

NSW APIARISTS' ASSOCIATION INC.



Bees and beekeepers are essential for Australia

Submission to the Australian Senate Inquiry into: The future of the beekeeping and pollination service industries in Australia

To the Senate Standing Committee

Please find here the submission from the New South Wales Apiarists' Association (NSWAA) to the Senate Inquiry: Future of the beekeeping and pollination service industries in Australia.

NSWAA is the state peak body for commercial beekeepers, and the Association represents its members to all levels of government.

There are currently around 3,000 registered beekeepers in NSW, which represents about 45 per cent of Australia's beekeeping industry. NSW commercial beekeepers manage over 140,000 hives, but these numbers are declining at an alarming rate – 30% since 2006 – and this is reflected nationally.

While the beekeeping industry is a relatively small one, it plays a highly significant role within the agricultural sector of NSW, and more broadly across Australia. Beekeeping is essential not just for honey and other hive products, but also for pollination of the food crops that feed us and our livestock.

Most importantly, our industry stands between Australia and a looming food security crisis. However, Australian commercial beekeepers can't stave off this crisis without assistance.

There are three significant threats to our industry, which endanger the vital pollination services provided by beekeepers. These are access to floral resources, pests and diseases, and increasing pressures on the industry's economic viability. We address these issues in detail below.

We would like to thank the Senate Standing Committees on Rural and Regional Affairs and Transport for making available this opportunity to provide you with this submission on the importance of beekeeping and pollination services in Australia.

Casey Cooper
President
New South Wales Apiarists' Association

Submitted by:

Kate McGilvray Secretary/Treasurer New South Wales Apiarists' Association	Casey Cooper President New South Wales Apiarists' Association
--	--

Contents

Submission to the Australian Senate Inquiry into: The future of the beekeeping and pollination service industries in Australia	1
Case studies	2
Overview	3
Terms of Reference for the current Senate Inquiry	4
A. The importance of beekeeping and pollination service industries from a food security, environmental and financial point of view	4
Key challenges	4
Recommendations - A	5
Financial importance	6
Valuing pollination services: better crops and food security	7
Research and development: increasing production and value adding	9
B. Current challenges facing the industry domestically and internationally, and its future sustainability	12
Key challenges	12
Recommendations - B	12
Honey bees need flowers: access to floral resources	13
Putting the buzz in honey beekeeping: attracting and training beekeepers	15
Training	15
C. The adequacy of the current biosecurity arrangements for imported and exported honey, apiary products, package honey bees and queen honey bees	16
Key challenges	16
Recommendations - C	16
Threats to honey bee populations: from varroa to pesticides	16
D. Australia's food labelling requirements, and how these affect the honey beekeeping industry	19
Key challenges	19
Recommendations - D	19
E. The recommendations from the House Standing Committee on Primary Industries and Resources 2008 report More than Honey; the future of the Australian honey bee and pollination industries, and the Rural Affairs and Transport References Committee 2011 report Science underpinning the inability to eradicate the Asian honey bee	21
F. Any related matters	22
Appendix I - References and further reading	23

Case studies

Case study: Almond pollination in America – the largest pollination event on Earth	8
Case study: Bees improve crop production	9
Case study: Active honey – making more out of Australian honey	11
Case study: Honey for science – making graphene	12
Case study: Where does a honey bee go?	14
Case study: How to retain a good beekeeper	16
Case study: How much would varroa mite cost Australia?	18

Overview

It is essential that Australia has a vibrant and sustainable beekeeping industry, which will contribute billions of dollars directly and indirectly to the Australian economy. It will do this through the production of honey and other hive products, and through the provision of crucial pollination services to a wide range of Australian horticultural industries.

The NSW beekeeping industry is estimated to contribute \$36 million annually to the state's economy through the production of honey, bees wax and other hive products, while the pollination services provided by honey bees are estimated at \$4-6 billion nationally.

However, at greater stake is the very security of our agricultural and horticultural industries, which will need to rely increasingly on managed honey bees and pollination services to maintain productivity in the face of a varroa mite or other honey bee pest invasion and the looming global food crisis.

But the beekeeping industry cannot help Australia meet this crisis head on when it is in crisis itself.

Our industry is in serious decline:

- The number of registered commercial beekeepers in NSW (that is, those with more than 200 hives) has decreased 30 per cent since 2006 to around 200; and these commercial beekeepers represent only 7 per cent of registered beekeepers in NSW
- The number of registered hives for NSW commercial beekeepers has also decreased 30 per cent since 2006 to 140,000+

These declines are reflected at a national level, and research by Pollination Australia has shown that we will need up to twice as many commercial hives to sustain pollination services in the face of the varroa mite.

The NSW Apiarists' Association and its members are committed to ensuring the future of beekeeping in Australia. Our vision is for a vibrant and diverse industry that:

- Enhances food security by –
 - guaranteeing pollination for almond growers and others who are dependent on the supply of large numbers of managed honey bee colonies
 - boosting the production and quality of many horticultural products (see Table 1)
 - preparing to rebuild pollination services rapidly in response to honey bee disease outbreaks, such as the varroa mite
- Serves Australian and overseas demand for honey, including high-value boutique honey and specialist honey products, such as medically active honey, specialist floral honey varieties and mead
- Develops new markets for honey based on its antibacterial, wound healing and prebiotic properties
- Employs a new generation of beekeepers who work smarter, not harder, and with the skills required for modern commerce

However, there are some significant obstacles in the way of this vision, including:

- Insecurity around reliable access to eucalypts and native forests for nectar and pollen resources
- Poor recognition among horticulturalists of pollination services provided by managed honey bees
- The threat from pests and diseases, in particular varroa, tracheal and tropilaelaps mites, as well as further Asian bee incursions
- Low honey and pollination service prices, compared to the increasing costs of production

- An ageing community of professional beekeepers, with few new people entering the profession and few opportunities for training and career development.

The 2008 Senate Inquiry and resulting *More than Honey* report provided hope for creating a viable future for Australian beekeeping. However, too few of its recommendations have been implemented successfully. Since then, the risk of varroa and other pests has become more evident, as has the importance of managed honey bee populations for food security.

The NSW Apiarists' Association believes that the current Senate Inquiry offers a second chance to ensure the future of this essential industry for our nation.

We present here a series of recommendations to give Australia its best chance to create and maintain a viable and sustainable beekeeping industry, and to safeguard our country against a future food security crisis.

Terms of Reference for the current Senate Inquiry

On 12 December 2013, the Senate moved that the following matters be referred to the Rural and Regional Affairs and Transport References Committee for inquiry.

The future of the beekeeping and pollination service industries in Australia, with particular reference to:

- The importance of these industries** from a food security, environmental and financial point of view
- Current challenges facing the honey beekeeping industry** domestically and internationally, and its future sustainability
- The adequacy of the current biosecurity arrangements** for imported and exported honey, apiary products, package honey bees and queen honey bees
- Australia's **food labelling requirements**, and how these affect the honey beekeeping industry
- The **recommendations from the House Standing Committee on Primary Industries and Resources 2008 report *More than Honey: the future of the Australian honey bee and pollination industries***, and the Rural Affairs and Transport References Committee 2011 report *Science Underpinning the Inability to Eradicate the Asian honey bee*.
- Any related matters.

A. The importance of beekeeping and pollination service industries from a food security, environmental and financial point of view

Key challenges

- Communicating to the broader community the role of managed honey bees and pollination services in Australian food production, and their crucial importance in ensuring that we have adequate food supplies
- Getting the agricultural and horticultural industries to understand that paid pollination services are valuable; that managed honey bees can increase crop productivity; and that they can be susceptible to inappropriate use of agricultural chemicals
- Preventing the establishment of varroa mite and other exotic pests
- Enabling further research into honey bee health and pollination services, as well as into honey for boutique consumer, manufacturing and medical purposes
- Encouraging industries that benefit from pollination services to see themselves as stakeholders and to contribute to relevant research and development programs

- Ensuring the viability of Australian commercial beekeeping to meet the increasing need for pollination services and to help protect Australia from a food security crisis

Recommendations - A

1. Support further research into:
 - a. the economic benefits to the agricultural and horticultural industries of using managed honey bees, including optimal hive numbers and placement, and management for pollination services
 - b. management strategies that minimise pesticide-related bee deaths
2. Australian Government to continue funding the Pollination R&D Program and the Honeybee R&D Program beyond their current periods
3. Pollination Australia to demonstrate stronger and more strategic management
4. Australian Government to reconsider funding a Honey Bee CRC
5. Dedicate more funding through the Honeybee R&D program (or alternative funding to a CRC, university or other research programs) to investigate alternative and boutique uses of Australian honey and honey-related products, as well as their markets.
6. Support research into:
 - the medical and veterinary applications of honey, and promotion of the results to relevant professionals
 - the benefits of consuming honey
 - the development and marketing of 'value added' honey products

Food Security

The critical importance of beekeeping for food security must not be underestimated. There is an emerging global crisis, and food security will be a significant issue for our nation in the coming years. However, one of the biggest challenges facing the beekeeping industry is the lack of understanding by agricultural industries, government and the public about the role that managed honey bees and pollination services play in food production, and their broader contribution to the Australian economy.

Of the 100 crop species that provide 90 per cent of the world's food, over 70 are pollinated by honey bees (UNEP, 2010). However, as the world's demand for food is increasing, populations of unmanaged honey bees are declining dramatically.

Some of our day-to-day foodstuffs are 100 per cent reliant on pollination by managed honey bees due to these population declines. For example:

- There would be no almonds – and no almond industry anywhere in the world – without managed honey bees to pollinate orchards.
- In New Zealand there would be no stone fruit. Managed honey bees now pollinate all of New Zealand's stone fruit, since the varroa mite wiped out unmanaged bee populations after its arrival in 2000.
- In NSW, cherry farmers in the Young area are now turning to the pollination services of managed honey bees after a couple of years of failed crops.

Table 1 (below) shows some of the more important crops that depend on managed honey bees.

Table 1: The dependence of selected crops on honey bee pollination (as percentage of yield)

Crop	Dependence %	Crop	Dependence %
<i>Tree crops</i>		<i>Vine crops</i>	
Almond	100	Blueberry	100
Apple	100	Cucumber	100
Apricot	70	Kiwi	80
Avocado	100	Pumpkin	100
Cherries	90	Rockmelon	100
Citrus ^a	30-80	Squash	10
Grapefruit	80	Watermelon	70
Lemon & Lime	20		
Macadamia	90	<i>Seed production</i>	
Mandarin	30	Beans	10
Mango	90	Broccoli	100
Nectarine	60	Brussels sprout	100
Orange	30	Cabbage	100
Papaya	20	Canola	100
Peach	60	Carrot	100
Pear ^a	50 – 100	Cauliflower	100
Plum & Prune	70	Celery	100
		Clover	100
<i>Ground crops</i>		Lucerne	100
Peanut	10	Mustard	100
		Onions	100
<i>Broad acre crops</i>			
Canola	15		
Cotton	10		
Soy	10		
Sunflower ^a	30-100		

^a Depends on variety

From Monck, M., Gordon, J., & Hanslow, K. (2008). *Analysis of the market for pollination services in Australia*. Rural Industries Research and Development Corporation.

The threats to unmanaged honey bees are many, complex and interrelated: from habitat loss and urbanisation to pesticides, pathogens, invasive species and climate change. Collectively these issues are having a massive effect on their populations worldwide, with reported colony losses of between 30 and 90 per cent in some areas. The impact of this loss on food security is huge.

Financial importance

Honey is the main product of the Australian beekeeping industry, with most commercial beekeepers supplying one of three major packers – Capilano, Beechworth and Superbee. Honey and other hive products are worth around \$100 million per annum in Australia, according to current estimates.

It is also estimated that 65 per cent of Australian horticultural and agricultural produce relies on pollination services from honey bees (RIRDC, 2010), with 35 crops completely dependent on honey bees for pollination.

In 2009, the Department of Agriculture estimated that the contribution of pollination services to plant-based industries; wool, meat and dairy production; and related business activity was worth \$4-6 billion (Australian Government, 2009).

Studies show that such contributions can only increase, as crops pollinated by managed honey bees prove more viable, productive and profitable than those pollinated by unmanaged bees or other local pollinators.

Moreover, paid pollination services will need to play an increasingly critical role in protecting the economic viability of many agricultural sectors in the face of declining unmanaged honey bee populations and threats such as the varroa mite.

The importance of pollination services was recognised in the 2008 Inquiry and in the subsequent establishment of the Pollination R&D Program:

The humble honey bee is one of the most important contributors to the success of Australian agriculture. Many crop and pasture species are heavily or totally reliant on honey bees for pollination. Commercial prosperity within the agricultural sector requires honey bees. So does the food security of Australia and the world – APH, 2008.

Over the last 10 years, the number of Australian beekeepers providing paid pollination services has grown from 10 to 60 per cent. However, pollination services still only represent about 15 per cent of industry income.

One of the industry's most significant challenges is demonstrating the value of paid pollination services to farmers, who have historically relied on the free service provided by unmanaged bees. These bees can live in the trees surrounding farmland or come from locally managed hives – unbeknown to the farmer. Farmers also need to understand that without a viable beekeeping industry their crops will suffer when the varroa mite or other honey bee pests become established in Australia.

Valuing pollination services: better crops and food security

What happens when there are no longer enough honey bees to pollinate our major food crops, and those which we use to feed livestock, such as clover and lucerne?

Of particular concern is the varroa mite, which has already decimated unmanaged honey bee populations in other countries and is threatening to reach our shores.

In 2008, Pollination Australia examined the impact of a varroa invasion on Australia's industry. Using a projection of 2011 honey bee populations, they estimated that:

- More than half of Australia's 500,000 commercial hives would be required for paid pollination services
- If varroa mite became established in Australia, an additional 480,000 colonies of honey bees would be required to provide pollination services every year
- Peak demand could lift this to 750,000 colonies – which would far exceed the populations available.

Australia has managed to stay varroa mite free. However, the threat remains and we do not have enough managed honey bees to meet our food needs in the face of an invasion.

Countries like New Zealand learned the hard way, with two seasons of failed stone fruit crops before producers turned to paid pollination services. A similar fate awaits Australian crops unless we prepare for these threats and create a viable beekeeping industry to meet our future pollination and crop-production needs.

In being so prepared, we might also find opportunities to assist countries like China, the USA and EU with their pollination requirements, through the provision of packaged honey bees.

Case study: Almond pollination in America – the largest pollination event on Earth

<https://rirdc.infoservices.com.au/items/10-108>

Almonds are the biggest player in the paid pollination industry, as they are entirely reliant on the pollination services of managed honey bees to fruit.

Honey bees are recognised as the most efficient and practicable pollinating insects of almond blossom and are in huge demand worldwide for their pollination service.

The size of the Australian almond industry has doubled in the past 10 years, and will continue to grow with increased demand from India and China.

The biggest players in the industry are California, Australia, Spain and Portugal.

In the USA it takes more than half of the country's entire stock of managed honey bees just to service the almond industry – more than 1.5 million hives are trucked to California every spring to pollinate the orchards.

The pollination of almonds in California is the largest pollination event on Earth, with the honey bees pollinating nearly one million acres of almonds worth nearly \$US34 billion in 2011.

Increased crop productivity and profitability

Beekeepers have long believed that one day our agricultural and horticultural industries would become more dependent on paid pollination – generally they haven't. Almonds are the exception; otherwise, paid pollination is increasing only slowly – RIRDC, 2007a

A sustainable beekeeping industry benefits the horticultural and agricultural industries even without threats to unmanaged bee populations, such as varroa.

There is an increasing body of research that illustrates the advantages of commercial crop pollination by managed honey bees. Reports say pollination can result in crops that are faster to mature, provide higher yields and produce better fruit, which is worth more at market. These improvements in crop yield and quality can be attributed to the higher densities of healthy managed honey bees visiting the flowers and transferring pollen between them. Also, for large-scale monocultures, such as almonds and rockmelons, adequate pollination is beyond the capacity of unmanaged bees even if they exist in the area.

Case study: Bees improve crop production

Bees better for strawberries

www.theage.com.au/environment/bees-better-for-strawberries-20131204-2

German and Swedish scientists have found that strawberries pollinated by bees, rather than wind or self-pollination, generated higher prices and had a longer shelf-life, due to their firmer flesh.

This in turn reduced waste by at least 11 per cent, the researchers estimated. The researchers, led by agro-ecologist Teja Tscharntke, of Germany's University of Gottingen, estimate that 90 per cent of fruit becomes unmarketable after just four days in storage.

The findings are likely to translate to other fruit and vegetable varieties, the authors note. "Pollination appears to be much more economically important than previously recognised," they concluded.

Putting bees into faba beans

www.depi.vic.gov.au/agriculture-and-food/grains-and-other-crops/crop-production/growing-faba-bean

Faba beans have limited ability for self-pollination and yields benefit from insect pollinators to maximise seed set. If native bee numbers are not high, the use of bees can significantly increase yield (by up to 40 per cent).

(DEPI suggest) growers consider introducing bee hives to their faba bean plots to increase yield. They recommend at least one hive for each 2.5 hectares, if there is less than one bee per square metre in mid-afternoon. Faba bean flowers open in mid-afternoon and close again at dusk. As days lengthen and the air temperatures increase, bees become active.

Improving Australian cotton

www.publish.csiro.au/paper/EA01063.htm

A paper published in the Australian Journal of Experimental Agriculture showed that cotton quality and quantity was improved by the introduction of honeybees, with more bee visits leading to greater improvements.

In a field trial, significant increases for the total number of bolls harvested (11.1 per cent), total mass of bolls (16.5 per cent), total lint mass (15.8 per cent), total seed mass (19.7 per cent) and total number of seeds per sample (16.5 per cent) were obtained from plots receiving the highest number of bee visits compared with plots receiving the lowest number of bee visits. Lint-quality examinations resulted in a significant improvement for micronaire and fineness with increased bee visits.

Non-significant increases were obtained for the mass of 100 seeds (3.8 per cent), average single seed weight (3.9 per cent), average number of seeds per boll (4.7 per cent) and average weight of lint per boll (5 per cent). Caged plots with honey bees had significantly greater total boll mass; total seed mass; and average single-seed weight than caged plots without honey bees.

Research and development: increasing production and value adding

To date, research and development in the beekeeping industry has focused mainly on biosecurity and pollination through the Honeybee R&D Program and the Pollination R&D Program. However, despite the repercussions for many industries much larger than the beekeeping one, it is the beekeeping industry that is shouldering many of these costs. Given our industry size, we cannot generate enough revenue for essential research.

We acknowledge the work done since 2008 in the creation and funding of Pollination Australia (through RIRDC) and the continued support of the Honeybee and Pollination R&D programs.

However, initial funding of Pollination Australia was problematic due to a change of government and the Global Financial Crisis, and it has not fulfilled the promises made to industry. It needs a far more proactive management team to achieve its initial goals. In many ways the organisation has also worked against future collaboration between the beekeeping industry and pollination-dependent industries because many horticultural commodity groups see it as introducing a cost burden rather than added benefits.

In addition to biosecurity and pollination research, there is also a need for adding value to Australian honey (active honey for healthcare, boutique honey products and alternative uses for honey).

In response to the 2008 Inquiry, the Australian Government (2009) said that it was reluctant to support a Honey Bee CRC or a similar research initiative. However, we believe that this would provide great benefit to the industry and to the nation as a whole.

As the beekeeping industry's importance reaches much further than our own industry, we need more support from dependent agricultural industries, which have far higher profits and much to lose if pollination services decline.

Adding value to Australian honey

There is a significant opportunity to take the many unique and under-marketed Australian honeys and honey-related products to the consumer, just as cellar doors have done with wine, and microbreweries have done with beer in this country.

Honey is pure, natural and unprocessed – all highly valued properties by 'foodies'. Boutique honey, like boutique beer, delivers a diverse range of distinctive flavours, many of which are unique to Australia. There is also a market for other honey-related products, such as mead.

Leatherwood honey is one example that has done well from good marketing. There are also many different types of Australian honey that could be marketed for their unique and complex flavours. Around 70 to 80 per cent of the NSW honey crop comes from eucalypt forests, producing numerous distinct honeys from native flora.

Australian honey sourced from some species of *Leptospermum* has significant antibacterial properties, and the veterinary community has adopted it as a wound dressing. It is also slowly gaining acceptance as a dressing for human health in conventional medical practices.

Case study: Active honey – making more out of Australian honey

Summary of an article that appeared in August-September 2013 Honeybee News

A common misconception is that honey is a standard product.

However, along with the taste and colour, the antimicrobial activity of honey will vary greatly, depending on which flowers the honey bees visit to collect their nectar. In fact, while all honeys possess some level of antimicrobial (i.e. germ-killing) activity, some are up to 100 times more effective than others.

The activity of over 475 Australian honeys was tested and over half had clinically useful levels of antimicrobial activity. A number also had the 'special' type of activity of manuka honey, for which New Zealand is famous (RIRDC Report (2012) Carter, Blair, Irish).

Active honey

It is now well established that numerous honeys have medically useful levels of antimicrobial activity. That is, they are powerful agents against infectious organisms such as methicillin-resistant *Staphylococcus aureus* (MRSA), also known as Golden Staph. In fact, some honeys are even effective against multi-drug resistant germs, a.k.a. superbugs. These superbugs cause very serious and potentially deadly infections, and cost thousands of lives and millions of dollars to the health care system every year.

The antimicrobial activity of honey is due to:

- *High sugar content (about 80%)*
 - All of the sugar molecules in honey bind so tightly to any water molecules that the water is not available for the germs to use, making the honey too "dry" for them to grow.
- *Low pH*
 - Typical pH ranges from 3.2 to 4.5, which is too low for the growth of most germs.
- *Hydrogen peroxide*
 - When honey bees are making honey, they add a variety of things to the nectar, and one of these is an enzyme called glucose oxidase.
 - When honey is mixed with water, this enzyme produces hydrogen peroxide (like bleach), which is toxic to microbes but at concentrations low enough to be harmless to human skin.
- *Floral factors*
 - Healing properties vary, depending on which flowers are a source of nectar for the honey bees.
 - Some honeys have exceptional antimicrobial activity due to their floral source. The most famous examples are certain *Leptospermum* honeys from New Zealand and Australia (colloquially known as manuka and jelly bush honey, respectively).

There are also very exciting preliminary studies showing that the consumption of Australian honey is very good for gut health when eaten. Many honeys have exceptional prebiotic activity – that is, they help promote the growth of 'good bugs' in the gut, which is something that doctors and scientists now recognise as very important for overall health (<https://rirdc.infoservices.com.au/items/09-179>).

More research is warranted into the medical and health benefits of Australian honey and other honey bee products.

We are yet to really discover the true potential of honey-related products and services. A great example is CSIRO scientists' recent discovery that honey can produce graphene; the new super

material used in everything from smart phone screens to solar cells and nerve regeneration. The possibilities are endless – as long as there is money available for this basic research to take place.

Case study: Honey for science – making graphene

Extract from Sydney Morning Herald Article, 20 Jan 2014

www.smh.com.au/technology/sci-tech/material-of-the-future-20140113-30pbb.html

Graphene is one of the most promising new materials in science. It's been touted as the next big thing in an amazing array of areas, from medicine to manufacturing. It's the world's thinnest material, but is also very flexible and 2000 times stronger than steel.

Moving from nanoscale (production) to the commercial scale remains hugely complex. Making enough of it is still tricky. "We want to be able to press a button and have kilometres of the stuff come out," says CSIRO's Cathy Foley. At the moment, complex chemical and thermal processes are used to obtain graphene, but most take hours or days, involve toxic ingredients or they only produce small amounts, not the mass quantities consumer products would need.

One group of CSIRO researchers thinks they've solved that conundrum, in part thanks to a bad cold. In 2011, PhD student Donghan Seo was at home in Sydney nursing a cold with lemon and honey tea... "I suddenly thought, why wouldn't honey work in making graphene? I had a strong religious feeling that it would work, and from a scientific point of view it made sense," he says.

The next day, he took some honey to the lab, where he subjected less than a gram to plasma testing, pelting it with highly charged ions to purify it down to its basic carbon structure. The CSIRO Plasma Nanoscience team he's part of can now create a 1cm x 1cm sheet of graphene in nine minutes – "While I go and get a coffee," he says. While not everyone is convinced, Seo says they have already used honey-derived graphene in a gas sensor and butter-derived graphene in a battery. "We know it works in the lab."

B. Current challenges facing the industry domestically and internationally, and its future sustainability

Key challenges

- Ensuring commercial beekeeper access to floral resources, which provide the nectar and pollen essential for sustaining viable businesses and healthy honey bee populations
- Gaining recognition for beekeepers as key stakeholders in land-use planning, including forestry agreements and bushfire planning
- Developing a nationwide access agreement
- Attracting new recruits to beekeeping and making it a more attractive career path
- Obtaining Government support and funding for industry training
- Creating supportive visa opportunities for migrant workers who are interested in joining the industry long-term

Recommendations - B

1. State and Federal Governments to develop an overarching policy for beekeeping on public land, which offers the beekeeping industry a coordinated approach rather than requiring individual submissions to different government agencies and inquiries on a case-by-case basis
2. Governments to consider and consult with beekeepers in regional land-use planning and rezoning, as it is not permissible to keep bees within a certain distance of residential and commercial properties

3. Federal Government to support Vocational Education and Training (VET) through Registered Training Organisations (RTOs), such as TAFE places and apprenticeships for beekeepers, including funding Certificate III or Certificate IV qualification for beekeepers to teach best-practice honey beekeeping, covering biosecurity and marketing
4. Australian Government to provide better access to visas and 457 working visas and other more supportive visa arrangements for migrant workers

Honey bees need flowers: access to floral resources

The honey bee industry is dependent upon native forest for honey production and recovery from pollination operations.... Without access to floral resources, the potential of the honey bee industry to grow to meet the demands for crop pollination is compromised – APH, 2008

In Australia, our managed honey bees depend on access to flowering native vegetation to feed, breed and increase their colony size for the purpose of honey production and/or commercial pollination.

In the USA honey bees rely very little on native vegetation, with commercial crops providing 90 per cent of their nectar needs.

In Australia commercial crops only provide 2-5 per cent of nectar for honey bees. Approximately 70 to 80 per cent of NSW's honey production is derived from eucalypt species.

Australian beekeepers prefer Eucalypts as they have relatively long flowering events, produce more nectar and result in our unique Australian honey varieties. They are also an excellent nutritional resource for building up strong and healthy honey bee colonies.

With commercial crops there is a significant risk of pesticides killing bees, as has happened in a number of cotton growing areas in Australia. Working large monoculture crops can also be very taxing on honey bees and detrimental to their health, due to the relatively poor nutrition this provides for them.

Case study: Where does a honey bee go?

Around 70 to 80 per cent of NSW honey is from eucalypt trees, with different species flowering at different times of year and many flowering only every three to five years. Beekeepers spend a large amount of time chasing these irregular food sources for their honey bees across vast distances.

The time spent in eucalypt forests is therefore critical to the health of a beekeeper's business.

Following is a year in the life of 720 hives, moved and managed by a beekeeper near Tamworth (NSW):

- 4/10/12 **Forestry sites** near Port Macquarie
 - approx. distance travelled: 480 km
 - time spent: 133 days
- 14/02/13 **National Parks & Forestry sites** near Narrabri
 - approx. distance travelled: 480 km
 - time spent: 44 days
- 29/04/13 Bingara area on **LHPA Reserves** and private properties
 - approx. distance travelled: 160 km
 - time spent: 98 days
- 6/08/13 Hillston (private property) for **Pollination of Almonds**
 - approx. distance travelled: 900 km
 - time spent: 31 days
- 5/09/13 **National Parks & Forestry sites** near Narrabri
 - approx. distance travelled: 780 km
 - time spent: 42 days
- 16/10/13 Coonabarabran area on private properties
 - approx. distance travelled: 110 km
 - time spent: 74 days
- 29/12/13 Tamworth area on **LHPA Reserves** and private properties
 - approx. distance travelled: 180 km
 - time spent: 31 days
- 29/01/14 **Forestry sites** near Port Macquarie
 - approx. distance travelled: 250 km
 - time spent: 18 days ongoing

For beekeepers, the issue of access to resources is twofold. Firstly, eucalypts and other native flowering species are being removed through a number of mechanisms, including urbanisation, forestry pine plantations, dieback, firewood harvesting, land clearing, changing land-use priorities and changing fire regimes.

In addition, land managers have limited beekeeper access to native vegetation areas. This issue was addressed by the 2008 Inquiry, and the following recommendation was made:

The Australian Government, in conjunction with state and territory governments, establish guidelines for beekeeper access to public lands and leasehold lands, including national parks, with a view to securing the floral resources of the Australian honey bee industry and pollination-dependent industries – APH, 2008.

However, access to floral resources continues to be an ongoing problem for the beekeeping industry. The implementation of the 2008 Inquiry's recommendations has varied from state to state. Victoria has led the way, but other states, including NSW, have been slow to follow.

In August 2013, the Victorian Government announced it would open up more honey beekeeping sites on public land (www.premier.vic.gov.au/media-centre/media-releases/7613-roadmap-to-revitalise-honey-bee-industry.html).

In NSW, some progress has been made since 2008, with greater certainty granted to NSW beekeepers around access to National Parks. However, we still have issues with local jurisdictions applying policy incorrectly and excluding beekeepers.

The current NSW *National Parks Beekeeping Policy* allows beekeepers to work within National Parks, but there is no provision to create new beekeeping sites or to replace the ones that have been lost to industry. The beekeeping industry has lost sites when land was gazetted as a National Park and they lost access to unoccupied sites.

In addition, if a beekeeping site in a state forest or Travelling Stock Reserve is vacant (i.e. not allocated) when a National Park is declared, then the site is lost to industry.

In 2009, the NSW State Government changed the management of the Travelling Stock Reserves, placing them back under the control of Crown Lands, who are now considering changing the usage of many of these reserved areas. These stock reserves are a very important resource to the beekeeping industry and their use needs to be considered in this planning process. Crown Lands initiated an extended review process that has created uncertainty, adding further pressure to beekeeping businesses.

Access to public lands for beekeepers continues to be granted in an ad-hoc manner. Beekeepers are forced to make case-by-case submissions each time they require access, due to differing requirements from different land managers in geographic areas. In addition, there have been some instances where local managers refuse or complicate access, despite their own organisations supporting access.

The beekeeping industry needs state and federal policies that support and simplify access to public lands. To address these issues, there must be consistent access policies for public land and the involvement of beekeepers and beekeeping bodies in:

- The development of publicly managed forest agreements
- The development of bushfire management strategies
- Strategic regional and urban land-use planning.

Putting the buzz in honey beekeeping: attracting and training beekeepers

There are around 1000 commercial operators who supply most of Australia's honey and pollination services.

The industry will need to grow to meet future pollination service requirements. However, it is hard to attract new commercial players for a number of reasons:

- It is difficult to gain reasonable and consistent access to adequate floral resources, with access issues compounded by the biology of eucalypts, which only flower every three to five years, as well as the impact of drought.
- Financial returns are not secure and overheads can be very high. It can cost millions of dollars to start a commercially viable operation of more than 500 hives.
- There is a lack of training opportunities and clear career pathways for those entering the industry.

Training

The need for improved training and extension has been identified as a significant issue for an industry facing many pressures, economic and otherwise – APH, 2008

In response to the 2008 Inquiry, the Australia Government (2009) referred the industry to existing funding offered by the Federal Government to those enrolled in Certificates II, III and IV under the

Australian Apprentices arrangement. However, one of the main obstacles remains: establishing apprenticeship programs for beekeepers.

Beekeepers in NSW have investigated the delivery of Certificate III and IV programs through the Registered Training Organisation (RTO) system, but this has not progressed due to a small and geographically diverse training market. Consideration must be given to alternative training mechanisms or additional government support of these programs.

The Federal Government should support Vocational Education and Training (VET) through RTOs, such as TAFE places and apprenticeships for beekeepers, including funding Certificate III or Certificate IV qualification for beekeepers to teach best-practice beekeeping, including covering biosecurity and marketing.

Case study: How to retain a good beekeeper

A relatively young and passionate beekeeper was struggling in the industry due to the geographic isolation of his operation, and lack of career development, communication and networking skill development opportunities in the industry.

The NSW Apiarists' Association sponsored his attendance of the Marcus Oldham Rural Leadership Program, an intensive five-day workshop conducted on the college campus at Geelong.

This was a great boost to his skills and he is now an active member of the industry. He feels that this opportunity had a very positive impact on his career, and this means we have retained a commercial beekeeper in the state, which will become crucial once varroa arrives.

C. The adequacy of the current biosecurity arrangements for imported and exported honey, apiary products, package honey bees and queen honey bees

Key challenges

- Maintaining adequate and effective quarantine and biosecurity testing facilities
- Keeping the quarantine facility in Sydney because NSW beekeepers predominantly use it; the state's honey-bee habitat makes Sydney more suitable than Melbourne; and it will be an important location for safely and easily importing varroa-resistant stock when varroa arrives

Recommendations - C

1. The Australian Government (through the Department of Agriculture) to continue supporting the National Bee Pest Surveillance Program (formerly the Sentinel Hive Program), and providing greater capital
2. Federal Government to maintain quarantine and testing facilities in NSW
3. Federal Government (through Department of Agriculture) to support the preparation and implementation of national best-practice guidelines for honey bee biosecurity
4. Biosecurity training to be provided to beekeepers through RTOs or DPIs

Threats to honey bee populations: from varroa to pesticides

The causes of the worldwide honey bee decline are complex and interrelated. They include varroa mite, honey bee virus and other diseases, climate change, deforestation and intensive agricultural practices, including the use of pesticides and the planting of large areas with monocultural crops.

Australia's honey bees are still relatively healthy in comparison to the global populations. We are one of the few countries in the world that is still varroa mite free. However, incursions are the biggest

biosecurity threat to the Australian beekeeping industry, rather than imports of hive products and bees – although these also have the potential to negatively impact the beekeeping industry.

Apart from varroa mite there are other biosecurity threats to our industry, and these include other mites such *Tropilaelaps* (*Tropilaelaps clareae*), Tracheal (*Acarapis woodi*) mites, as well as other bee species, including Asian bees and African ones.

Although we have the National Bee Pest Surveillance Program (formerly the Sentinel Hive Program), Australia's continued status as 'varroa mite free', and our current freedom from these other biological threats, is arguably due more to luck than the robustness of the Surveillance Program.

It is essential that this program continue in order to protect the Australian honey bee industry. However, the current budget of just \$210,000 for port surveillance/prevention of exotic pest establishment is ridiculously low. Varroa alone could cost Australia millions a year.

The Australian almond industry highlights this potential danger. The industry, which is 100% reliant on commercial beekeeper for spring pollination, has doubled in the past 10 years, with a predicted value of \$570 million by 2015. The arrival and establishment of varroa will have a devastating impact on this industry.

It is essential that appropriate Federal funding continues to maintain this program, and that funding levels are increased. The beekeeping industry is much smaller, and earns much less, than the horticultural industries that rely on it for pollination services. These services will become more crucial and much more expensive when we become infected with varroa.

Changes to the quarantine station arrangements

We are concerned about the proposal to relocate the NSW quarantine facility to the new AQIS facility in Melbourne.

The 2008 Inquiry recommended the establishment of a new quarantine facility to replace the facility at Eastern Creek, which is scheduled to close in August 2015.

The quarantine station planned for Victoria is far from ideal for honey bees, due to lack of floral resources and weather conditions. Many of the current facility's main users are also based in NSW.

The NSW Apiarists' Association strongly advocates for the preservation of quarantine and testing facilities in NSW, and recommends that government consider the alternative site at the Elizabeth Macarthur Agricultural Institute (EMAI) to the currently proposed Victorian site.

The inevitability of varroa

Incursions of exotic honey bee pests and diseases have the potential to not only severely disrupt the honey bee industry, but also many of our agriculture and horticulture industries. Preventing the introduction of exotic pests and diseases must be a priority of governments and industry – APH, 2008.

Despite our best biosecurity efforts, varroa mite will most likely arrive and wipe out most of Australia's unmanaged bees within just a few seasons. Many commercial hives will also be lost if we do not respond quickly enough. Agricultural production will drop significantly.

To protect our agricultural and horticultural industries, we need to do as much as we can to prepare for that eventuality. We need to build resilience in the commercial honey beekeeping industry and begin to promote pollination services by managed bees rather than relying on unmanaged bees – as detailed above.

The development and enforcement of national best practice guidelines for beekeeping could further assist the country to protect itself against biosecurity threats.

Case study: How much would varroa mite cost Australia?

www.daff.gov.au/animal-plant-health/pests-diseases-weeds/animal/Varroa-mite

The varroa mite would decimate Australia's unmanaged bee population and cause a rapid increase in demand for pollination services.

It is estimated that varroa mite could cost Australian plant industries between \$21.3 million and \$50.3 million per year over 30 years (Source: CSIRO Submission no. 33, p. 10, to the House of Representatives Standing Committee Inquiry into the Future Development of the Australian Honeybee Industry).

However, this seems to be a significant underestimation as varroa could be the tipping point for many commercial beekeepers and the loss to the almond industry alone could be well in excess of \$50 million per annum.

The industries whose crops rely on honey bees for pollination services would bear the main cost of varroa. These include almonds, avocados, cotton, stone fruits, apples and pears, melons and pumpkins.

In 2000, varroa mites were discovered in New Zealand and they have already had a major economic impact, with significant control costs and losses of honey bees, hives, honey production, crop yields and export revenue.

Other pests and disease

Although varroa mite presents the greatest and most imminent threat to the honey bee populations, we are also concerned about other potential incursions, as well as current battles with endemic pests and diseases.

Potential incursions

- Other honey bee mites, including Tropilaelaps mite (*Tropilaelaps clareae*), Tracheal mite (*Acarapis woodi*), are significant pathogens in the global beekeeping industry
- Viruses, such as acute bee paralysis virus and deformed wing virus, which cause bee mortality when associated with varroa mite infestations
- Other bee species from Asia, which can carry diseases and/or exhibit aggressive/honey-robbing behaviour towards our honey bee (*Apis mellifera*), including:
 - the Asian honey bee (*Apis cerana*) – discussed later in this submission
 - giant honey bee (*Apis dorsata*)
 - dwarf honey bee (*Apis florea*)
 - recently identified species, of which little is known, such as *Apis andreniformis*, *Apis koschevnikovi*, *Apis nigrocinta*, and *Apis nuluensis*
- Africanised bees (*Apis mellifera scutellata* and its hybrids) and Cape honey bees (*Apis mellifera capensis*)

Current endemic pests and diseases

- Small hive beetle (originally from Africa) and the microbial parasite, *Nosema ceranae*
- American foul brood, European foul brood and Sacbrood
- A range of honey bee viruses, including chronic paralysis virus, Israel acute paralysis virus, Kashmir bee virus, black queen cell virus and cloudy wing virus

These pests cause varying degrees of problems to beekeepers, from inconvenient to colony destroying. We desperately need further research on the best ways of preventing/managing infestations.

Use of pesticides

The 2008 Inquiry recognised the need to improve chemical labelling to reduce the impact of pesticides on honey bees. The Australian Pesticides and Veterinary Medicines Authority (APVMA) is helping to push this forward. However, there are still inconsistent labelling conventions, and there have been a number of recent incidents where beekeepers have lost a significant number of their hives due to direct spraying or spray drift. The EPA has appeared to be toothless when dealing with past incidents involving the incorrect use of agricultural chemicals and their detrimental impact on a number of large beekeeping operations.

D. Australia's food labelling requirements, and how these affect the honey beekeeping industry

Key challenges

- Creating transparency in food labelling so customers can immediately understand if the honey they are purchasing is 100 per cent Australian
- Developing consistency in taxation and quality-assurance testing of imported honey and Australian honey exports
- Ensuring that honey is given due consideration in free trade agreements, instead of being ignored or used as a bargaining chip

Recommendations - D

1. Change food-labelling standards to ensure appropriate labelling of imported honey so consumers know what they are buying
 2. Change labelling regulations to make it easier for consumers to choose products that are actually 100 per cent Australian
 3. Address the methodological issues of categorising natural foods like honey when the 'traffic light labelling' or similar is introduced
 4. Ensure more thorough inspections of imported honey so that it is subject to the same quality-assurance testing as Australian honey exports
 5. Australian Government to consider honey when negotiating free trade agreements and export tariffs
-

Food Labelling and the quality of imported honey

Food labelling and current import/export arrangements were identified as concerns of the industry in the 2008 Inquiry. However, at that time the Government referred the industry to existing channels to peruse their concerns about:

- The quality (and testing) of imported honey
- Food-labelling laws, especially in regards to local and imported honey
- Inequality in import and export taxes and tariffs
- Free-trade agreements.

The concern about the quality of imported honey is twofold:

- It is very difficult for the Australian beekeeping industry to be competitive with honey from other large international producers, where it can be produced with much cheaper labour and overheads.
 - Imported honey is not subject to the same quality-assurance testing that Australian honey must undergo when it is exported.
-

Given the lack of such quality-assurance testing, the industry is very concerned about the food quality of imported products. There have been instances, for example, of imported honeys that were adulterated with sugar and contaminated with other compounds that are banned from use in Australia.

The lack of testing is also a particular concern because Australia's current food-labelling laws make it difficult for the consumer to tell if they are buying a 100 per cent Australian honey, an imported honey or a blend. The product only needs to be packed in Australia to hold the 'Australian Made' label.

Current regulations stipulate that only 5 per cent of imported honey needs to be tested for quality, residues, adulteration, etc. This is clearly too low. However, alarmingly we are aware that no imported honey has been tested for quality parameters in the past year, other than some confirmation that labels conformed to standards.

The industry raised a range of trade and economic issues in 2008. However, in most cases the Government recommended that existing mechanisms should deal with these issues and that no special consideration be given to the honey industry in terms of quality testing for imported honey, labelling, formal price monitoring, more favourable visa conditions for migrant workers, import and export tariffs, and free trade agreements.

In their response to the 2008 Inquiry, the Australian Government (2009) said that it was not aware of any gaps in the international honey-testing standard. However, the industry maintains that imported honey is not subject to the same testing as Australian honey when it is imported into other countries.

Import competition is having a significant impact upon returns to Australian producers – but much of this competition derives from low-cost countries with poor quality-control regimes. Australian exporters on the other hand often face a range of tariff and non-tariff barriers in accessing overseas markets. Clearly, there is no level playing field. In addition, lax labelling laws have allowed foreign honey to be 're-badged', with serious implications for the reputation of Australian hone – APH, 2008.

At that time the Government indicated that the industry should pursue any changes they wanted to labelling through Food Standards Australia New Zealand.

If the industry requires specific additional food regulatory measures in the code (for example, for equivalence to those in force in the European Union or more specific requirements with regard to the country of origin of individual honeys in a final mixed product), it can make an application to Food Standards Australia New Zealand (FSANZ) – Australian Government, 2009.

There are currently also discussions underway for a 'traffic light' system, or something similar, to be used for food labelling to provide easily interpreted information using colour codes. Red, amber and green 'traffic light' shapes on the front of food packages will show consumers, at a glance, whether a product is high, medium or low in fat, saturated fat, sugar and salt.

While industry supports moves to improve the health of Australians through making healthier food choices, there are problems with some of the proposed methodologies for categorising certain food and drinks, particularly 'natural, non-manufactured' foods like honey.

The proposed traffic light nutrition labelling system could unfairly label honey as 'bad', despite scientific evidence of its potential as a prebiotic, and the fact that at the standard consumption of one to two tablespoons a day the sugars in honey are not detrimental as part of a balanced diet.

E. The recommendations from the House Standing Committee on Primary Industries and Resources 2008 report *More than Honey; the future of the Australian honey bee and pollination industries*, and the Rural Affairs and Transport References Committee 2011 report *Science underpinning the inability to eradicate the Asian honey bee*.

We acknowledge the *More than Honey* inquiry and report undertaken in 2008. In this submission we identify the successes from this inquiry, but also the issues that need more work and those which have become more pressing since 2008. We refer to this as the 2008 Inquiry throughout.

The inquiry made 25 recommendations in the following key areas:

- Current and future prospects (Recommendation 1)
- Research and training funding (Recommendations 2, 3, 24 and 25)
- Control of chemical use on honey bees (Recommendations 4 and 9)
- Resource security (Recommendations 5, 6, and 7)
- Biosecurity (Recommendations 8 and 10 to 16)
- Economic and trade issues (Recommendations 17 to 23)

We have addressed these recommendations and the 2009 Government responses throughout this submission where they are relevant to the current terms of reference.

In summary:

- Pollination Australia and the RIRDC Honeybee and Pollination R&D programs need continued and increased funding, and in the case of Pollination Australia, better management.
- In 2009 the Government stated that it did not think a Cooperative Research Centre was needed for honey bee research. With the increased threat of varroa and other pests, and the complexity of other issues to be studied, we believe that a CRC remains the best way to improve and coordinate funding from across industry, the R&D programs and universities. The Australian Government should reconsider this position.
- With regards to training, it was stated in 2009 that the industry needed to use existing funding offered by the Federal Government to those enrolled in Certificates II-IV under the Australian Apprentices arrangement. However, one of the main obstacles remains: establishing apprenticeship programs for beekeepers. We'd like the Federal Government to support Vocational Education and Training (VET) through RTOs, such as TAFE places and apprenticeships for beekeepers, including funding Certificate III or Certificate IV qualification for beekeepers to teach best-practice honey beekeeping, including covering biosecurity and marketing.
- The Industry is still hampered by inconsistent access to essential floral resources. There has been progress in some jurisdictions, like Victoria, but this is still a problem in NSW and local managers don't always abide by the policies. We need an overarching policy applicable to beekeeping on public land. That is, offering the beekeeping industry a coordinated approach to undertaking their activities on public land, rather than requiring individual submissions to different government agencies and inquiries on a case-by-case basis.
- Our quarantine measures are inadequate, and we have remained free from major incursions probably mostly through luck. There is an urgent need for more government support of these measures, and for the continued operation of a quarantine facility in NSW.
- The beekeeping industry also believes that we still require some national best practice biosecurity guidelines.
- There has been little, if any progress on food labelling laws since 2008, with review after review but no action. 'Made in Australia' and 'Product of Australia' labels are still misleading and concern a range of industries, not just beekeepers. We would like to see the Government take more direction on this.

- In 2009 the Government said that it did not see any inequity in quality testing for imported honey, but the industry maintains that imported honey is often inferior and we would like to see more imported honey subjected to quality testing.

F. Any related matters

None.

Appendix I - References and further reading

APH (The Parliament of the Commonwealth of Australia) (2008) *More than honey: the future of the Australian Honeybee and pollination industries*, report of the inquiry into the future development of the Australian honey bee industry, House of Representatives, Standing Committee on Primary Industries and Resources.

DAFF and DPI (2007) *National Best Management Practice for Beekeeping in the Australian Environment*, Australian Honeybee Council report for the Department of Agriculture, Fisheries and Forestry and the NSW Department of Primary Industries. Available at: <http://honeybee.org.au/pdf/NBPFBAE.pdf>

Australian Government (2009) *Government Response to the House of Representatives Standing Committee on Primary Industries and Resources Inquiry Report: 'More Than Honey: the future of the Australian honey bee and pollination industries'*. Available at: www.daff.gov.au/_data/assets/pdf_file/0004/1206904/gov-response-sentinel-hive.pdf

RIRDC (2007a) *Commercial Beekeeping in Australia*, report prepared by Frederick S Benecke to the Rural Industries Research and Development Corporation.

RIRDC (2007b) *Australian Honeybee Industry Survey 2006-2007*, report prepared by Sarah Crooks, Australian Bureau of Agricultural and Resource Economics to the Rural Industries Research and Development Corporation.

RIRDC (2008) *Analysis of the Market for Pollination Services in Australia*, report prepared by Michael Monck, Jenny Gordon and Kevin Hanslow, The Centre for International Economics for the Rural Industries Research and Development Corporation.

RIRDC (2009) *Pollination Five-Year R&D Plan 2009-2014*, report for the Rural Industries Research and Development Corporation. Available at: <https://rirdc.infoservices.com.au/items/09-125>

RIRDC (2010) *Pollination Aware: The real value of pollination in Australia*, report prepared by Robert C Keogh, Anthony PW Robinson and Ian J Mullins, Strategen Environmental Consultants to the Rural Industries Research and Development Corporation and Horticulture Australia Limited. Available at: <https://rirdc.infoservices.com.au/items/10-081>

(Includes 35 individual case studies)

RIRDC (2012) *An Investigation into the Therapeutic Properties of Honey*, report prepared by Dee Carter, Shona Blair, Julie Irish.

Pollination Australia (2008) *Business Plan*, report to the Rural Industries Research and Development Corporation, the Department of Agriculture, Fisheries and Forestry and Horticulture Australia Limited.

Plant Health Australia (2012) *Biosecurity Manual for the Honey Bee Industry; reducing the risk of exotic and established pests affecting honey bees*. Available at: <http://www.animalhealthaustralia.com.au/wp-content/uploads/2012/11/Biosecurity-Manual-for-the-Honey-Bee-Industry.pdf>

RIRDC (2012) *Honeybee Research, Development and Extension Plan 2012-2017*. Available at www.rirdc.gov.au/docs/default-document-library/the-honeybee-five-year-r-and-d-plan-2012-2017.pdf?sfvrsn=0

UNEP (2010) *United National Environment Program Emerging Issues: Global Honey Bee Colony Disorder and Other Threats to Insect Pollinators*. Available at: www.unep.org/dewa/Portals/67/pdf/Global_Bee_Colony_Disorder_and_Threats_insect_pollinators.pdf

Honeybee R&D Program: www.rirdc.gov.au/research-programs/animal-industries/honey-bee

Pollination R&D Program: www.rirdc.gov.au/research-programs/rural-people-issues/pollination