOTIC PEST

Varroa mites

What are varroa mites?

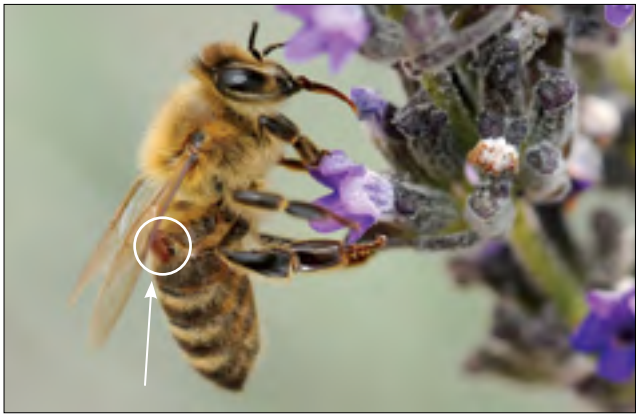
Varroa mites (*Varroa destructor* and *V. jacobsoni*) are external parasites of adult honey bees, and drone and worker bee brood. Varroa mites feed and reproduce on larvae and pupae, causing malformation and weakening of honey bees as well as transmitting numerous viruses. Heavy varroa mite infestations can build up in 3-4 years and cause scattered brood, crippled and crawling honey bees, a reduction in honey bee population, supersedure of queen bees and ultimate colony breakdown and death of the hive.

CSIRO

Varroa mites on honey bee pupa

What do they look like?

Adult female varroa mites are oval, flat, red-brown and around 1.1 mm long and 1.5 mm wide. They can be seen with the naked eye. Varroa mites complete their life cycle in honey bee brood and can be observed in both drone and worker bee brood. Examining the brood involves uncapping brood (preferably drone) to check for the dark mites in the cell and against the pearly white bodies of the developing brood. They can also be observed between the sclerites and between the head and thorax on adult worker bees and drones.



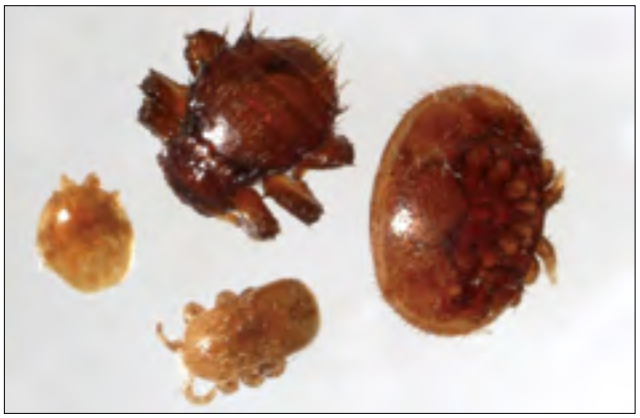
Kathy Keatley Garvey, UC Davis Department of Entomology

Varroa mite on a forager worker bee

What can they be confused with?

Varroa mites could be confused with the braula fly (*Braula coeca*) which is red-brown, 1.5 mm long, covered in spine like hairs and has six long legs. This pest is currently only present in Tasmania and is generally considered quite harmless. Varroa mites could also be confused with pollen mites (*Mellitiphis alvearius*) which are light brown and are around 0.75 mm long and 0.75 mm wide. Pollen mites are not harmful to honey bees but are sometimes found in hives.

Varroa mites could also be confused with other exotic parasitic mites, most notably tropilaelaps mites (*Tropilaelaps clareae* and *T. mercedesae*). If any mites are observed on adult honey bees or in the brood, call the Exotic Plant Pest Hotline immediately on 1800 084 881.



Food and Environment Research Agency (Fera), Crown Copyright

Braula fly (top), varroa mite (right), tropilaelaps mite (bottom) and pollen mite (left)

What should beekeepers look for?

Symptoms are dependent on the level of varroa mite infestation, the level of brood within the colony and the potential of viral infections transmitted by the varroa mites. Colonies with low infestation generally show very few symptoms. As varroa mite infestation grows, it results in the significantly reduced weight of worker bees and drones, impaired flight performance and a lower rate of return to the colony after foraging, a reduced lifespan as well as deformed wings and abdomens. Colony symptoms, commonly called parasitic mite syndrome (PMS), include a reduction in the adult honey bee population, loss of coordinated social behaviour, distorted and deformed honey bees, scattered brood with dead or uncapped brood and rapid honey bee de-population in the colony.

How do they spread?

Varroa mites can spread through drifting drones and worker bees as well as through swarms and absconding colonies. The transport and movement of hives, used beekeeping equipment, packaged bees and queen bees are also effective means of spread.

Where are they now?

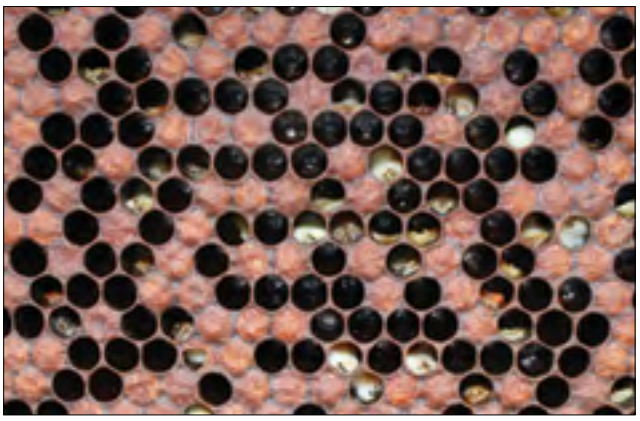
Varroa destructor is present in Europe, North America, South America, Africa, parts of Asia and New Zealand. The genotype of *Varroa jacobsoni* that parasitises European honey bee brood is currently only present in some regions of Papua New Guinea.

How can beekeepers protect their hives from varroa mites?

This pest is currently not present in Australia and there are strict quarantine requirements in place to protect the Australian honey bee industry.

If you see any of these symptoms, or observe mites on your honey bees or in the brood, call the Exotic Plant Pest Hotline.

EXOTIC PLANT PEST HOTLINE
1800 084 881



Rob Snyder, www.beeinformed.org

Parasitic mite syndrome (PMS) caused by varroa mites

The Food and Environment Research Agency (Fera), Crown Copyright

Worker honey bee with severe wing deformities as a result of varroa infestation

For more information about varroa mites, go to **www.beeaware.org.au/varroa-mites**. The BeeAware website contains extensive information on varroa mites, including:

- Life cycle
- Effect on bees
- Detection methods
- Spread and distribution
- Overseas experiences
- Additional fact sheets and videos

EXOTIC PEST

Tracheal mite

What is tracheal mite?

Tracheal mite (*Acarapis woodi*) is a microscopic, white coloured, internal mite of the honey bee respiratory system, capable of infecting queen bees, drones and worker bees. Tracheal mite infects and reproduces inside the tracheae (breathing tubes) of the honey bee and feeds on the honey bee's haemolymph (blood). Infection affects the honey bee's capacity to breathe, which results in weakened and sick honey bees which have a significantly reduced lifespan. If Tracheal mite infestation is combined with other stresses (disease, lack of pollen or nectar, etc.) it can lead to the death of the colony.

What can it be confused with?

General symptoms associated with tracheal mite infestation such as population drop, honey bees staying in their hive and crawling and disoriented honey bees could be confused with other factors affecting honey bee colonies, such as a lack of pollen or nectar, pesticide use or various other pests and diseases.

What should beekeepers look for?

Tracheal mites are invisible to the naked eye and there are no reliable or diagnostic visible symptoms of infestation. Tracheal mites spend their whole life inside adult honey bees, except for mature female tracheal mites, which have a mobile phase, and leave the host to attach to younger honey bees through bee to bee contact.

Despite this, serious tracheal mite infestation does cause general colony symptoms such as large numbers of crawling honey bees at the entrance of the hive which are unable to fly, honey bees appearing disorientated, honey bees holding their wings at odd angles ('K wing'), large numbers of honey bees staying in the hive rather than foraging and, in extreme cases, the hive population dropping dramatically. The only accurate diagnostic method for tracheal mite is laboratory examination of the honey bee's tracheae.

Simon Hinkley and Ken Walker Museum Victoria, PADIL

Tracheal mites are microscopic and only visible by dissecting the bee's trachea

Simon Hinkley and Ken Walker Museum Victoria, PADIL

As their name suggests, tracheal mites live inside the air ways of honey bees

Long Lane Honey Bee Farms

Honey bee showing signs of 'K wing'

Honey bee colonies are more susceptible to tracheal mite in cooler climates and during autumn and winter. Tracheal mites can spread easily when a colony is in close proximity to each other, such as a winter cluster, and can contribute to heavy winter losses. Always be aware of any unusually high winter losses.

How does it spread?

Adult female tracheal mites are picked up by younger honey bees and are spread within the hive through bee to bee contact. Tracheal mites can also spread to new areas through the transportation of infected colonies and through swarming and absconding. Once in an area it can spread throughout an apiary through drone and worker bee drift between hives.

Where is it now?

Tracheal mite is not present in Australia but is found in most other honey producing regions of the world, such as Europe, North America and parts of Asia.

How can beekeepers protect their hives from tracheal mite?

This pest is currently not present in Australia and there are strict quarantine requirements in place to protect the Australian honey bee industry.

If you observe any symptoms that you think may be caused by Tracheal mite, call the Exotic Plant Pest Hotline.

EXOTIC PLANT PEST HOTLINE
1800 084 881

For more information about tracheal mite, go to **www.beeaware.org.au/tracheal-mite**. The BeeAware website contains extensive information on tracheal mites, including:

- Life cycle
- Symptoms
- Similar pests
- Spread and distribution
- Additional fact sheets and videos

EXOTIC PEST

Tropilaelaps mites

What are tropilaelaps mites?

Tropilaelaps mites are native to Asia and parasitise the brood of the giant honey bees of Asia. Two species of tropilaelaps mites (*Tropilaelaps clareae* and *T. mercedesae*) are also able to parasitise European honey bees (*Apis mellifera*) and reproduce on their brood. If tropilaelaps mites were to become established in Australia, they would cause significant losses to managed and feral honey bee colonies.

What do they look like?

Tropilaelaps mites are active, red-brown mites which are around 1 mm long and 0.5-1 mm wide. They can be seen with the naked eye on both adult honey bees or in the brood.

Adult tropilaelaps mites lay eggs in the brood cells of honey bee larvae and feed on developing honey bees. Infestation results in the transmission of honey bee viruses and causes the death of many pupae, resulting in an irregular brood, deformed honey bees with missing legs or wings and ultimately colony decline or absconding. Crawling honey bees and brood discarded at the entrance of a colony may indicate a colony heavily infested with tropilaelaps mites.

What can they be confused with?

Tropilaelaps mites could be confused with the braula fly (*Braula coeca*) which is red-brown, 1.5 mm long, covered in spine like hairs and has six long legs. This pest is currently only present in Tasmania and is generally considered quite harmless. Tropilaelaps could also be confused with pollen mites (*Mellitiphis alvearius*) which are light brown and are around 0.75 mm long and 0.75 mm wide. Pollen mites are not harmful to honey bees but are sometimes found in hives.

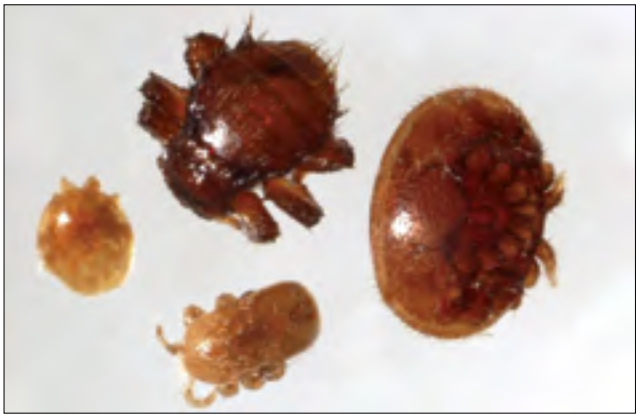
Tropilaelaps mites could also be confused with other exotic parasitic mites, most notably varroa mites (*Varroa destructor* and *V. jacobsoni*). If any mites are observed on adult honey bees or in the brood, call the Exotic Plant Pest Hotline immediately on 1800 084 881.

Ken Walker Museum Victoria, PADIL

Tropilaelaps mites are longer than they are wide

Denis Anderson, CSIRO

Tropilaelaps mites on European honey bee pupae, and a deformed honey bee resulting from tropilaelaps mite infestation



Food and Environment Research Agency (Fera), Crown Copyright

Braula fly (top), varroa mite (right), tropilaelaps mite (bottom) and pollen mite (left)

What should beekeepers look for?

Observing tropilaelaps mites on adult honey bees is difficult because only 3-4% of adult tropilaelaps mites attach themselves to adult honey bees. When adult tropilaelaps mites emerge from a brood cell, they almost immediately enter another brood cell within 24 hours, which makes it unlikely that they will be noticed until the level of infestation is quite high. As tropilaelaps mite infestation grows, honey bees will develop symptoms such as stunted wings, missing legs, shrunken thoraces and other deformities. Nurse bees may also start removing infested brood and deformed honey bees and deposit them at the hive entrance.

How do they spread?

Tropilaelaps mites can spread through the transportation of infested hives and adult honey bee drift. However, unlike varroa mites which can potentially survive on adult honey bees for months, tropilaelaps mites can only survive on adult honey bees for up to three days. Therefore, the level of tropilaelaps mite spread is dependent on the level of brood within colonies.

Where are they now?

Tropilaelaps clareae is currently only present in the Philippines, while *Tropilaelaps mercedesae* is present throughout regions of mainland Asia, including Papua New Guinea.

How can beekeepers protect their hives from tropilaelaps mites?

This pest is currently not present in Australia and there are strict quarantine requirements in place to protect the Australian honey bee industry.

If you see any of these symptoms, or observe mites on your honey bees or in the brood, call the Exotic Plant Pest Hotline.

EXOTIC PLANT PEST HOTLINE
1800 084 881

Food and Environment Research Agency (Fera), Crown Copyright

Deformed pupae are a sign of tropilaelaps mites

Denis Anderson, www.beesdownunder.com.au

Tropilaelaps mite feeding on a giant honey bee, *Apis dorsata*, pupa

For more information about tropilaelaps mites, go to **www.beeaware.org.au/tropilaelaps**. The BeeAware website contains extensive information on tropilaelaps mites, including:

- Life cycle
- Appearance
- Detection methods
- Spread and distribution
- Similar pests
- Additional fact sheets and videos

ESTABLISHED PEST

American foulbrood

What is American foulbrood?

American foulbrood (AFB) is a fatal microbial disease of honey bee brood caused by the spore forming bacterium *Paenibacillus larvae*. The disease is caused when young larvae ingest spores of the bacterium which germinate in the honey bee's gut. The brood usually dies at the pre-pupal or pupal stage.

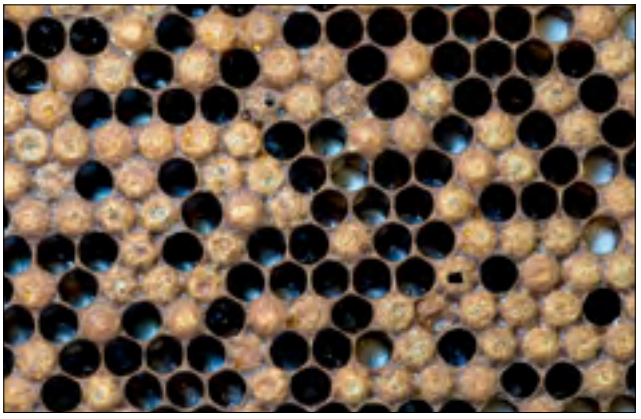
What should beekeepers look for?

Brood combs should be thoroughly examined for AFB at least twice a year, preferably in spring and in autumn, although AFB can occur in hives at any time of the year. Beekeepers should remove each brood frame from the colony and look for symptoms such as sunken, darkened and greasy looking, perforated cappings and irregular brood pattern in advanced infections. Look closely, as early infections may only have as few as one or two cells showing disease signs.

Brood infected with AFB generally die after the cells are capped and the affected brood becomes discoloured, changing from the healthy pearly white to a darker brown as the disease progresses. At this stage of infection beekeepers should conduct the ropiness test. Thrust a matchstick into the infected individual in the cell and if the semi-fluid remains are drawn out in a ropy thread it indicates the hive could be infected with AFB. After about a month, infected brood dry to a dark scale which adheres to the wall of the cell.

What can it be confused with?

AFB can be confused with European foulbrood (EFB). The majority of EFB infected larvae die before capping and appear coiled in their cells, unlike AFB where the majority of infected larvae die after capping. However, when EFB infected brood die at older stages they can be confused with AFB.

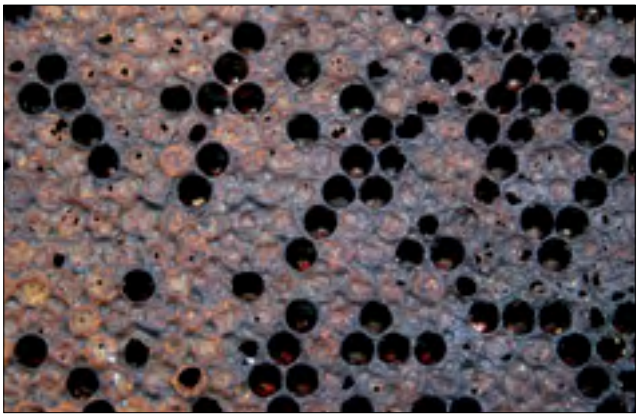


Doug Somerville, NSW DPI

Initial infection of AFB showing a few cells which are sunken and have chewed through cappings

Food and Environment Research Agency (Fera), Crown Copyright

A common test is to insert a matchstick into the dead brood and if there is a 'rope' AFB could present



Doug Somerville, NSW DPI

Advanced infection of AFB showing a large area of sunken, dark and chewed through cappings

Another potential difference between AFB and EFB is that when the ropiness test is conducted, by placing a matchstick into the affected brood, AFB infected brood could be drawn out in a longer ropy thread than EFB infected brood. However, when *Paenibacillus alvei* (a common secondary invader in EFB) is present it may also cause some extra ropiness which makes EFB infected brood resemble AFB infected brood. Laboratory diagnosis is the only accurate means to differentiate AFB from EFB.

How does it spread?

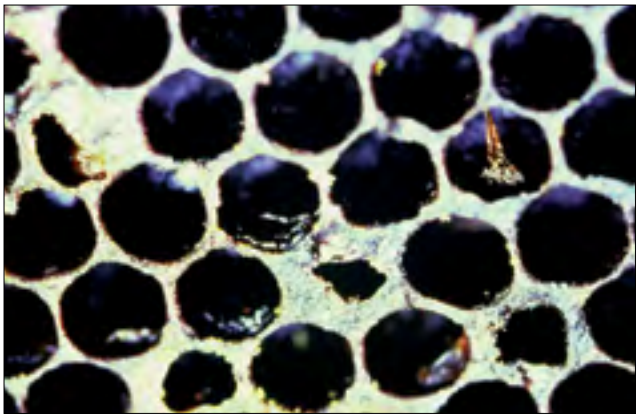
The main methods of AFB spread are through the interchange of infected combs and hive components, by feeding colonies infected honey or pollen, by honey bees robbing honey from infected hives or from extraction sites, as well as by honey bees drifting from infected colonies into neighbouring colonies. The spores of the bacterium are very infectious to larvae less than 24 hours old and can remain dormant for over 50 years.

Where is it now?

AFB is present throughout Australia; however, it has not been reported or confirmed in the NT, or Kangaroo Island (SA).

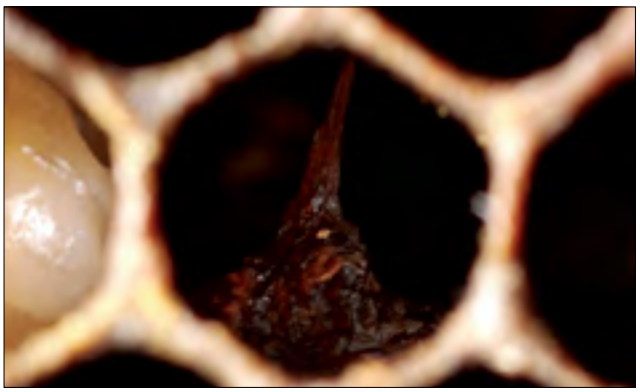
How can beekeepers protect their hives from American foulbrood?

Beekeepers should always check brood combs at least twice a year for early signs of AFB. Brood combs should be replaced every 3-4 years as old brood combs can act as a reservoir of the bacterium. To greatly minimise the spread of AFB throughout hives, beekeepers should put in place a barrier management system and clean hive tools and apiary equipment between hives and apiaries. If AFB is found in a hive, thoroughly clean all hive tools, gloves and apiary equipment before inspecting other hives or another apiary. When AFB is detected, contact your local department of agriculture, kill the infected colony and either irradiate or burn infected hive parts in a pit and cover the remains.



Michael Hornitzky

AFB infected cells showing brood drying to a dark scale on the side of the cell, and one scale having a 'tongue' can sometimes be observed



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Black scale with a tongue is sometimes visible at the bottom of cell walls after the larva has died and dried out

For more information about AFB, go to **www.beeaware.org.au/american-foulbrood**. The BeeAware website contains extensive information on AFB, including:

- Disease cycle
- Symptoms
- Detection methods
- Spread and distribution
- Similar pests
- Management options
- Additional fact sheets and videos

ESTABLISHED PEST

Asian honey bee (Java genotype)

What is the Asian honey bee?

The Asian honey bee (AHB), *Apis cerana*, is found throughout the tropical, sub-tropical and temperate zones of south-east and mainland Asia. This wide distribution has led to variations, commonly known as genotypes or strains, particularly between the temperate and tropical AHB.

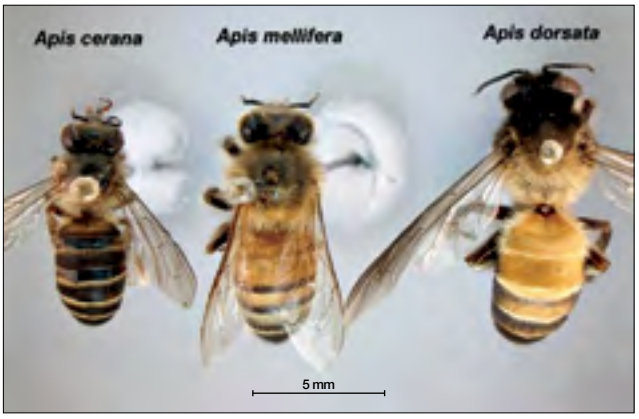
Although there are numerous strains or genotypes of *Apis cerana*, this fact sheet will specifically focus on the AHB that is present in Cairns (Queensland). The AHB found throughout the Cairns region of Queensland is *Apis cerana* Java genotype. This genotype cannot be managed for honey production and pollination services due to its frequent swarming and tendency to abscond. The AHB produces less honey than the European honey bee (EHB), *Apis mellifera*, and also commonly robs the EHB of their honey stores. It also has the potential to become a major competitor for nectar, pollen and nesting sites in the natural environment.

What does it look like?

The AHB is approximately 10 mm long and looks like a slightly smaller version of the EHB.

What can it be confused with?

The AHB could be confused with the EHB, which is present throughout Australia in both managed and feral honey bee colonies. However, the AHB is slightly smaller, has a darker abdomen, is slightly less hairy and has a more erratic flying pattern than the EHB. The AHB also differs to the EHB by having a distal abscissa of vein M in the hind wing, as well as its drone brood containing pin hole sized pores on the top of the cell, which become prominent within a week of hatching from the cell.

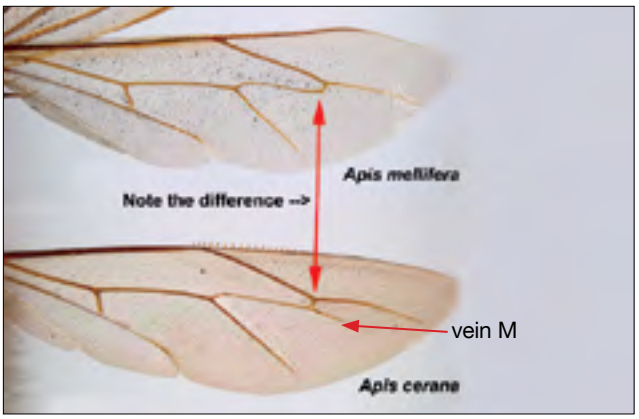


Ken Walker Museum Victoria, PADIL

Asian honey bee (left) compared to the European honey bee (middle) and the giant honey bee (right)

Denis Anderson, CSIRO

AHB worker bees



Ken Walker Museum Victoria, PADIL

Hind wing venation difference between the EHB and the AHB

What should beekeepers look for?

Beekeepers should look for AHB nests and swarms. The AHB is a cavity nesting honey bee and therefore prefers enclosed openings such as tree hollows. The AHB can also swarm and nest in urban and disturbed environments. In Cairns (Queensland), the AHB has been found in cavities such as letterboxes, walls of buildings, compost bins and on machinery. AHB nest and swarm sizes can range anywhere from 200–10,000 honey bees.

How does it spread?

The AHB can spread naturally through swarming and absconding. AHB colonies can produce up to 10 swarms per year and have been reported to travel up to 10 km from the original colony, but most commonly swarm only 1-2 km from the original colony. Reproduction, nest disturbances, pest and disease pressure or even a lack of nectar or pollen can cause the AHB to swarm or abscond.

The AHB is a proven hitchhiker on a variety of modes of transport and can spread over large distances into new areas on boats, trains, trucks and on shipping cargo.

Where is it now?

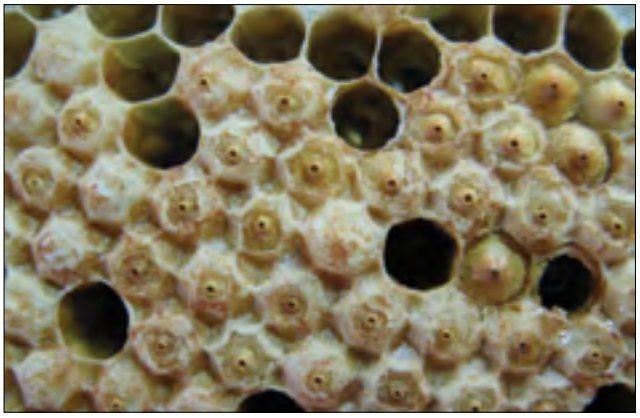
The AHB originated in Java (Indonesia) and has since spread throughout Irian Jaya, Papua New Guinea and the Solomon Islands. In 2007 the AHB was detected in the Cairns region of Queensland and has since been found westwards to Julatten, south to South Johnstone and north to Mossman. It has not been found outside this region in Australia.

How can beekeepers protect their hives from the Asian honey bee?

Currently, the only method of control is to find the AHB nest and destroy it. If you find, or think you have found the AHB it should be reported to your local department of agriculture immediately.

Queensland Department of Agriculture and Fisheries

AHB swarm in a letterbox



Ben Oldroyd, University of Sydney

AHB drone brood with pin hole sized openings

For more information about AHB, go to **www.beeaware.org.au/asian-honey-bee**. The BeeAware website contains extensive information on AHB, including:

- Appearance
- Detection
- Spread and distribution
- Management options
- Additional fact sheets and videos

ESTABLISHED PEST

Black queen cell virus

What is Black queen cell virus?

Black queen cell virus (BQCV) is caused by the *Black queen cell virus* (*Cripavirus*). BQCV causes mortality in queen bee pupae, with dead queen bee larvae turning yellow and then brown black. The disease is most common in spring and early summer. It is believed that infection with BQCV may be transmitted by *Nosema apis*, a microsporidian parasite of the honey bee that invades the gut of adult honey bees.

What should beekeepers look for?

Infection with BQCV causes queen bee pupae to turn yellow and the skin of the pupae to become sac-like. At latter stages of infection, the dead queen bee may change to brown-black. The walls of the queen bee cell also become a darker, brown-black colour. BQCV is often associated with *Nosema apis* infection. If nosema disease is present within a queen bee breeding operation, it is always useful to look for signs of BQCV on a regular basis.

What can it be confused with?

BQCV can potentially be confused with sacbrood virus as the pupae show the same symptoms of yellow colouration, the skin becoming plastic-like and the dead pupa becoming a fluid filled sac. However, as its name suggests, BQCV usually affects queen bee pupae, while sacbrood virus mainly affects developing worker bee larvae.

How does it spread?

BQCV is thought to be transmitted by nurse bees when they feed larvae infected brood food. The virus may remain viable in larval remains, honey or pollen for up to four weeks. *Nosema apis* infection in a colony may be another transmission route of BQCV. Honey bees drifting between hives, contaminated water and equipment can also spread BQCV.

Food and Environment Research Agency (Fera), Crown Copyright

Worker bees on a queen bee cell

Rob Snyder, www.beeinformed.org

Queen cell infected with BQCV

Food and Environment Research Agency (Fera), Crown Copyright

Sacbrood disease affect larvae. BQCV causes the queen bee pupae to sometimes display similar symptoms

Where is it now?

BQCV is present throughout Australia; however, it has not been reported or confirmed in the NT.

How can beekeepers protect their hives from Black queen cell virus?

BQCV is usually able to be controlled in most colonies with appropriate nutrition, young queen bees with populous hives, comb rotation every 3-4 years and the placement of hives in a warm and sunny position over the autumn, winter and spring periods. This will help keep colonies strong, remove extra stresses and also reduce the potential of nosema disease infection.

Beekeepers should maintain good apiary hygiene and be aware of the symptoms of BQCV or nosema infection within any queen bee breeding operation. If a beekeeper is a queen bee breeder and believes cell starters or nucleus hives are infected with BQCV, they should not be used for raising queen bees, or sold or distributed. This will help stop the spread of infected queen bees to other hives and regions.

If BQCV is detected in a queen bee breeding operation, it is recommended that the beekeeper contact their local department of agriculture and request to send in a sample for laboratory diagnosis.

For more information about BQCV, go to **www.beeaware.org.au/black-queen-cell-virus**. The BeeAware website contains extensive information on BQCV, including:

- Appearance
- Similar pests
- Spread and distribution
- Management options
- Additional fact sheets

Sam Malfroy

When breeding queen bees, look for signs of BQCV in queen bee cell starters

Sam Malfroy

Queen bee cages

ESTABLISHED PEST

Braula fly

What is braula fly?

The braula fly lives in honey bee colonies and attaches itself to honey bees where it feeds on nectar and pollen at the honey bee's mouth and on material secreted by the host. The pest is not considered a serious threat to commercial beekeeping as it does not damage or parasitise any stage of the honey bee life cycle. However, its presence may reduce the egg laying capacity of queen bees and could potentially make the detection of external parasitic mites difficult.

What does it look like?

The braula fly is a small (0.9 mm wide by 1.5 mm long) wingless fly. It is red-brown, covered in hairs and has six legs. The braula fly lay small eggs (0.84 mm by 0.42 mm) throughout the hive, however, only the eggs deposited on capped honey comb will hatch. The hatched larvae tunnel under the cappings leaving narrow tracks about 1 mm wide across the surface of the comb. This tunnelling gives the comb a fractured appearance, a key characteristic of braula fly presence.

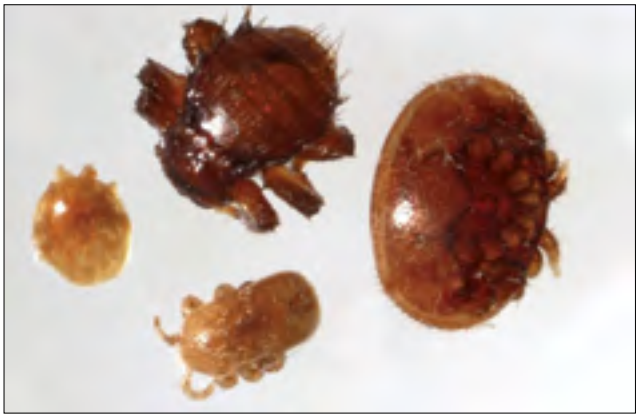
What can it be confused with?

Braula fly could be confused with the exotic parasitic varroa mites (*Varroa destructor* and *V. jacobsoni*) and tropilaelaps mites (*Tropilaelaps clareae* and *T. mercedesae*). Adult female varroa mites are oval, flat, red-brown, and 1 mm long and 1.5 mm wide. tropilaelaps mites are active, red-brown mites which are around 1 mm long and 0.5-1 mm wide.

Braula fly could also be confused with pollen mites (*Mellitiphis alvearius*) which are light brown and around 0.75 mm long and 0.75 mm wide. Pollen mites are not harmful to honey bees but are sometimes found in hives. If any mites are observed on adult honey bees or in the brood, call the Exotic Plant Pest Hotline immediately on 1800 084 881.

Simon Hinkley and Ken Walker Museum Victoria, PADIL

Braula fly is small and wingless



Food and Environment Research Agency (Fera), Crown Copyright

Braula fly (top), varroa mite (right), tropilaelaps mite (bottom) and pollen mite (left)

The Food and Environment Research Agency (Fera), Crown Copyright

An outline of the braula fly on a finger, note the 6 prominent legs

What should beekeepers look for?

Braula fly have a preference to attach to queen bees, but have also been observed on drones and worker bees as well. As a result of this preference, queen bees should be thoroughly and regularly checked. Beekeepers should also look through harvested comb honey, as braula fly larvae can tunnel through honey cappings, damaging the appearance and marketability of any comb honey produced.

How does it spread?

Braula fly can spread through swarming or absconding honey bee colonies and drifting honey bees. Braula fly can also spread through the interchange of hive components from apiary to apiary, as well as the movement of hives. The larvae can also be spread by the removal and transport of infected comb honey.

Where is it now?

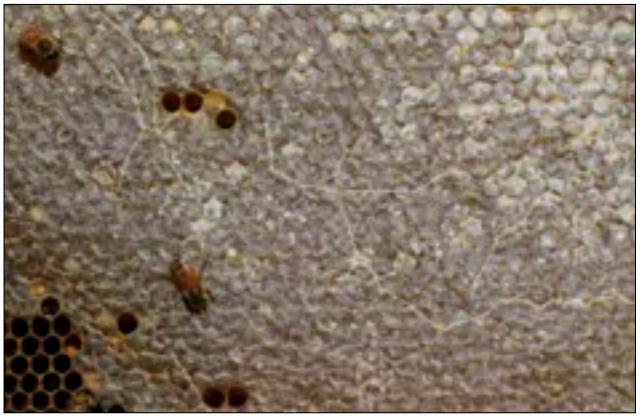
Braula fly are only found in Tasmania and are not present on mainland Australia.

How can beekeepers protect their hives from braula fly?

Braula fly has not been shown to cause a weakening of honey bee colonies. However, beekeepers specialising in comb honey production may need to consider control measures if the braula fly becomes a problem during peak production periods. Control measures include freezing (-15°C) comb honey for at least 24 hours which will kill all life stages of the braula fly. The normal practice of extracting honey is another effective means to control the larval stage of the braula fly.

Lindsay Bourke

Numerous braula fly on the thorax of a queen bee



NSW DPI

Fractured appearance of honey comb from burrowing braula fly larvae

For more information about braula fly, go to **www.beeaware.org.au/braula-fly**. The BeeAware website contains extensive information on braula fly, including:

- Life cycle
- Appearance
- Detection methods
- Spread and distribution
- Similar pests
- Management options
- Additional fact sheets and videos

ESTABLISHED PEST

Chalkbrood disease

What is chalkbrood disease?

Chalkbrood disease is caused by the fungus *Ascosphaera apis*. The fungus produces spores which are swallowed by honey bee larvae when they are fed by nurse bees. The spores germinate in the honey bee's gut and ultimately cause the larvae to die of starvation. Chalkbrood is present throughout Australia and its incidence is generally higher when the colony is under stress due to cool wet weather or poor nutrition. It is more common in the spring when the brood nest is rapidly expanding and a smaller adult workforce cannot maintain brood nest temperature.

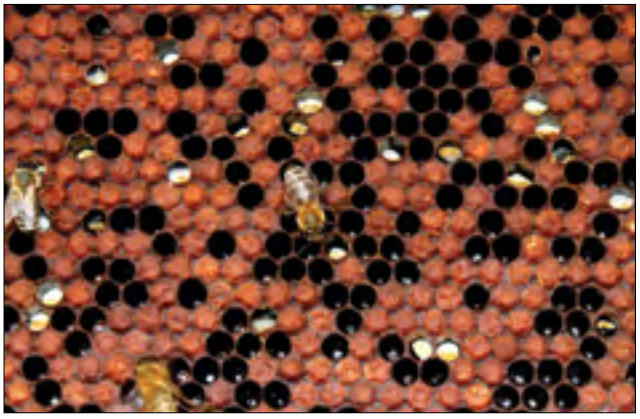
Rob Snyder, www.beeinformed.org

The chalkbrood fungus starting to envelop a developing pupa

What should beekeepers look for?

Infected hives show a scattered brood pattern with perforated cappings. Larvae infected with chalkbrood disease usually die after capping and the fungus grows to fill the cell. The larval body dehydrates creating diagnostic 'mummies' – hard, shrunken and chalklike. The fungal mycelium infiltrates the larval tissue and fruiting gives the mummies a white-grey colour.

The cappings of cells containing dead larvae may be chewed away by the honey bees and the mummies removed to the hive entrance, dropped to the bottom board, or on the ground outside the hive.



Rob Snyder, www.beeinformed.org

Comb infected with chalkbrood disease showing a scattered brood pattern with mummies in cells

What can it be confused with?

Chalkbrood disease symptoms of scattered brood with perforated cappings could be confused with either American foulbrood (AFB), European foulbrood (EFB) or sacbrood virus. However, the presence of mummies in the cells, the hive entrance and bottom boards, together with no ropy thread when conducting the ropiness test, would suggest chalkbrood disease is the cause.

Food and Environment Research Agency (Fera), Crown Copyright

Dead larvae in cells that have turned white due to fungal growth

How does it spread?

Chalkbrood disease can be easily spread between hives through the drifting behaviour of drones and worker bees, as well as the robbing behaviour of worker bees. Once inside a hive, fungal spores are quickly spread throughout the hive from mummies. It can also be transferred between apiaries on contaminated equipment, pollen and in water. The chalkbrood spores may remain viable for 15 years.

Where is it now?

Chalkbrood disease is present throughout Australia; however, it has not been reported or confirmed in the NT.

How can beekeepers protect their hives from chalkbrood disease?

Beekeepers should replace diseased combs which can act as a reservoir for chalkbrood disease spores, as well as cleaning away mummified larvae from the bottom boards and around the entrance of the hive. These activities will remove the main source of infection within a hive, and assist in preventing reinfection of the disease. Hives should also be placed in a well-ventilated, dry area with the sun facing the entrance of the hive to reduce conditions that favour the disease.

Honey bee stocks differ in susceptibility to chalkbrood disease, so beekeepers should replace the infected colony's queen bee with one supplied by a reputable breeder. This variation in susceptibility is mainly due to differences in the hygienic ability of the honey bees to uncap and remove diseased brood. By selecting queen bees or obtaining honey bees from hives that show this trait, the effects of chalkbrood disease can be reduced.

Food and Environment Research Agency (Fera), Crown Copyright

Mummies on the hive floor

Rob Snyder, www.beeinformed.org

Mummies are moved from the infected cells or hive floor by nurse bees to the hive entrance

For more information about chalkbrood, go to **www.beeaware.org.au/chalkbrood**. The BeeAware website contains extensive information on chalkbrood, including:

- Life cycle
- Appearance
- Similar pests
- Spread and distribution
- Management options
- Additional fact sheets

ESTABLISHED PEST

European foulbrood

What is European foulbrood?

European foulbrood (EFB) is a brood disease caused by the bacterium *Melissococcus plutonius*. Larvae of all ages are susceptible to infection and become infected after ingesting contaminated food. The bacterium then multiples in the gut of the larvae and competes for food, resulting in the larvae dying of starvation. The incidence of EFB is generally higher when the colony is under stress such as in spring, when the weather can be cool and wet or when nutrition is poor.

What should beekeepers look for?

Brood combs should be thoroughly examined for EFB in spring and in autumn. Beekeepers should remove each brood frame from the hive and look for symptoms such as an irregular brood pattern with a mottled appearance. Infected larvae die in a coiled or twisted position, and change from the healthy pearly white to yellow and then to brown. Beekeepers should specifically look at unsealed brood because most infected larvae usually die before their cells are capped.

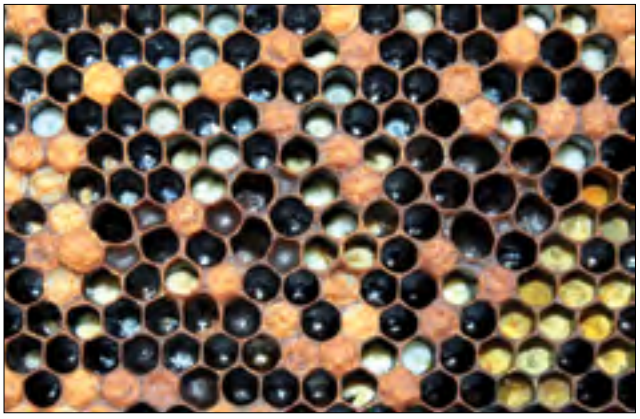
At this stage of infection beekeepers should conduct the ropiness test on older dead brood. Thrust a matchstick into the infected individual, and if the semi-fluid remains are drawn out in a ropy thread it indicates the hive could be infected with EFB. In older dead brood, a strong ammonia-like smell may also be present.

What can it be confused with?

EFB can be confused with American foulbrood (AFB). The majority of EFB infected larvae die before capping and appear coiled in their cells, which is in contrast to AFB where the majority of infected larvae die after capping. However, when EFB infected brood die at older stages they can be confused with AFB.

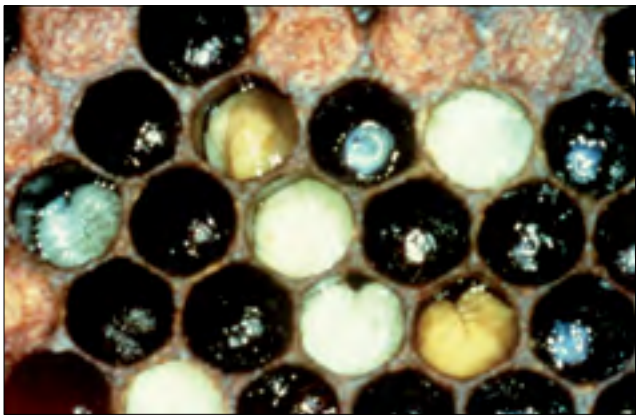
Food and Environment Research Agency (Fera), Crown Copyright

Spotted brood pattern is an indicator of EFB



Rob Snyder, www.beeinformed.org

Central cells are infected with EFB and are curled upwards and off coloured



Doug Somerville, NSW DPI

Infection of EFB in its early stages showing infected larvae turning yellow

Another potential difference between AFB and EFB is that when the ropiness test is conducted by placing a matchstick into the affected brood, AFB infected brood is usually drawn out in a longer ropy thread than EFB infected brood. However, when *Paenibacillus alvei* (a common secondary invader in EFB) is present it may also cause some extra ropiness which makes it resemble AFB infected brood. Laboratory diagnosis is the only accurate means to differentiate EFB from AFB.

How does it spread?

EFB can be spread within an apiary and between apiaries by the interchange of infected combs and hive components, feeding hives infected honey or pollen, honey bees robbing honey from infected hives or from extraction sites, as well as by honey bees drifting from infected colonies into neighbouring colonies. EFB is highly infectious and can remain viable for several years.

Where is it now?

EFB is present in all states and territories in Australia, except for WA and NT.

How can beekepers protect their hives from European foulbrood?

Beekeepers should always try to keep strong colonies with a young and healthy queen bee, as well as replacing brood combs every 3-4 years as these can act as a reservoir for the bacterium. Brood combs should be thoroughly checked for early signs of EFB in Spring and Autumn. To greatly minimise the spread of undetectable levels of EFB throughout loads of hives, put in place a barrier management system and disinfect hive tools and apiary equipment between hives and apiaries.

Rob Snyder, www.beeinformed.org

Healthy larvae are pearly white, while EFB infected larvae are a darker, yellowish colour and are in a coiled and twisted position

Rob Snyder, www.beeinformed.org

After two to four weeks, infected larvae may dry up to form a scale at the bottom of the brood cell

For more information about EFB, go to **www.beeaware.org.au/european-foulbrood**. The BeeAware website contains extensive information on EFB, including:

- Disease cycle
- Symptoms
- Detection methods
- Spread and distribution
- Similar pests
- Management options
- Additional fact sheets and videos

ESTABLISHED PEST

Greater and lesser wax moth

What are wax moths?

There are two species of wax moth, the greater wax moth (*Galleria mellonella*), and the lesser wax moth (*Achroia grisella*). Both species are pests of active hives, however they most commonly cause damage to unattended combs in storage, especially in areas that are dark, warm and poorly ventilated. Both species will eat beeswax, particularly unprocessed wax, pollen, remains of larval honey bees, honey bee cocoon silk and enclosed honey bee faeces found on walls of brood cells.

What do they look like?

The greater wax moth is a small grey coloured moth with some mottling on its wings and about 13-19 mm long. The lesser wax moth has similar colouration but is only 10-13 mm long.

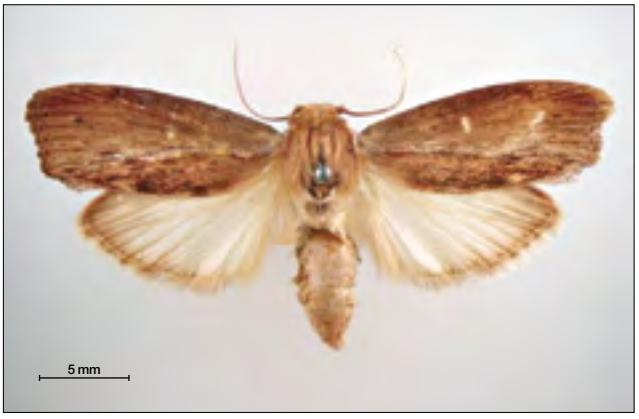
Eggs are laid by the adult wax moths in dark cracks and crevices around the hive or in unattended combs. The resulting larvae burrow and eat into the combs, leaving behind webbing and tunnels of silk. Fully grown larvae spin dense and tough white silk cocoons that are commonly found firmly attached to the frame or hive body. The cocoon is cemented into a boat shaped cavity that the larvae chew in the wood. This damage persists in equipment long after the wax moth emerges. Once the cocoon is spun, the larvae change to the pupal stage, and then develop into an adult wax moth.

What can they be confused with?

Wax moth larvae are similar to small hive beetle (SHB) larvae, however there are two simple distinguishing characteristics between the two pests. Firstly, SHB larvae cause the honey to ferment and the hive to become 'slimed out', which is not present when only wax moth are present. Secondly, wax moth larvae leave behind webbing mass and tough white cocoons on the frames and hive body, which are not present when only small hive beetle larvae are present.

Simon Hinkley and Ken Walker Museum Victoria, PADIL

Lesser wax moth: note wings are spread for identification purposes, they would usually be closed over body



Simon Hinkley and Ken Walker Museum Victoria, PADIL

Greater wax moth: note wings are spread for identification purposes, they would usually be closed over body

Susan Ellis, USDA APHIS PPQ, www.Bugwood.org

Greater wax moth larva

What should beekeepers look for?

Beekeepers should look for tunnels of silk throughout combs, cocoons stuck to frames and hive body parts as well as a disintegrating comb which is caused by larvae burrowing in the comb. Beekeepers should also specifically look through weak, stressed or queenless colonies, as well as unattended combs as these are the most susceptible to wax moth infestation.

How do they spread?

Wax moths mainly fly at night and are able to fly between hives and cause new infestations. The pest can also be spread between apiaries by the movement of infested hives.

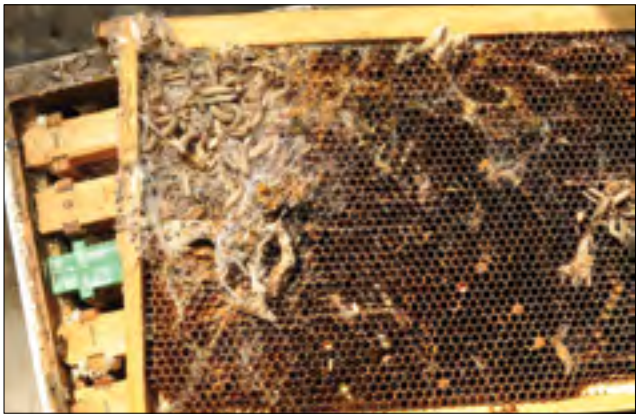
Where are they now?

Both species of wax moth are present in all states and territories of Australia.

How can beekeepers protect their hives and products from wax moths?

The honey bees themselves are the best method of protection against wax moth. Beekeepers should always try to keep strong colonies with a high bee-to-comb ratio and a young and healthy queen bee. Beekeepers should also keep their apiary clean from weak or stressed colonies, dead out colonies, or old unattended combs which provide a perfect breeding environment for wax moth.

Beekeepers should store empty combs, supers and any wax moth affected material that has been cleaned to be reused in low temperature control rooms. Cool rooms maintained at 10°C or less will prevent wax moth reproduction and living larvae from becoming active. Freezing frames and hive parts at -7°C will kill all stages of wax moth within 4-5 hours.



Kathy Keatley Garvey, UC Davis Department of Entomology

Wax moth larvae and webbing in stored combs

Chantal Forster

Wax moth cocoons stuck onto frames

For more information about wax moth, go to **www.beeaware.org.au/wax-moth**. The BeeAware website contains extensive information on wax moth, including:

- Life cycle
- Appearance
- Detection methods
- Spread and distribution
- Similar pests
- Management options
- Additional fact sheets and videos

ESTABLISHED PEST

Nosemosis

What is nosemosis?

Nosemosis, or nosema disease, is caused by two species of microsporidian parasites (a type of spore forming fungus) called *Nosema apis* and *Nosema ceranae*. Both species can infect worker bees, queen bees and drones. Both species produce spores which are ingested by adult honey bees through contaminated water or food, through food exchange with other honey bees or from cleaning contaminated combs. The spores then germinate in the mid-gut of the honey bee and infection may result in reduced adult honey bee life, colony health and performance.

What do they look like?

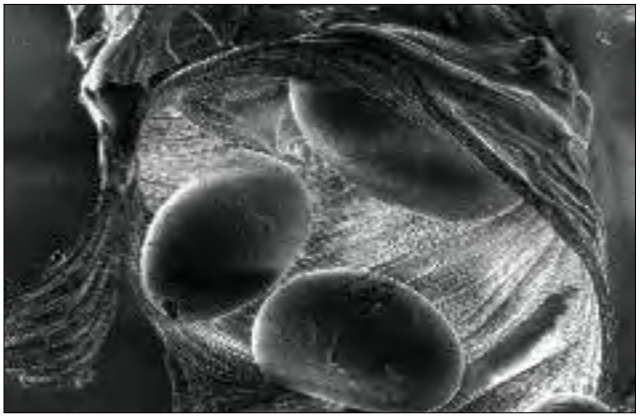
Nosema apis causes general symptoms such as crawling honey bees with swollen and greasy abdomens and dislocated wings, honey bees crawling onto and around the hive entrance, dysentery within and around the hive, a reduction in queen bee egg laying ability and her possible supersedure, as well as the rapid dwindling of colony strength and heavy winter losses. *Nosema ceranae* causes similar symptoms; however, none of the dysentery or crawling honey bee behaviour usually related to *N. apis* infection has been reported for *N. ceranae*. Signs of nosemosis are more evident in the cooler months, particularly in autumn and spring when nutrition is poor and/or weather conditions are cold and wet. Unlike *N. apis*, *N. ceranae* appears to thrive in warmer climates.

What can they be confused with?

There are no reliable field diagnostic symptoms associated with nosemosis, and many of the general symptoms associated with the disease could be confused with symptoms caused by other honey bee pests, diseases and/or disorders.

Food and Environment Research Agency (Fera), Crown Copyright

Hives should be regularly checked for signs of pests and diseases



Food and Environment Research Agency (Fera), Crown Copyright

Nosema spores in mid-gut of a honey bee

D.Broberg, www.flickr.com/photos/dbroberg

Honey bees defecating at the entrance of the hive can be a symptom associated with *N. apis* infection

What should beekeepers look for?

Beekeepers should look for colony symptoms such as a declining population, poor honey production, reduced brood production, dysentery in and around the entrance of the hive, poor survival over winter and worker bees crawling around the hive with swollen and greasy abdomens.

How do they spread?

Nosema spores are passed from infected honey bees to non-infected honey bees through contaminated water or food, through food exchange with other honey bees or from cleaning contaminated combs. It is also spread through bees removing waste material, specifically faeces from within and around the entrance of the hive. The spores are long lived and can quickly spread throughout the hive. Nosemosis can also be spread between colonies by using contaminated equipment and through the drifting behaviour of worker bees and drones.

Where are they now?

Both species of nosema (*N. apis* and *N. ceranae*) are found in all states and territories of Australia, except for *N. ceranae*, which has not been reported in WA.

How can beekeepers protect their hives from nosemosis?

Good management practices such as appropriate nutrition, young queen bees with populous hives and comb rotation every 3-4 years will keep colonies strong and remove possible causes of stress. Beekeepers should place their hives in a warm and sunny position over the autumn, winter and spring periods allowing the colony to regularly forage and defecate outside of the hive to prevent the accumulation of nosema spores in faeces deposited in the hive. Beekeepers should always ensure that any hive equipment that may have been infected with nosema spores is decontaminated before and after use.

D.Broberg, www.flickr.com/photos/dbroberg

Dysentery around the hive entrance

Michael Plein

Dysentery within a hive

For more information about nosemosis, go to **www.beeaware.org.au/nosema**. The BeeAware website contains extensive information on nosemosis, including:

- Disease cycle
- Symptoms
- Detection methods
- Similar pests
- Spread and distribution
- Management options
- Additional fact sheets and videos

ESTABLISHED PEST

Sacbrood virus

What is sacbrood virus?

Sacbrood virus is caused by the *sacbrood virus* (*Iflavirus*) which affects worker bee larvae thought to be infected by consuming contaminated water, pollen or nectar. Infected larvae die shortly after capping and become a fluid filled sac. Infected brood are found scattered amongst healthy brood and the cappings may be discoloured, sunken or perforated. Sacbrood virus may remain viable in dead larvae, honey or pollen for up to four weeks.

What should beekeepers look for?

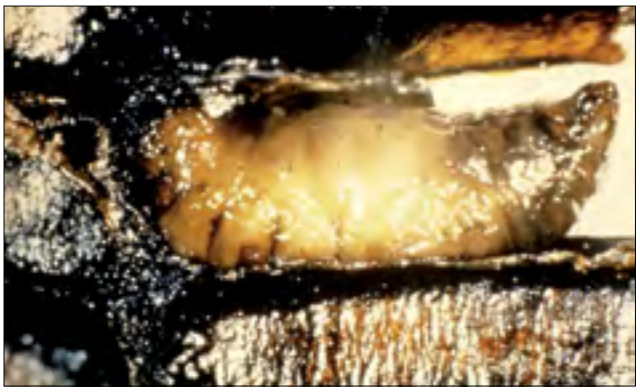
Beekeepers should look for symptoms of sacbrood virus such as an uneven brood pattern with discoloured, sunken or perforated cappings. Infected larvae change from a healthy pearly white, to yellowish, then grey-brown and finally dark brown-black. Darkening begins at the head of the dead larva and spreads to the rest of the body. The skin of the dead larva also changes into a tough plastic-like sac, which is filled with fluid. The larva dies with its head characteristically raised in a banana shape toward the top of the cell and stretched out on its back in the cell. Nurse bees usually uncap the cell exposing the dead larvae.

What can it be confused with?

Brood symptoms of sacbrood can be confused with other brood diseases such as European foulbrood (EFB) and American foulbrood (AFB). Unlike AFB infected larvae, the dried remains of sacbrood infected larvae are easily removed from their cells. The diseased remains appear first as a plastic like sac with darkening at the head and later as a dried scale, both of which appear banana shaped. If the ropiness test is used where a matchstick stick is put into the larval remains and the remains are drawn out in a ropy thread of up to 2-5 cm long, it indicates that the hive is infected with either EFB or AFB.

Rob Snyder, www.beeinformed.org

Larva affected by sacbrood virus with its head raised in a banana shape and stretched out on its back in the cell, with healthy larvae around



Food and Environment Research Agency (Fera), Crown Copyright

Infected larva in cell showing the change in colour and the mouthparts turning black and pointing upwards

Rob Snyder, www.beeinformed.org

Old sacbrood virus infected larva turning brown

How does it spread?

Nurse bees transmit sacbrood virus when they feed larvae with infected brood food. Sacbrood virus may remain viable in larval remains, honey or pollen for up to four weeks. Honey bees drifting between hives, contaminated water and equipment can also spread sacbrood virus.

Where is it now?

Sacbrood virus is present throughout Australia; however, it has not been reported or confirmed in the NT.

How can beekeepers protect their hives from sacbrood virus?

Honey bees are usually able to control sacbrood virus in most colonies through hygienic behaviour and the ability to detect and remove infected larvae. However, sacbrood virus can become severe when combined with other stresses, such as a shortage of nectar or pollen, unfavourable climatic conditions, a poor queen bee or infestation with other pests or diseases.

Beekeepers can protect their hives by removing infected brood combs and taking other management measures to restore colony strength, such as providing food and adding to the worker bee population.

Honey bee stocks can also differ in susceptibility to sacbrood virus, so beekeepers should replace the infected colony's queen bee with one supplied by a reputable breeder. This variation in susceptibility is due to differences in the hygienic ability of the honey bees to uncap and remove the infected brood. By selecting queen bees or obtaining honey bees from hives that show this trait, the effects of sacbrood virus can be reduced.

Rob Snyder, www.beeinformed.org

Infected larva in cell that has become dark brown-black

Food and Environment Research Agency (Fera), Crown Copyright

Body of a sacbrood virus affected larva that has become a fluid filled sac

For more information about sacbrood virus, go to **www.beeaware.org.au/sacbrood**. The BeeAware website contains extensive information on sacbrood virus, including:

- Disease cycle
- Symptoms
- Similar pests
- Spread and distribution
- Management options
- Additional fact sheets

ESTABLISHED PEST

Small hive beetle

What is small hive beetle?

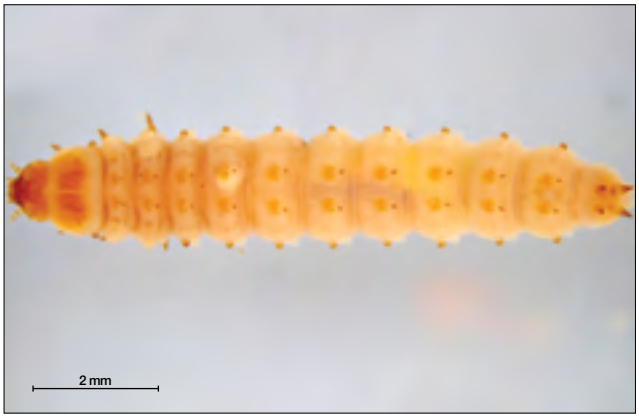
Small hive beetle (SHB) (*Aethina tumida*) is a small (0.5 cm long 0.3 cm wide) brown-black beetle with clubbed antennae. The larvae of SHB cause the majority of damage to honey bees by burrowing into combs, eating brood, honey and pollen. Whilst feeding, the larvae also carry a yeast (*Kodamaea ohmeri*) which contaminates the honey, causing it to ferment. Heavy infestations cause the hive to become 'slimed out' and may cause the colony to die or abscond. In Australia, SHB has the greatest impact in the warm and humid coastal strip between Victoria and North Queensland.

James D Ellis, University of Florida

Adult SHB are brown-black with clubbed antennae

What does it look like?

Adult SHB are brown-black. The eggs are tiny (about 1 mm long) and are pearly white. In strong colonies, eggs are laid in the crevices of the hive, while in weak colonies eggs are laid directly on brood comb. Larvae are white, 10 mm long with three pairs of prolegs near the head. Once they mature, larvae leave the hive and burrow into the ground surrounding the hive to pupate.



Ken Walker Museum Victoria, PADIL

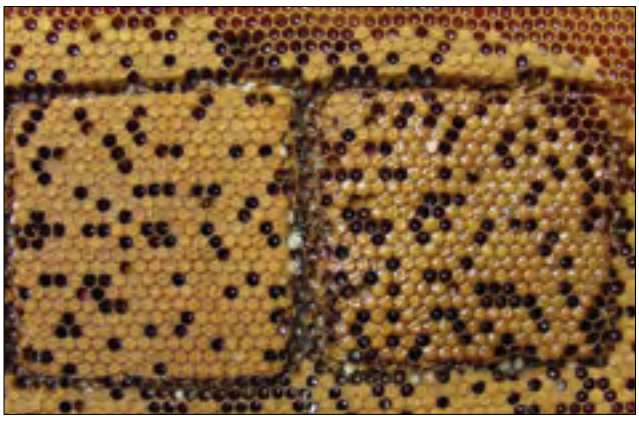
Larvae of SHB are pearly white and about 10 mm long

What can it be confused with?

SHB larvae look similar to wax moth larvae. To distinguish between the two pests, SHB cause the honey to ferment and the hive to become 'slimed out', while wax moth larvae leave behind webbing mass and tough white cocoons on frames.

What should beekeepers look for?

Beekeepers should look for the adult SHB in the darker parts of the hive. Adult SHB avoid light and will seek refuge quickly when the hive is inspected. Inspect underneath the hive lid, as well as the brood box and bottom board. Weak and stressed colonies with a low bee-to-comb ratio are considered the most susceptible. Also look for larvae on frames in the brood box and in the above honey supers.



Kieth Delaplane, University of Georgia

Cells infested with SHB (right) show a slimy appearance when compared to healthy unaffected cells (left)

The larvae cause the majority of the damage by burrowing into combs, eating brood, honey and pollen. Whilst feeding, the yeast species (*K. ohmeri*) that the larvae carry contaminates the honey, causing it to ferment, which makes the honey look greasy and slimy and weep out of the cells.

How does it spread?

SHB can spread by beekeepers moving infested hives to non-infested areas. SHB is also a strong flyer and can fly up to 7 km to find new hives and colonies. The SHB is believed to be attracted to new hives by honey bee colony odours and slumgum.

Where is it now?

SHB is present throughout NSW, Qld, Vic, ACT and in parts of SA and WA. It has not been recorded in NT or Tas.

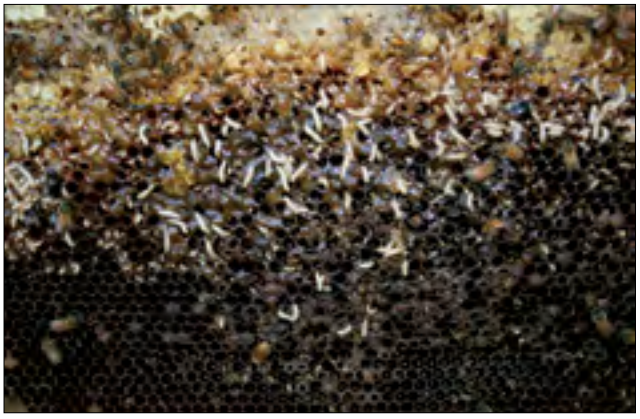
How can beekeepers protect their hives from small hive beetle?

To protect hives against SHB it is critical to maintain strong, healthy colonies with a young productive queen bee and a high bee-to-comb ratio. Beekeepers should maintain good hygiene practices in the hive (e.g. remove debris on bottom boards, remove burr comb etc.) to reduce areas where SHB can hide and breed. It is also important to maintain good hygiene practices around the apiary (e.g. remove beeswax scraps, old combs and dead colonies etc.) which can attract SHB. Cool rooms maintained at 10°C or less for excess supers and combs will prevent the adult SHB laying eggs and will minimise SHB larvae activity. Freezing frames and hive parts at -7°C will kill all life stages of SHB within 4-5 hours. A range of in-hive chemical and non-chemical options are also available to beekeepers.

Please Note: The SHB larvae carry a yeast species (*Kodamaea ohmeri*) that poses a threat to immuno-compromised people. Be aware of the risk of handling and cleaning SHB slimed honey bee equipment and take precautions.

Jessica Lawrence, Eurofins Agroscience Services

Adult SHB are about 2-3 times smaller than honey bees



Nick Annand, NSW DPI

Heavy infestation of larvae on comb produces a slimy appearance

For more information about SHB, go to **www.beeaware.org.au/small-hive-beetle**. The BeeAware website contains extensive information on SHB, including:

- Life cycle
- Appearance
- Detection methods
- Spread and distribution
- Similar pests
- Management options
- Additional fact sheets and videos

Glossary

Term	Definition
Abscond	When the entire colony of honey bees abandons the hive because of pests, diseases or other adverse conditions.
Apiary	A group of hives assembled in one area or location for beekeeping operations; also known as a bee yard.
Biosecurity	A set of measures designed to protect honey bees from the entry and spread of pests at a national, regional and individual property or apiary level.
Brood	Immature honey bees that have not yet emerged from their cells. Brood can be in the form of eggs, larvae, or pupae of different ages.
Brood box	Usually the bottom box of the hive used for rearing honey bees.
Colony	A colony of honey bees that consists of worker bees, drones, queen bee and developing brood living together as a social unit in one hive, or other dwelling.
Comb (honey comb)	A structure of beeswax built by honey bees in an array of hexagonal cells for storing nectar, honey, pollen and/or brood.
Drifting	The process by which honey bees join a hive other than their own, often due to loss of direction or hives placed too close together.
Drone	Male honey bee.
Endemic	Pests that are present in regions of Australia.
Established	Pests that are established throughout Australia, or regions of Australia.
Feral bees	Honey bees that are not managed by a beekeeper and live wild in the environment.
Frame	A construction of wood or plastic containing wax or plastic foundation and used in hives.
Hive (bee hive)	A series of boxes, including a brood box and supers, used for housing a colony of honey bees.
Hive tool	A flat metal device with a curved scraping surface used to open hives and pry apart and scrape frames.
Migratory beekeeping	The moving of colonies of honey bees from one locality to another during a single season to take advantage of multiple honey flows.
Package bees	A quantity of adult honey bees (1.5-2 kg), with or without a queen bee, contained in a screened shipping cage with a food source.
Pollination	The transfer of pollen from the anthers to the stigma of flowers.
Queen bee	A female honey bee with a fully developed reproductive system responsible for the egg laying in a colony.
Queen excluder	A metal or plastic screen used to confine the queen bee to the brood box.
Requeening	The replacement of the queen bee in the hive with another (usually younger) queen bee.
Robbing	The stealing of nectar or honey by honey bees from other colonies which happens more often during a nectar dearth.
Smoker	Device used to blow smoke on honey bees to calm them and thus reduce stinging of the operator.
Super	A separate box that contains frames and is placed on top of the brood box. It is part of the hive and used for the storage of surplus honey for harvest.
Supersedure	The natural replacement of an established queen bee by a queen bee newly reared by the colony in the same hive.
Surveillance	The collection, collation, analysis, and dissemination of pest and disease data.
Swarm	A large number of worker bees, drones and usually the old queen bee that leaves the parent colony to establish a new colony.
Wax (bees wax)	Wax secreted from glands on the underside of the worker bee abdomen and moulded by honey bees into honey comb.
Worker bee	A female honey bee.

The Australian Honey Bee Industry Council (AHBIC)

The Australian Honey Bee Industry Council Inc. (AHBIC) is the peak body for beekeepers in Australia. AHBIC aims to maximise the efficient use of industry resources and funds to ensure the long term economic viability, security and prosperity of the Australian honey bee industry. AHBIC is funded by voluntary contributions from beekeepers and honey packers.

AHBIC makes representation on behalf of all beekeepers at a national level to all levels of government, private enterprise and public organisations. AHBIC also looks after national issues such as biosecurity, obtaining the best results for beekeepers, maintaining trade access for honey and live bees, representing the industry at various Government Inquiries and communicating information to beekeepers Australia wide, such as this manual.

For more information about AHBIC visit **www.honeybee.org.au**

Consider joining your relevant beekeeping association listed below to support, and to play a role in, the Australian honey bee industry.

New South Wales Apiarists' Association Inc. (NSWAA)

Queensland Beekeepers Association (QBA)

Victorian Apiarists' Association Inc. (VAA)

Tasmanian Beekeepers Association (TBA)

South Australian Apiarists' Association Inc. (SAAA)

Western Australia Farmers Federation Inc. Beekeepers Section

Amateur Beekeepers Association (ABA) NSW

Beekeepers Association of the ACT

All beekeepers, from commercial operators, to backyard enthusiasts form part of the honey bee industry. Each and every beekeeper has a role to play in protecting honey bees from established and exotic pests and diseases. Beekeeping associations provide an effective avenue of obtaining the latest information on pest and disease management and learning about what is happening in the honey bee industry.

Plant Health Australia
Level 1, 1 Phipps Close
Deakin ACT 2600

Phone 02 6215 7700
Email biosecurity@phau.com.au
www.planthealthaustralia.com.au

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