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Rural Industries Research and Development Corporation

Pollination Australia

Biosecurity risk management

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Foreword

This report informs the pollination industry on issues relevant to the identification and the quantification of the risk associated with the incursion of Varroa mite (and other exotic pests and diseases) and the risk associated with structural change to the honeybee industry and pollination dependent industries.

The report is concerned with highlighting the key issues that need to be considered in identifying, prioritising and actioning strategies to manage the risks for pollinators and growers dependent upon pollination for the production of crops. Investment in risk management strategies will assist in securing reliable, consistent quality and cost effective pollination services, without which many Australian rural industries would not be productive.

The project has its genesis in the Honeybee Industry Linkages workshop hosted by the Rural Industries Research and Development Corporation (RIRDC) in Canberra in April 2007, funded by the Department of Agriculture, Fisheries and Forestry (DAFF) under its Advancing Agricultural Industries Programme (Advancing Industries) and by RIRDC. The workshop was attended by stakeholders across a range of pollination dependent industries.

At that workshop the pollination industry agreed to form an entity known as Pollination Australia, prepare a business plan for that entity and complete three linked consultancies to inform the business plan. The consultancies included a risk management assessment, an education and training strategy for the pollination industry and a Research and Development (R&D) strategy. This report is the outcome of the first consultancy. Advancing Industries and RIRDC are providing support for the formation of the industry alliance and for development and endorsement of the business plan.

Pollination Australia is intended to be an industry alliance between the honeybee industry as providers of pollination services and those horticultural and agricultural industries that are dependent on honeybee pollination.

All industries with a dependency on pollination services, should consider the possible strategies suggested and participate in planned industry decision-making.

This report has been prepared as part of a project for the Australian Government's Advancing Agricultural Industries Program and the Rural Industries Research and Development Corporation by Dr Rob Keogh, Impact Consulting Group.

This report, an addition to RIRDC's diverse range of over 1800 research publications, forms part of our Honeybee R&D program, which aims to improve the productivity and profitability of the Australian beekeeping industry.

Most of our publications are available for viewing, downloading or purchasing online through our website:

- downloads at www.rirdc.gov.au/fullreports/index.html
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Peter O'Brien

Managing Director

Rural Industries Research and Development Corporation

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Abbreviations

| | |
|-------|--|
| AHA | Animal Health Australia |
| AHBIC | Australian Honeybee Industry Council |
| CCD | Colony Collapse Disorder |
| CIE | Centre for International Economics |
| DAFF | Australian Government Department of Agriculture Fisheries and Forestry |
| DPI | Department of Primary Industries |
| EADRA | Emergency Animal Disease Response Agreement |
| EPPRD | Emergency Plant Pest Response Deed |
| HAL | Horticulture Australia Limited |
| PHA | Plant Health Australia |
| QA | Quality Assurance |
| R&D | Research and Development |
| RIRDC | Rural Industries Research and Development Corporation |
| SHB | Small Hive Beetle |

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Executive summary

What the report is about?

This report on biosecurity management is one of three studies that were undertaken to develop a comprehensive business plan for the Australian pollination industry. The two other components (presented here) review research and development requirements and develop an education and training needs strategy for the pollination industry.

Who is the report targeted at?

The report is targeted at all who have an interest in pollination industry in Australia including beekeepers; those who grow pollination dependent crops and those who service support and regulate these activities.

Background

- Contribution of pollination

The contribution of pollination to Australia's agricultural and horticultural industries, argued by some to be critical to production and worth up to \$3 billion annually, is not widely appreciated.

Active feral honeybee colonies are widespread in regional areas, ensuring reasonable levels of incidental pollination, and represent a significant component of the total pollination.

The prevalence of feral bees tends to obscure the need for, and optimal management of, managed honeybee colonies in many pollination-dependent industries.

Conversely, the prime focus of the apiary industry in Australia has traditionally been upon the production of honey with the provision of managed pollination services forming a smaller part of the industry. Only a small number of beekeepers are specialised in providing managed pollination services.

- Future of pollination

The recent advent and rapid growth of large-scale almond production, which has a high dependence upon and demand for managed pollination services, is one of three key emerging factors likely to shape the honey production and pollination industry in this country. The other two key factors are an increased risk of disease incursions and a threats to the continuity of access to floral resources for apiarists.

The impact of the rapidly growing almond industry is likely to be two-fold:

- precipitating a restructuring of arrangements within the apiary industry to meet the scale and intensity of required pollination services
- defining a new standard for the quality of management of both elements of the pollination industry.

The threat of an incursion into Australia of a serious pest or disease, particularly Varroa mite, which if it became endemic would:

- decimate the feral honeybee population, eliminating it as an effective contributor to the provision of pollination services
- significantly increase the intensity of management and cost of inputs required to maintain managed honeybee colonies in a condition required to provide pollination services
- contribute to an increase in demand for, and the cost of, managed pollination services.

The balance between the demand for, and supply of, melliferous floral resources are essential to maintain a viable base of honey production for the Australian apiary industry. Access to these resources also enables beekeepers to provide pollination services. Access to native forests, especially the *Myrtaceae* and *Proteacea* families, are of particular importance for these purposes.

Methods Used

This study has applied the Australian Standard for Risk Management (AS4306¹) to identify, evaluate and assess the principal risks facing the Australian pollination industry and to guide the development of strategies to address and ameliorate these risks.

Key Findings

- Biosecurity risks to pollination

A prime focus of this study has been the risks associated with an incursion of an exotic pest or disease of significance to the pollination industry and, in particular, the mite *Varroa destructor* (Varroa mite). Research and consultation undertaken as part of this study suggest that the pollination industry should have a broader view of pests and diseases that threaten the industry than has been anticipated. Four broad areas that require attention include:

1. Pests and diseases of honeybees that would impact upon the cost and availability of supply of pollination services.
2. Pests and diseases of major pollination crops or floral resources that would affect demand for, and provision of, pollination services.
3. Pests and diseases of plants that are vectored by bees which, if they spread in Australia, could result in bee movement restrictions, thus impacting upon the ability of beekeepers to provide pollination services.
4. Other pests and diseases of plants or animals that, if spread to Australia, could give rise to spill-over effects that restrict the movement of bees.

- Varroa

Whilst as in other countries, it is likely that the potential impact of a Varroa incursion into Australia will take some years to be fully realised, the ultimate effect of an incursion could be more damaging than has been experienced elsewhere.

One reason for such an outcome could be the relatively high prevalence and wide distribution of feral honeybee colonies in Australia and the consequent heavier dependence on the contribution these feral populations make to the pollination of commercial plants in this country.

Given the highly negative impacts of Varroa in other places and the possibility of a worse outcome here, every reasonable effort should be made to:

- ensure its exclusion and early detection; and
- eradicate it if and when detected.

Such efforts should include enhanced surveillance and response preparedness and a review of the national expertise required to assist these efforts.

On the basis of cryptic nature of the pest, the recent experience with Small Hive Beetle (SHB) in Australia and Varroa in the USA and New Zealand, the pollination industry and government response agencies should recognise and prepare for the likelihood that following first detection of Varroa, it will quickly be discovered that the pest is well established and beyond eradication.

¹ Standards Australia, 2004

Given this prospect, it is essential that interested parties and/or parties with a statutory responsibility for responding to and managing pest and disease incursions, have agreed in advance on the processes and protocols for national coordination and conduct of a containment/management plan. This would help to minimise the spread of the pest and the disruption to the pollination and apiary industries.

- **Responding to an incursion**

Plant Health Australia (PHA) and Animal Health Australia (AHA) are organisations established by the Commonwealth and State/Territory Governments and relevant rural industry bodies to coordinate national pest and disease emergency response and management plans. Together PHA and AHA represent all of the parties involved in the pollination industry and all of the parties involved in responding to and managing pests and diseases². It is PHA and AHA that should coordinate the development of the national processes and protocols to coordinate and conduct containment and/or management plans..

A key requirement for any response or management program is the real-time identification and tracing of the national stock of managed honeybee colonies. Current arrangements do not satisfy prevailing best practice standards and should be upgraded.

Implications for relevant stakeholders

With regard to the growth and development of the pollination industry, including the need to increase knowledge and standards of management on either side of the pollination industry, there is a need for a **research program** to provide the basis for optimising and continuously improving the management of pollination services and a **training and education program** to devolve the outputs from the research program throughout the industry.

The combination of an expansion of pollination-dependent industries and an incursion of a pest or disease, such as *Varroa*, would result in a significant increase in the number of:

- managed honeybee colonies required to meet an increased demand for pollination services
- people skilled in the management of bees and pollination to service the additional colonies.

The pollination process and biosecurity management across the pollination supply chain are currently under-represented in **biosecurity** and **quality assurance** programs within both the apiary and horticultural industries. Enhancing the status of pollination and its biosecurity management in such programs would contribute to an improvement in the standards of pollination management and would assist in minimising the incidence and impact of pests and diseases on the pollination industry.

With regard to access, availability and allocation of floral resources for the apiary industry, there is an apparent deficiency in basic information at a national level on the:

- current and projected demand for and supply of native floral resources
- impact of a pest or disease, such as *Varroa*, on this balance.

With this information to hand, there are also needs to:

- understand and address the issues that have led to beekeeper exclusion from some of these floral resources
- ensure that allowed access achieves efficient utilisation of these resources
- develop alternative options including improved ‘artificial’ nutrition regimes.

Although evidence from other countries would appear to suggest that, even in the presence of *Varroa*, honeybees will remain the dominant agent for large-scale pollination, there is a case for extending

² PHA and AHA also have member industries that are not directly involved in the pollination industry.

research into the usefulness of other agents, particularly native Australian bees for the provision of pollination services, especially in specialist small-scale applications.

Recommended strategies

To manage the risks facing the pollination industry, strategies and actions proposed in this report are summarised below.

Strategy 1: Minimise the risk of incursion of exotic pests and diseases

- Surveillance
- Quarantine
- Biosecurity planning
- Research and development

Strategy 2: Management of incursions of pests and diseases

- Emergency response planning
- National disease containment and management protocol
- Beehive identification and tracing
- Disease response and management training and simulations

Strategy 3: Enhance the capability and performance of the pollination industry

- Optimise efficiency of pollination management in Australia
- Pollination awareness training and education plan
- Coordination and articulation of pollination industry biosecurity and quality assurance plans

Strategy 4: Secure necessary floral resources

- Supply and demand for floral resources
- Access to and allocation of floral resources
- Biosecurity of floral resources

Strategy 5: Additional pollination options

- Native insect pollinators

1. Study purpose

1.1 Introduction

In April 2007, the Honeybee Industry Linkages Workshop was held. At this workshop, it was proposed that an industry alliance for Pollination Australia should be formed. The Workshop:

- gave rise to a project to produce a Business Plan for the Australian pollination industry
- identified the major risks to the pollination industry in Australia as:
 - the incursion of Varroa mite (*Varroa destructor*) or other exotic bee pests and diseases
 - restricted access for apiarists to native floral resources
- specified the development of:
 - a Biosecurity Risk Management Strategy for the pollination industry
 - a Biosecurity Research and Development Plan for the pollination industry
 - an Education and Training Strategy for the pollination industry

These three documents will form part of the Pollination Industry Business Plan that is being developed for Pollination Australia by the Centre for International Economics (CIE). CIE is also undertaking an additional assignment to investigate the economic aspects of the current pollination industry and assess likely future developments and potential.

This report documents a comprehensive risk management strategy that includes a national contingency plan for Varroa mite and other exotic pests and diseases. There are two primary elements to the development of the strategy:

- a comprehensive risk assessment to identify and quantify the risk associated with the incursion of the Varroa mite (and other pests and diseases) and the risk associated with structural change that could occur to the honeybee industry and the pollination-dependent industries
- development of a risk management strategy based on the findings from the risk assessment.

Impact Consulting Group completed this study for the Rural Industries Research and Development Corporation (RIRDC) and the Department of Agriculture, Fisheries and Forestry between October 2007 and February 2008. RIRDC managed the study on behalf of the industry and other bodies that intend to form Pollination Australia. The study was a component of a broader project, funded under the DAFF Advancing Industries programme, for the formation of the Pollination Australia industry alliance and for development and endorsement of a business plan.

1.2 Objectives

The key objective of the study is to make a significant contribution to the development of the business plan for the pollination industry that:

- has full backing by the industry participants
- can be independently administered by an industry based alliance/organisation
- can be maintained under continued industry funding.

Outcomes from the study and parallel examinations of education and training, and research and development, will be discussed in a workshop of future Pollination Australia alliance members to be held in March 2008. It will also be used to develop immediate directions that an alliance can work towards within the framework of the business plan that is being prepared by the CIE. It is expected that the business plan will be completed by June 2008.

Development of a comprehensive risk management strategy is to include a national contingency plan for Varroa mite and other exotic pests and diseases, incorporating two primary parts:

- to undertake a comprehensive risk assessment that identifies and quantifies:
 - the risk associated with the incursion of Varroa mite (and other exotic pests and diseases)
 - the risk associated with structural change that could occur to the honeybee industry and pollination dependent industries
 - the probability of incursion and the likely spread dynamics and timing of exotic pests and disease incursions and their direct impact on the development of effective risk management strategies
- to develop a risk management strategy based on the findings from the risk assessment, applicable to pre and post exotic pests and disease incursions
 - incorporating a plan to reduce the impact of exotic pests and diseases if they arrive
 - encompassing three primary choices the Industry Alliance will need to determine regarding the direction for the industry to pursue in mitigating risks associated with the pollination industry. For example:
 - developing a strategy that only focuses on reducing the possibility of exotic pests and disease from establishing in Australia
 - developing a strategy that focuses on managing the spread of exotic pests and diseases that establish in Australia, whilst enabling the pollination industry and pollination-dependent industries to adjust to economic impacts that the exotic pests and diseases may induce
 - prior to the entry of additional exotic pests and disease into Australia, building a pollination industry that can manage an incursion and minimise the biosecurity and economic impact, whilst dealing with additional demands placed upon the industry regardless of an incursion (e.g., ensuring a viable pollination industry to meet the expected increase in demand for services from the almond industry).

These options are not mutually exclusive, but require alternative risk management strategies and individual assessment to provide the Industry Alliance with a set of choices when setting directions within the Business Plan.

The consultancy will also have to investigate the **short term adjustment needs** of the pollination industry, for example:

- prevention of entry strategies
- early warning systems
- emergency response preparedness
- management strategies for pollinators
- more long term adjustment issues, for example, access to floral resources and expected demand and supply of pollination services regardless of an exotic pest and disease incursion.

The risk management strategies will:

- focus on biosecurity issues
- recognise that:
 - the honeybee industry and pollination-dependent industries are interdependent
 - any structural change in the apiary industry will have flow-on effects
 - if the process of structural change in the apiary industry is not managed properly there could be large costs imposed upon the pollination dependant industries.

The consultancy has considered the experiences of other countries (especially the United States and New Zealand) in dealing with their Varroa mite and other exotic pests and disease incursions and has evaluated the risk management strategies that are in place.

The consultancy has also considered quarantine, state issues, policy development and the likely co-operation/coordination that could be generated from Plant Health Australia (PHA) and Animal Health Australia (AHA).

The early focus of the study was on one of the number of pests and diseases that pose risks to the pollination industry in Australia, the Varroa Mite (*Varroa destructor*).

There are other organisms that pose significant risk to pollination in Australia and the focus on Varroa was adopted as an efficient means of understanding the key biological, operational and commercial relationships that are involved in the pollination industry in Australia and as Varroa is widely regarded as the most severe and imminent risk facing the Australian industry.

Furthermore, on the basis of the work undertaken, it is readily apparent that the risks posed by Varroa can reasonably be regarded as broadly representative of those posed by the other pests and some of the diseases threatening the pollination industry in Australia

Biosecurity issues are not the only source of risk factors for the pollination industry. Others include:

- access to pollen and nectar resources, especially access to native forests
- climate change issues
- future research capacity and availability of experienced researchers
- industry restructuring and the development of pollination brokerage entities.

The risk factors being studied in detail in this project and the development of risk management strategies for biosecurity will provide input into consideration of the R&D gaps and priorities. Further, the outcomes of this consultancy will be taken up by the CIE in its development of a business plan for the proposed Pollination Australia.

2. Risk management process

2.1 Steps in the risk management process

The Comprehensive Risk Management Strategy is being completed in seven stages:

1. Project inception.
2. Pollination Industry Relationships and Supply Chain Mapping.
3. Application of the Risk Management Framework.
4. Preparation of the Risk Assessment Strategy.
5. Draft Risk Management Strategy Report prepared and submitted.
6. Final Risk Management Strategy Report submitted.
7. Presentation to Industry Alliance members.

The approach involves the application of the Risk Management Framework, prepared by AHA³, to assess any risks inherent in the pollination industry across all its segments and specifically, the honeybee industry, providing:

- a high level risk assessment
- a mechanism for each of the stakeholders in the pollination industry to understand the likely specific risks resulting from its application.

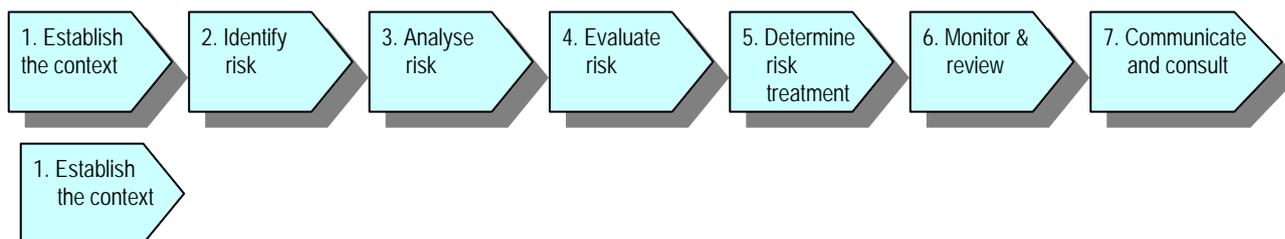
The assessment is using the Risk Management Framework which itself is modelled on the Australian Standard Risk Management Process (AS 4360), as outlined in the Figure 2.1.

³ AHA, 2003a

Figure 2.1 Risk Management Process AS4360

| | |
|--|--|
| 1. Establish the context | |
| Establish the strategic context | |
| Establish the organisational context | |
| Establish the risk management context | |
| Develop risk evaluation criteria | |
| Define the structure | |
| 2. Risk identification | |
| What can happen | |
| How and why it can happen | |
| Tools and techniques | |
| 3. Risk analysis | |
| Determine existing controls | |
| Consequences and likelihood | |
| Types of analysis | |
| Sensitivity analysis | |
| 4. Risk evaluation | |
| 5. Risk treatment | |
| Identifying options for risk treatment | |
| Assessing risk treatment options | |
| Preparing treatment plans | |
| Implementing treatment plans | |
| 6. Monitoring and review | |
| 7. Communication and consultation | |

The following diagram shows the overall steps in the application of the Risk Management Framework in undertaking the risk assessment of the operations of the pollination industry. It is taken from the Risk Management User Manual, prepared for AHA by Impact Consulting Group in March 2005. The risk assessment of the pollination industry will address steps 1 to 5, with the emphasis on steps 2 to 5.



1 Establish the context

The context is the pollination industry as it operates in Australia, in relation to the honeybee industry and pollination dependent industries and can be defined in terms of:

- the main entities involved – for example, AHA, PHA, Commonwealth, State and Territory Governments and the pollination industry organisations, particularly the Australian Honeybee Industry Council and Horticulture Australia Limited (HAL)
- the relationship between the pollination industry strategic objectives and the management of all the risks to which it is exposed
- the relationship between the pollination industry and the broader environment
- stakeholders - internal and external, their objectives, perceptions.



2 Identify risk

This step involves listing the main risks and categorising them in terms of:

- source of risk
- area of impact
- related performance measures.

Much work has already been done through developing the National Animal Health Performance Standards and the National Plant Pest Risk Mitigation Program. By determining the risks that are being addressed by the relevant biosecurity plans and through each performance measure, most of the risks should be identifiable.

The full list of risks then needs to be looked at from the point of view of the Source of Risk categories.



3 Analyse risk

The objectives of the risk analysis are to:

- separate the minor acceptable risks from the major risks
- provide data to assist in the evaluation and treatment of risks.

Risk analysis involves consideration of:

- sources of risk
- their consequences
- the likelihood that those consequences may occur.

Risk is analysed by combining estimates of consequences and likelihood in the context of existing control measures.



4. Evaluate risk

4 Evaluate risk

In this step, the level of risk found during the analysis process (Step 3) is compared with any previously established risk criteria, and

- the list of risks is prioritised for further action
- negligible, low and medium risks are monitored



5. Determine risk treatment

5 Determine risk treatment

For each risk categorised as high or extreme (and moderate risk if desired), a risk treatment strategy is developed with the aim of reducing the risk rating.



6. Monitor & review

6 Monitor and review

The entire risk management plan needs to be reviewed and updated at regular intervals and amended to take account of new risks and changes within the organisation or the broader environment that may impact on risk to the pollination industry. The timing of the risk assessment process should immediately precede the industry's internal business planning process to enable key risk management initiatives to be implemented and funded.



7. Communicate and consult

7 Communicate and consult

A communication and consultation strategy is ideally developed at the beginning of the process and implemented. The strategy will, at a minimum, address communication and consultation with:

- staff of jurisdictions and industry organisations
- stakeholders, including:
 - other jurisdictions
 - pollination industry organisations and/or industry organisations concerned with pollination
 - PHA
 - AHA.

Sources of risk

The sources of risk are listed in the following table. Not all will apply to the pollination industry. Where they are applicable, they will vary in terms of their impact on the industry.

Table 2.1 Sources of Risk

| Risk source | Risk source description |
|---------------------------------------|---|
| Bee disease | A fundamental source of risk to the Animal Health System. This source of risk can include those diseases of domestic and feral bees as well as other diseases of livestock and other domestic and native animals. |
| Plant disease | A fundamental source of risk to the Plant Health System. This source of risk can include those pests and diseases of pollination-dependent crops and pastures that are covered under the plant health system, as well as other diseases of domestic and native plants. |
| Economic | A broad category of risk, which would include specific sources such as: <ul style="list-style-type: none"> ▪ national or global economic conditions affecting: <ul style="list-style-type: none"> - government budgets and the amount of funds allocated or available to manage the animal health and/or the plant health systems - Income of pollination industry stakeholders and the extent to which they can manage honeybee and other pollinator health and/or plant health ▪ pollinator numbers in Australia and the impact of changes on the distribution of livestock, livestock movements ▪ international trade and market access, with decisions which impact on the pollinator health system ▪ changes to the fundamental structure of the pollinator industry (e.g. through industry rationalisation and restructure, major changes elsewhere in the value chain etc). |
| Organisation and management | Given the large number of entities involved in the animal and plant health systems, the sources of risk could include, for example: <ul style="list-style-type: none"> ▪ loss of knowledge and skills within the organisations responsible for managing the animal and plant health systems ▪ changes to availability of resources within organisations, including people, funding, equipment, facilities, laboratories etc ▪ changes to decision-making structures within and between organisations that have a detrimental effect on the ability to manage the animal and plant health systems ▪ impairment of relationships between the different entities involved in managing the animal and plant health systems (e.g. loss of trust, communication breakdown etc). |
| Environment and natural events | This would include natural disasters such as fire and flood, as well as normal natural events (cyclic climatic conditions etc) and fundamental changes in weather patterns (global warming as well as other sources related to the natural environment). <p>The risks in this category are varied, for example: increased risk of a disease outbreak following a natural disaster, competition for scarce resources (e.g. water) in the event of a natural disaster or climatic changes in land use patterns, or disease and vector distribution due to climate change.</p> |
| Community and human behaviour | This would include more general sources of risk from the general community or particular local communities. <p>Examples include: a lessening of community knowledge and/or vigilance to guard against the introduction of disease, changing community attitudes towards animal and/ or plant health issues such as quarantine, importance of livestock and crop</p> |

| Risk source | Risk source description |
|---------------------------------|---|
| | production, animal welfare etc which adversely affects the behaviour of individuals in the context of animal and plant health. |
| Commercial and legal | <p>There are various commercial, financial and legal risks that could pose a threat to the animal and/or plant health systems that can be described as emanating from sources under a commercial and legal category.</p> <p>Examples of events under this source of risk category are:</p> <ul style="list-style-type: none"> ▪ inadequate or inconsistent legislative protection across all jurisdictions, which impairs the ability to implement decisions that need to be made to protect the animal health status of livestock industries and the plant health status of pollination-dependent industries in Australia ▪ commercial decisions made by pollination industry producers or others in the value chain which may impact on the animal and/or plant health systems, particularly in those industries in which there are a small number of very large producers ▪ a major lawsuit against one or more of the organisations that have a role in providing advice or services under the animal and/or plant health systems (e.g. improper action or advice by a jurisdiction during an emergency animal or plant disease outbreak, lack of vigilance by AQIS in preventing diseased livestock from entering Australia etc). |
| Political | <p>This risk category includes any source of risk related to the political environment at the global, national, state/territory and local level.</p> <p>Examples include:</p> <ul style="list-style-type: none"> ▪ a government making a decision on the priority given to managing the animal and plant health systems (e.g. especially reducing the priority) ▪ a government changing the design of the animal and/or plant health system or delivery of animal and/or plant health services ▪ lobbying efforts which impact on the animal and plant health systems and/or force changes in agricultural practices including those of beekeepers e.g. exclusion of beekeepers from public lands ▪ changes in the political balance or priorities internationally, to which Australian governments must respond, and which have an impact on the pollination industries. |
| Sabotage | This would include threats or actions of deliberate sabotage by persons, for reasons of terrorism or other motives, which impact on the animal and/or plant health systems. |
| Technology | <p>This source of risk category covers any risk source relating to technology and systems, including mechanical, electronic and genetic engineering technologies and communication and information systems.</p> <p>Examples include:</p> <ul style="list-style-type: none"> ▪ new diagnostic techniques for animal and plant disease ▪ new plant and animal breeding and selection systems ▪ livestock tracing systems ▪ improved agricultural production systems ▪ better communication systems and information management systems. |
| Regulation and standards | This source of risk category covers any risk source relating to the regulatory system, including Acts, regulations, codes of practice, standards etc. |

Areas of Impact

The areas of impact are listed in the following table.

Table 2.2 Areas of Impact

| Area of impact | Description |
|-----------------------------------|---|
| Livestock and plant health | A direct impact on the health of domestic bees and/or pollination-dependent crops. |
| Human health | A direct or indirect threat to the health of humans. |
| Economic | An impact on any aspect of the economy, including: <ul style="list-style-type: none"> ▪ access to local or international markets ▪ other impact on the national, State or local economy. |
| Commercial | An impact on commercial activities or operations of an individual, group or sector, for example: <ul style="list-style-type: none"> ▪ impact on the financial status of individual producers ▪ impact on the financial status of other businesses in the value chain ▪ impact on financial status of businesses and individuals in a particular geographic area (such as a declared emergency animal disease area) ▪ impact on the ability of any of the above to carry on with normal business activities (business interruption). |
| Environmental | Impact on the natural environment, including flora, fauna, waterways, soil, air, general ecosystem. |
| Organisational capability | Impact on the ability of organisations involved in managing the animal and plant health systems, individually and collectively, for example: <ul style="list-style-type: none"> ▪ governance structures and systems (of the animal and plant health system) ▪ decision-making at the national level and within jurisdictions and industries (collaborative decision-making and internal decision-making) ▪ knowledge base ▪ resource availability, including capable people ▪ technical capacity and technical capability ▪ communication ▪ relationships. |
| Political | Impact on Federal, State/Territory and Local Governments, on political parties and individual politicians. |
| Reputation and image | Generally this would be covered by or related to Economic or Political areas of impact, but may be considered an area of impact in its own right. The area of impact could include the reputation and image of: <ul style="list-style-type: none"> ▪ Australia – reputation as viewed by other individual nations, the international community as a whole, the people of Australia themselves ▪ State or Territory Governments. ▪ honeybee or pollination dependent industries. |

3. Pollination of commercial plant species in Australia

Importance of honeybee pollination to Australian industries⁴

3.1.1 The broad context

It is said that approximately 65 per cent of horticultural and agricultural production in Australia relies to some extent on pollination to achieve its potential⁵. There are three dimensions to this claim to consider:

- the degree to which particular crops and enterprises rely on pollination varies from the essential to the marginal
- the directness of the impact of pollination on production varies from direct to remote
- the involvement of honeybees, and managed honeybee colonies in particular, in performing the pollination service varies from central to incidental.

At one end of the scale sits the almond industry where there is a direct and immediate correlation between yield and pollination and where the relationship is so direct and important that to ensure adequate pollination an almond producer will almost always contract for managed hives to be located within the almond grove while the trees are flowering to provide pollination services.

At the other extreme might be a commercial dairying operation where pollination of the white clover component of the pasture currently performed primarily at no cost to the enterprise, by feral bees and other incidental pollinators might cease over time. The farmer would eventually observe a change in the composition of the pasture and experience a more frequent need to re-sow to maintain the clover component and/or be required to apply additional nitrogen fertiliser to replace the reduction in soil nitrogen attributable to the clover⁶.

At other points along the scale lie:

- **horticultural crops**, grown in glasshouses for which pollination is essential but for which honeybees are but one of a range of available or potential pollination agents
- **fruit crops**, such as apples and cherries
 - the importance of pollination varies between varieties
 - the impact, in the extreme, might be measured in yield but might also be expressed as fruit quality or storage properties
 - pollination is often by feral bees supplemented with some managed colonies
- **vegetable crops**, such as onions and broccoli
 - the production of the commercial crop (the bulb or head) has no direct requirement for pollination
 - however the production of seed for future crops is heavily and directly reliant on pollination usually provided using managed honeybee colonies
- **legume pasture species** like Lucerne and White Clover
 - vegetative growth and the production of fodder or hay is independent of pollination
 - however, seed production requires pollination
 - harvesting and sale of seed is part of the commercial enterprise, managed colonies are commonly used

⁴ Some of the material in this section was prepared for the Honeybee Industry Linkages Workshop 2007 and is drawn from Gibbs and Muirhead, 1998, Gordon and Davis, 2003 and Cook *et al*, 2005. It is also drawn from the Briefing Paper on Research and Development in the Pollination Industry prepared in November 2007.

² Gordon and Davis 2003; CIE 2007

⁶ MAF 2002

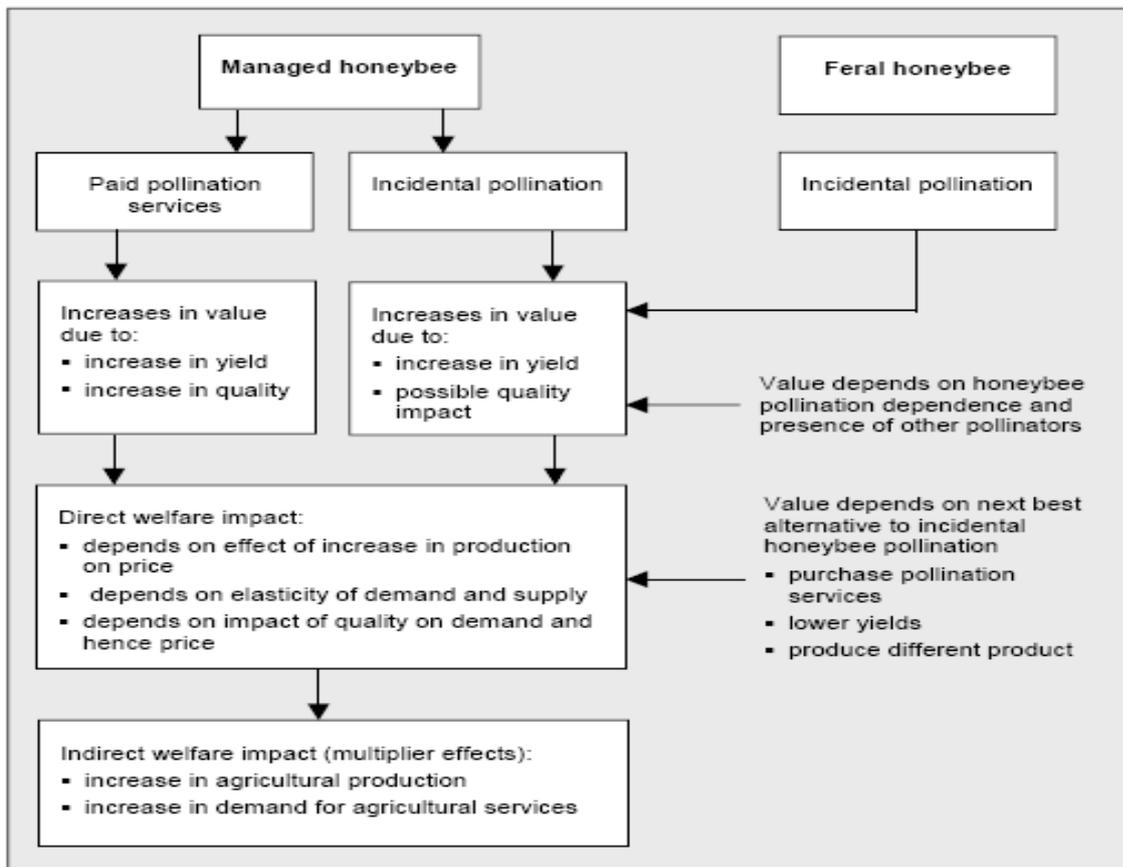
- **citrus crops**
 - there is a reliance on pollination, but
 - wind pollination is more important than the activity of insects including honeybees⁷
- the **Canola oilseed** production industry
 - generation of hybrid seed relies on honeybee pollination, but
 - paid pollination services are rarely used on broad-acre commercial crops despite research having demonstrated a yield response to pollination and which provide an important source of pollen and nectar to the honeybee industry⁸.

Off the scale lie enterprises seeking to produce “seedless” mandarins, where pollination is a distinct negative and efforts are made to exclude honeybees and other pollination agents from the orchard during flowering.

The quantum of pollination service provided may range from a single small hive to service a variety breeding and selection program being conducted by a commercial seed supplier, in a one metre square ‘tent’ to 30,000 hives used to pollinate a 5,000 ha almond enterprise.

Figure 3.1 depicts a flow diagram of the role that honeybees play in the horticulture and broad-acre industries that require pollination.

Figure 3.1 Economic Benefits Attributable to Honeybee Pollination Services



Data source: Gordon and Davis 2003

Honeybee pollination provides significant value to Australian horticulture and agriculture with the derived benefit being estimated at \$1.7 billion per annum in 1999-2000 for the 35 most important

⁷ Canard, M; personal communication November 2007

⁸ Somerville 2002a; Bourke, L; personal communication date December 2007; Salisbury P; personal communication January 2008

honeybee dependent crops⁹. When other crops, including pastures such as lucerne and clover, are added this estimate becomes even larger. If honeybee pollination were to stop completely, large losses would be felt in a horticultural sector that produces around \$3.8 billion per annum.

Pollination can be effected by:

- the wind
- feral honeybees
- paid pollination services by managed honeybees
- incidental and unpaid pollination by honeybees managed to produce honey or provide pollination services to other nearby crops
- by a range of other pollination agents including:
 - insects other than honeybees
 - birds
 - some smaller mammals
 - by **some combination of these factors.**

Paid pollination involves the grower contracting with an apiarist to place bee colonies on the grower's land in order for the bees to pollinate the grower's crop.

With **incidental pollination** by managed honeybees, the apiarist's specific purpose is either to produce honey or provide pollination services to some third party and pollination of the crop in question is a positive externality received by growers.

Figure 3.1 does not address pollination performed by agents other than honeybees. As indicated above, such agents are numerous but their contribution to agriculture in Australia while important in some instances, is relatively minor in total and these agents are not considered in detail in this study.

Further, Figure 3.1 does not address the non-monetary impacts for the apiarist providing the bees to perform the pollination services. Depending on the nature and condition of the crop being pollinated and the quality of the management of the crop and the bees providing the services, these impacts may be positive, neutral or negative.

Optimal circumstances occur where:

- the crop being pollinated provides a good balance of nectar and pollen of appropriate quality,
- competition between bees is managed to match the resources available
- there is nothing deleterious to the bees about the management of the crop being pollinated
- the colonies provided by the apiarist may complete the pollination service in strong conditions
- the harvest of honey supplements the monetary consideration paid by the grower for the pollination services provided.

Where managed bees are involved in the provision of pollination services under optimal circumstances, there can be benefits to the apiarist in the form of an additional income stream and in some instances supplementary production of honey and possibly an improvement in hive health and colony strength.

Non optimal circumstances occur where:

- a hive is located in a crop of a species that does not provide a good balance of nectar and pollen or for which the pollen is of undesirable quality
- the number of bees competing for the available resources is not well managed
- the crop is treated with chemicals that are adverse to the health of bees
- unfavourable weather conditions prevail during the pollination period.

⁹ Gordon and Davis, 2003

In these circumstances, the apiarist may find at the conclusion of the pollination contract that the colony is severely weakened and may require a significant investment of time and care to restore it to a condition in which it can be of further commercial value.

Both paid honeybee pollination services and incidental honeybee pollination increase the value of crops to growers through an increase in yield and/or an increase in quality. The outcome is that pollination has a direct impact on the economic welfare of those growers who benefit from pollination services.

In addition, there are general positive benefits:

- to the entire agricultural industry due to the flow-on effects that arise from an increase in the value of crops
- to consumers as it increases production (thereby putting downward pressure on prices) while providing better quality products.

Consequently any risk to the availability of honeybee pollination services can lead to a potential loss in the economic welfare of growers, apiarists and consumers. Losses from the absence of pollination services would be split between:

- producers who would forfeit horticulture and broad acre crop income
- apiarists who would lose an alternative source of income and other possible benefits
- consumers who would suffer the impacts of a reduction in the supply and/or an increase in the cost of many fresh fruits, nuts, vegetables and honey.

Although some of these crops could be replaced through imports, Australia's capacity to import many of the affected products would be limited by quarantine restrictions. Consequently, prices for the reduced supply of fresh fruits, vegetables, nuts and honey could be driven up by the reduction in supply, thereby reducing access to these products and potentially reducing consumer welfare.

Gordon and Davis¹⁰ have estimated that if honeybee pollination had stopped completely in 1999/2000, the agricultural industry would have experienced a loss of around \$1.7 billion in production and consumption, resulting in the loss of around 9,500 jobs. It was also estimated that there would have been short-term flow-on effects which would add an additional \$2 billion loss to agricultural industry output and a further 11,000 lost jobs. Partial loss in pollination services would also have resulted in major economic costs. For example, if dependence on pollination were half the level assessed by Gordon and Davis, the direct loss to Australia would have been \$0.6 billion per annum, reinforcing the importance of honeybee pollination to the agricultural industry. Inclusion of pasture species and the full range of agricultural crops only increase this impact.

For reasons outlined below, a more considered analysis indicates that the catastrophic premise upon which the above conclusions are based, is somewhat exaggerated.

3.2 The significance of pests and diseases

Varroa mite is cited as the major threat to the Australian honeybee industry and thereby to the pollination industry in this country. However, *Varroa* is not the only significant threat to the closely interdependent industries and the impact of any of the range of threats will depend upon the particular circumstances surrounding the realisation of the threat and the capability and quality of the response by the affected industries and relevant authorities.

The evidence from other parts of the world where one or more of these threats, including *Varroa*, has come to pass, is that **there is no biological process that would result in the immediate or total cessation in the availability of pollination services**. Even untreated, *Varroa* takes about a year to destroy a colony. Its geographic spread, whilst apparently inexorable, is relatively slow and, as is the case in the USA and New Zealand, at least there are means by which capable and committed apiarists

¹⁰ Gordon and Davis, 2003

can, in the presence of Varroa, manage hives to provide effective, albeit more costly, pollination services.

Whilst it is extremely unlikely that any biological threat could have a direct and severe ‘overnight’ impact on the pollination industry, regulatory restrictions on the movement of bees in the event of the presence of Varroa or one of the other serious biological threats being detected in Australia, could have an immediate and significant negative repercussion for the industry.

The prospect facing the pollination industry in Australia in the event of a threat such as Varroa being detected and eradication not attempted because it is determined that it could not be achieved, is that:

- over a period of two to five years, populations of feral bees would be decimated to the point that they could no longer be considered as significant or reliable providers of pollination
- more immediately, apiarists would incur significantly increased costs in monitoring, managing and maintaining colony strength in the presence of the disease.

Inevitably the higher costs would flow through to the users of paid pollination services, especially as, with the contribution from feral hives being severely discounted, the demand for paid services would be expected to increase.

The experience in other countries is that it is the apiary industry, more than those using pollination services, which are adversely affected by Varroa becoming established. The cost and effort required to maintain hives in the presence of Varroa has resulted in a consolidation of the commercial apiary industry into larger enterprises each managing a larger number of colonies¹¹.

If the current cost of operating a commercial apiary is about \$150 per hive per year and the additional management cost in the presence of Varroa is \$40 - \$50 per hive per year¹², the cost of Varroa in Australia might be of the order of \$32 million per year for the additional cost of managing the existing 650,000 hives and a further \$30 million to provide and manage an additional 150,000 hives to substitute for the loss of the contribution from feral bees.

For pollination service users the main effects would seem to be in terms of an increase in the costs of production due to the higher cost of pollination services rather than the loss of access to honeybee pollination services. Whether this would lead to a fundamental change in the economics of the enterprise would depend upon margins and returns within the industry and the particular enterprise. Only in a user industry on the edge of profitability would an incursion of Varroa be likely to result in a significant restructuring within that industry.

3 3 Crops dependent on honeybee pollination

The CIE has identified 35 Australian horticultural and agricultural crops to be included in the analysis of the market for pollination services in Australia¹³ and these are listed in Table 3.2. The 35 crops identified were ‘largely honeybee pollination-dependent’ and had readily available data. The list excludes other pasture crops, including lucerne and clover.

¹¹ Goodwin, 2004

¹² Goodwin, 2004; McDonald, B; personal communication, January 2008

¹³ CIE 2007, using a methodology developed by Gill, 1989

Table 3.2 Crops included in the Analysis of the Market for Pollination Services in Australia

| <i>Crop type</i> | <i>Dependence on honeybees^a</i> | <i>Crop type</i> | <i>Dependence on honeybees^a</i> |
|------------------|--|------------------|--|
| | Per cent | | Per cent |
| Almond | 100 | Lemon & Lime | 20 |
| Apple | 90 | Lettuce | 10 |
| Apricot | 70 | Lupin | 10 |
| Asparagus | 90 | Macadamia | 90 |
| Avocado | 100 | Mandarin | 30 |
| Bean | 10 | Mango | 90 |
| Blueberry | 100 | Nectarine | 60 |
| Broccoli | 100 | Onion | 100 |
| Brussels sprout | 30 | Orange | 30 |
| Cabbage | 30 | Papaya | 20 |
| Carrot | 100 | Peach | 60 |
| Cauliflower | 100 | Peanut | 10 |
| Celery | 100 | Pear | 50 |
| Cherries | 90 | Plum & prune | 70 |
| Cotton lint | 20 | Pumpkin | 90 |
| Cucumber | 90 | Strawberry | 40 |
| Grapefruit | 80 | Watermelon | 70 |
| Kiwi | 90 | | |

Our consultations with beekeepers, growers, and their representatives indicate:

- that the citrus crops listed rely more on pollination by the wind than bees or other biological agents, and that for the production of seedless mandarins growers make efforts to exclude potential insect pollinators¹⁴
- for many of the vegetables listed (onions, carrots, broccoli etc), pollination is required to produce seed but not for the production of the principal commercial crop
- crops excluded include hybrid Canola varieties and key pasture species such as lucerne and white clover, known to require pollination to achieve their potential seed-set and for which seed producers commonly pay for pollination services
- other crops, such as faba beans and other clover species¹⁵, are not currently considered to benefit from pollination but there is a belief that an economic return could be achieved with managed pollination.

With assistance from HAL, Table 3.3 has been prepared to better represent the pollination industry in Australia. Table 3.3 also indicates the principal periods of the year when pollination services are required for each of the plants listed. Those species for which the commercial value of pollination has yet to be demonstrated have been excluded.

Canola has also been included, because while pollination is essential for the generation of hybrid seed and non-hybrid Canola giving yield responses to pollination, a flowering Canola crop can provide a significant floral resource for many apiarists at a time of the year when alternatives capable of sustaining an improvement in colony strength may not be readily available¹⁶.

¹⁴ Canard, M; personal communication November 2007

¹⁵ Oakley, I; personal communication. January 2008

¹⁶ Somerville 2002a

Table 3.3 Period Pollination Services Required (after Sumner and Boriss, 2006)

| Crop | June | July | Aug | Sept | Oct | Nov | Dec | Jan | Feb | March | April | May | Key Production Areas | Comment |
|------------------|------|------|-----|------|-----|-----|-----|-----|-----|-------|-------|-----|--------------------------------------|---|
| Almond | | | ■ | | | | | | | | | | Riverland, Sunraysia, Riverina | Almonds highly pollination dependent |
| Apple | | | | | | ■ | | | | | | | | |
| Apricot | | ■ | ■ | ■ | | | | | | | | | Vic and NSW; SA, WA, QLD and TAS | Peak pollination occurs around August Bee pollination not required |
| Asparagus | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | Qld, NSW, Vic, WA | Variety of insect pollinators |
| Avocado | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | Most bean seeds are imported |
| Bean | | | | | | | | | | | | | | |
| Blueberry | | ■ | ■ | ■ | ■ | ■ | ■ | | | | | | Vic, Tas & Northern NSW | Oct-Nov for south; Jul-Sept for north |
| Broccoli | | | | ■ | ■ | ■ | ■ | | | | | | Tas, Vic | Pollination for seed production only |
| Brussels sprout | | | | ■ | ■ | ■ | ■ | | | | | | Tas, Vic | Pollination for seed production only |
| Cabbage, chinese | | | | | | | ■ | ■ | ■ | ■ | | | Tas, SE South Australia | Pollination for seed production only |
| Cabbage, other | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | Tas, Vic | Pollination for seed production only |
| Canola | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | All winter cereal growing areas | Pollination essential for hybrid seed |
| Carrot | | | | | | | ■ | ■ | ■ | ■ | | | Tas, (not verified in other states) | Pollination for seed production only |
| Cauliflower | | | | | | | ■ | ■ | ■ | ■ | | | Tas, Vic | Pollination for seed production only |
| Celery, parsley | | | | | | | ■ | ■ | ■ | ■ | | | Tas, SE South Australia | Pollination for seed production only |
| Cherries | | | | ■ | ■ | ■ | | | | | | | NSW, Vic, SA | |
| Cotton lint | | | | | | | | | | | | | | |
| Cucumber | | | | | | | | | | | | | | Pollination for seed production only |
| Grapefruit | | | | | | | | | | | | | | Bee pollination not critical |
| Kiwi fruit | | | | | ■ | ■ | ■ | ■ | ■ | ■ | | | | High bee densities required |
| Lemon & Lime | | | | | | | | | | | | | | Bee pollination not critical |
| Lettuce | | | | | | | | | | | | | SE Australia | Pollinated by wind; bees not critical |
| Lucerne | | | | | | | ■ | ■ | ■ | ■ | | | Southern Australia | Pollination only required for seed set. |
| Lupin | | | ■ | ■ | ■ | | | | | | | | Southern winter cereal growing areas | |
| Lychee | | ■ | ■ | ■ | | | | | | | | | Northern NSW & Qld | Various insects, services maybe used |
| Macadamia | | | ■ | ■ | ■ | ■ | | | | | | | Lismore, Gympie, Bundaberg regions | Bee pollination is critical |
| Mandarin | | | | | | | | | | | | | Victoria, NSW and SA. | Non pollinated seedless fruit preferred |
| Mango | ■ | ■ | ■ | ■ | | | | | | | | | Northern WA and NSW; NT & Qld | Various insects, services not used. |
| Nectarine | | ■ | ■ | ■ | ■ | | | | | | | | Vic and NSW; SA, WA, QLD and TAS | |
| Onion | | | | | | | ■ | ■ | ■ | ■ | | | | Pollination for seed production only |
| Orange | | | | | | | | | | | | | Vic and NSW; SA, WA, QLD and TAS | Bee pollination not critical |
| Papaya | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | Innisfail, Mareeba | Pollinated by Hawk Moths |
| Peach | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | Vic and NSW; SA, WA, QLD and TAS | |
| Pear | | | | ■ | ■ | ■ | | | | | | | | |
| Plum & prune | | ■ | ■ | ■ | ■ | | | | | | | | Vic and NSW; SA, WA, QLD and TAS | |
| Pumpkin | | | | | | | ■ | ■ | ■ | ■ | | | Qld, NSW, WA | Pollination for seed production only |
| Strawberry | ■ | | | ■ | ■ | ■ | | | | | | ■ | Qld; Vic, WA, SA, Tas | Bees and hand pollination used. |
| Watermelon | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | | |
| White Clover | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | Vic, Tas, SA and NSW | Pollination for seed production only |

3.4 Commercial pollination service supply chain

The Commercial Pollination Service Supply Chain involves a beekeeper delivering an agreed number of hives to a location specified by the pollination service customer on a specified date and leaving them there for an agreed period, usually a few weeks, to allow the bees to effect the pollination of the customer's crop or pasture.

Such a simple description grossly understates a process that may require the beekeeper to commence preparing the hives to perform the service months in advance and may render the hives so depleted in condition by the performance of the service, that they require a significant period of time with access to suitable supplies of pollen and nectar to recover before they can be of further commercial value to the beekeeper.

Such a description may also not adequately reflect the requirement for

- the preparation of the hives to occur at a location some hundreds of kilometres from the site at which the service is performed
- the number of hives providing the service to vary as the flowering of the crop progresses
- the hives to be transported to a possibly distant, third location to allow their recovery
- a further move, over a significant distance, to a fourth location where they resume activities that produce a commercial return to the beekeeper in the form of either the production of honey or the provision of pollination services.

Figure 3.4 provides a diagrammatic representation of the processes involved in the management of beehive prior to, during and following the provision of pollination services.

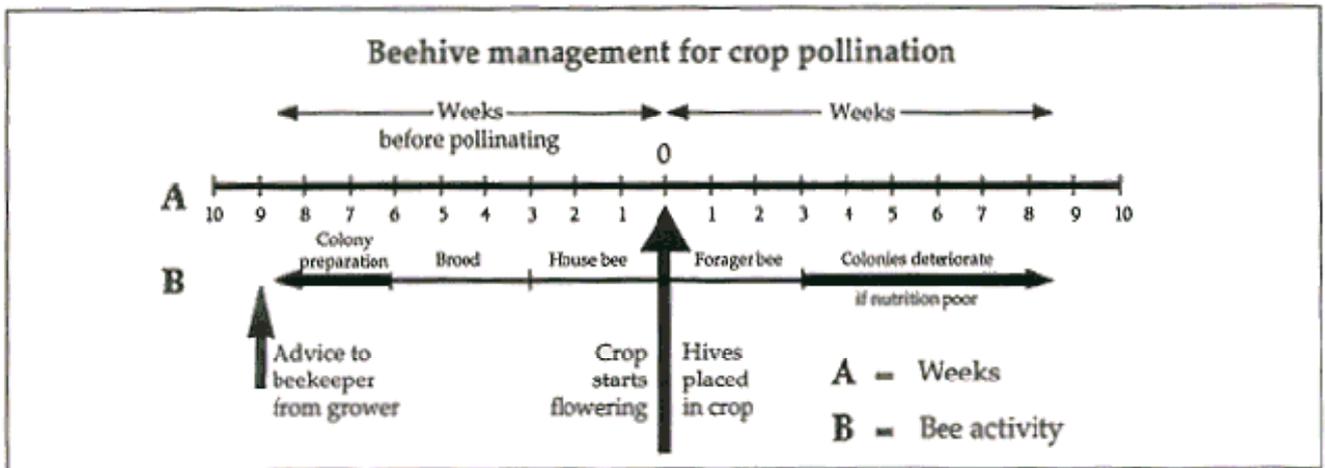


Figure 3.4 Beehive management for crop pollination – a beekeeper's view

Source: Parker 1989

The combination of activities that precede and follow the performance of a particular commercial pollination service will be determined by the interaction of a number of factors including:

- the time of the year at which the service is required
- the species and variety of the crop to be pollinated
- the location of the crop
- weather conditions at the time and at the site of the crop to be pollinated
- seasonal conditions and floral resources at the various sites where preparation or recovery of the hives may occur
- access to, and availability of, apiary sites at those locations
- the nature, location and timing of other demands for pollination services
- the incidence and severity of pest and disease burdens at each point along the supply chain.

For a beekeeper providing typical pollination services, about two thirds of the complement of colonies will be in a condition that meets the standard required to perform commercial pollination services at any given time. In any 12 month period a colony might be deployed to perform two, or at most three, month-long pollination contracts¹⁷. The actual availability of a colony to perform pollination services will be influenced by:

- weather conditions
- the nature and location of the crops to be serviced
- the total and timing of demand for pollination services
- the availability, location and quality of floral resources to rebuild colony strength
- prevailing weather conditions¹⁸.

As Table 3.3 indicates, there are periods of the year, particularly in spring, when the pollination requirements of a number of different crops coincide, intensifying the demand for available pollination services. In other periods, particularly late summer, autumn and winter there is effectively no demand for paid pollination services.

The apiarist servicing the pollination industry must maximise the number of hives available to be deployed in periods of peak demand and find other floral resources to maintain the hives when no pollination is required, preparing the hives for the next season at a time when conditions and resources are often not conducive to an improvement in colony strength and health.

In Australia the provision of pollination services has in the past largely been effected as a contract between the owner of the bees and the owner or manager of the crop to be pollinated.

In other parts of the world and most notably in the United States, there has developed over some decades a trend for pollination services to be arranged by **pollination brokers** who coordinate the provision of pollination services to one or more, usually large-scale, growers of pollination-dependent crops, with hives owned by a large number of beekeepers. In this arrangement the Pollination Broker provides certainty to the grower regarding the availability and quality of hives and certainty of payment for the service to the beekeeper¹⁹.

In recent years the role of the Pollination Broker has become established in Australia. The proportion of pollination services provided through brokers in Australia is currently small but likely to grow as the number of large plantations of pollination-requiring species, particularly almonds, increases. For these enterprises, the number of hives required may range from 3-10,000, and exceeds the amount that a single apiarist can supply.

3.5 Factors influencing the efficiency and effectiveness of a pollination service

Issues to be considered by the beekeeper and the grower of a pollination-dependent crop in the provision and use of managed pollination services are described in various reports and papers²⁰.

The effectiveness and efficiency of the delivery of a pollination service may be influenced by factors that are within the control of either (or both) the beekeeper and the grower, or other factors that are outside the control of either party²¹. These factors are listed in Table 3.4.

¹⁷ Monson,T;personal communication, January, 2008

¹⁸ Monson,T, personal communication, January, 2008

¹⁹ Agnew, 2007

²⁰ For examples, see Somerville 1999a&b, 2002a&b, 2005; Rhodes, 2006

²¹ Monson T, personal communication January, 2008

Table 3.4 Factors influencing the effectiveness and efficiency of pollination service delivery

| Within the beekeeper's control | Within the grower's control | Outside the control of either the beekeeper or the grower |
|---|--|--|
| <ul style="list-style-type: none"> ▪ precise location, aspect and configuration of hives ▪ stocking rate ▪ timing of insertion and withdrawal of bees ▪ availability of water ▪ traffic movements and other influences that disturb bees | | |
| <ul style="list-style-type: none"> ▪ strength and condition of the colony on delivery ▪ pest and disease status of the colony on delivery | <ul style="list-style-type: none"> ▪ access to the site ▪ choice of fruiting and pollinating cultivars ▪ arrangement of fruiting and pollinating cultivars ▪ compatibility of fruiting and pollinating cultivars ▪ condition of plants ▪ presence and nature of non-target species (weeds, undergrowth and adjacent plants) ▪ use of pesticides ▪ crop hygiene | <ul style="list-style-type: none"> ▪ weather conditions during pollination ▪ presence of incidental pollinators including feral bees ▪ quantity and quality of nectar and pollen ▪ presence and nature of non-target species outside property boundary |

Contracts for pollination services

Typically contracts for the provision of pollination services specify only the number of hives to be provided and include conditions that seek to ensure a minimum strength for the colonies, usually by specifying

- the number of frames present in a hive of a standard configuration
- a percentage cover of these frames at a specified temperature
- compliance with these conditions to be determined by inspection under the prescribed conditions usually by a third party.

Pollination contracts also usually include general obligations on the grower to avoid actions that would adversely affect the bees.

To date, provisions relating to the biosecurity of either the bees or the crop being pollinated have not generally been included in pollination service contracts.

Since the discovery of SHB in Australia, there is a requirement that hives crossing the NSW – Victoria border are certified by the relevant authority to be free of SHB. This requirement should provide a prima facie element of biosecurity assurance for certified hives, but whether this is in fact the case is not clear, as it seems the results of any inspection are not recorded or reported²².

²² Somerville D, personal communication; November, 2007

3.6 Asymmetries in the Australian pollination industry

Any consideration of the Australian pollination industry including management of the biosecurity risks confronting the industry must acknowledge and address a number of significant asymmetries between

- the demand and supply sides of the industry such as those with:
 - a commercial interest in the supply of, and demand for, pollination services
 - regulatory responsibility and authority for the conduct of beekeeping in Australia
 - statutory powers in the event of a plant or animal disease outbreak.

Many of these asymmetries may apply in other countries but some are either unique to the Australian industry or displayed in the extreme in this country. These asymmetries include:

- **Commercial asymmetries**
 - revenues earned from paid pollination services are minute compared to the value attributable to those services
 - revenues derived by the beekeeping industry from the provision of paid pollination services are small compared to those derived from other beekeeping activities, particularly the production of honey.
- **Operational asymmetries**
 - most enterprises that require pollination services need them for only about four weeks each year
 - a beekeeper may require three months or more to prepare hives to provide these services
 - a major concern for growers of pollination-dependent crops is the quality of the managed hives that they contract to perform pollination services, yet in many cases the same growers rely for a significant portion on the pollination services of feral bee colonies, the quality of which they can neither measure nor, by definition, control
 - many of the major pollination dependent industries are consolidating into ever larger operations
 - the apiary industry in Australia remains highly dispersed and comprised largely of small operations.
- **Biological asymmetries**
 - some of the crops most heavily dependent upon pollination require pollination at a time when hives, both managed and feral, are cyclically not normally in the best condition to meet the requirement
 - some pollination-dependant crops provide amounts of nectar that will not sustain the colonies pollinating them and therefore, even less honey to the apiarists providing the hives
 - in Australia the eucalypts which are key floral resources for apiarists providing highly important honey flows, have little or no requirement for pollination by honeybees
 - the requirement for commercial pollination services is generally quite time-specific and highly predictable, whilst in Australia, the events that produce the most honey and which are often used to condition hives to provide pollination services are generally imprecise and comparatively unpredictable.
- **Biosecurity asymmetry**
 - feral hives which currently perform a major component of pollination services for Australia's pollination-dependent industries represent the greatest biosecurity risk to themselves, other feral hives, managed hives and possibly, pollination-dependent industries.

- **Regulatory asymmetries**

- in all Australian jurisdictions regulatory authority for the management of diseases of bees rests with animal health authorities whilst, potentially, the greatest economic impact of bee diseases will be borne by plant-based industries dependent on pollination services provided by bees
- regulation of beekeeping activities is state-based whilst, along the eastern seaboard of Australia in particular, beekeeping in general and the provision of pollination services routinely involves the transport of colonies across state borders.

Whilst many of these asymmetries have little or no direct impact on the biosecurity risks faced by the pollination industry, they have the potential to impact the effective management of these risks.

4. Pollination industry biosecurity risk assessment

Process

The process followed has involved the first four steps of the framework outlined in Chapter 2 above:

- establishing the context
- risk identification
- risk analysis
- risk evaluation.

4.1.1 Preliminary outputs

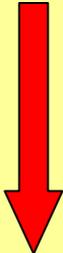
4.1.1.1 Establishing the context

The context of this assessment is a comprehensive risk assessment that identifies and quantifies:

- risks associated with incursion of Varroa mite (and other exotic pests and diseases)
- the probability of incursion and the likely spread of exotic pests and diseases
- risks associated with structural change that could occur to the honeybee industry and pollination-dependent industries.

Initially and consistent with the terms of reference for this project, the focus in considering the incursion of exotic pests and diseases was on the pests and diseases of honeybees. As the consultative risk identification process progressed it became apparent that incursions of a range of other exotic pests and diseases could have impacts of varying degrees of significance on the Australian Pollination Industry.

Including the pests and diseases of the honeybee, these fall into five classes and these groupings are listed below in descending order of likely impact on the pollination industry:

| Table 4.1 Classes of Pests and Diseases affecting the Pollination industry | |
|--|--|
| Likely Impact in Descending Order | Pest or Disease |
| Greater  Lesser | Pest or disease of bees that impacts cost and availability of the supply of pollination services |
| | Pest or disease of a major pollination crop that affects demand for pollination services |
| | Pest or disease of a key floral resource that impacts the non-pollination elements of beekeeping |
| | Pest or disease of plants that is vectored by bees and results in restrictions on movement of bees |
| | Pest or disease of other plants or animals, the management of which restricts the movement of bees |

4.1.1.2 Risk identification

Identification of risks requires detailed consideration of the sources of risk and the areas that these risks impact. Checklists of potential Sources of Risk and Areas of Impact have been developed to assist in this process, as outlined above. These checklists are modifications of those specified in the Australian Standard for Risk Management, AS4360.

Table 4.2 Risk Identification Checklists

| Source of Risk Checklist | Areas of Impact Checklist |
|--|--|
| <ul style="list-style-type: none">▪ Pests and diseases▪ Trade and economic▪ Organisation and management▪ Environment and natural events▪ Human behaviour▪ Commercial and legal▪ Political▪ Sabotage▪ Technology▪ Regulation and standards | <ol style="list-style-type: none">1. Health, productivity and quality of honeybees, crops and produce2. Human health3. Economic4. Commercial5. Environmental6. Organisational capability7. Political8. Reputation and image |

For this study the preliminary identification of risks was undertaken in a pair of small group brainstorming sessions conducted in Canberra on Friday 2 November 2007.

The first of these was a face-to-face session involving:

- Dr Denis Anderson, CSIRO
- Dr Iain East, DAFF
- Dr Ryan Wilson, PHA
- Dr Rob Keogh, Ms Jude Nettlingham, Mr John Coulson and Mr David Brous from Impact Consulting Group.

The second session was a teleconference involving the Impact Consulting Group team and:

- Mr Lindsay Bourke, a beekeeper from Tasmania
- Mr Stephen Ware, AHBIC
- Mr Kim James, HAL.

Subsequently, the project team members consulted on the output from these preliminary risk identification sessions with a wide range of stakeholders who have an interest in the Australian pollination industry. These consultations were undertaken to:

- determine whether there are other risks to be considered
- to determine the risks considered by the individual to be of greatest significance
- to complete the risk evaluation process for the identified priority risks.

Consultations on the risks facing the pollination were carried out face to face, over the phone or by email exchange including contributions from Dr Rob Manning, Department of Agriculture and Food Western Australia and from the Queensland DPI (see Appendix 1).

Combining the information arising from these consultations with the output from the initial brainstorming sessions and consolidating these data around common themes has given rise to a final list of risks to be analysed and assessed prior to developing risk management strategies.

Professor Jean Cross who was a member of the committee auditing the risk-based self-assessments undertaken by the member organisations of AHA, in fulfilment of their obligations regarding the National Animal Health Performance Standards, advises that the likelihood/consequence risk assessment methodology that is commonly applied may not be appropriate to some of the risks identified by processes such as the present study²³

To assist in clarifying the circumstances where this conventional assessment methodology is most relevant, Professor Cross has proposed that risks can be classified into one of three types:

- Type 1 (classic) risks that involve a demonstrable hazard, an example being an incursion by a honeybee pest.
- Type 2 (control failure) risks that derive from the failure of a specific control, an example being that the surveillance arrangements in place fail to detect the incursion.
- Type 3 (system factor) risks that refer to ‘weaknesses, deficiencies or changes in components of the system, or the environment in which the system operates,’ an example being the lack of adequately trained staff to identify the pest when it is detected.

Professor Cross also proposes that:

- Type 1 risks are amenable to the likelihood/consequence assessment process.
- Type 2 risks should be assessed by comparing the risk before and after the control is improved.
- Type 3 risks should be treated as factors that increase a type 1 risk.

Table 4.8 includes a column assigning each risk to one of the three types specified by Cross²⁴.

²³ Cross J, personal communication, January, 2008

²⁴ Cross J, personal communication, January, 2008

Table 4.3 Collation and grouping of risks arising from workshops and consultations

| Source of Risk (Refer Table 4.1 above) | Associated Impact (Numbers shown refer to Areas of Impact in Table 4.1 above) |
|--|--|
| Pests and Diseases | |
| Pest or disease that impacts on the cost and availability of supply of pollination services | #1, 3, 4, 5 |
| Asian honeybee incursion | #1, 3, 4, 5 |
| Pest or disease of a major pollination crop that affects demand | #1, 3, 4, 5 |
| Incursion of European honeybees with Africanised genes | #2, 1, 4, 8 |
| Pest or disease of key floral resource | #1, 3, 4, 5 |
| Pest or disease of plants that is vectored by bees and results in restrictions on movement of bees | #1, 3, 4, 5 |
| Disease or pest of bees well established before detection and not eradicable | #1, 3, 4, 5, 8 No opportunity to eradicate. Feral bees decimated. Greater floral resources for managed bees, |
| Other pest or disease of plants or animals that has a spill over effect on the movement of bees | #1, 4 Transport of hives restricted |
| Trade and Economic | |
| Significant change in the honey price such that <ul style="list-style-type: none"> ▪ if very low affects the viability of beekeeping or ▪ if high affects the opportunity cost of pollination services. | #1, 3, 4, 6 |
| Significant change in economics of a key pollination crop e.g. <ul style="list-style-type: none"> ▪ the price of almonds falls by 60 per cent reducing demand for pollination services or ▪ the price of almonds doubles and demand exceeds supply | 1, 3, 4, 6 |
| Demand for pollination services results in bee population exceeding the capacity of available floral resources to sustain colonies in non-pollination periods | 1, 3, 4, 6 |
| A biosecurity issue affects market access and the economics of beekeeping e.g. a disease incursion into Australia removes the rationale for excluding imports on quarantine grounds | 1, 3, 4, 6 |
| Growth of 'packaged bee' exports reduces the supply of local pollination services | #1, 4 |
| Growth of Queen Bee exports | #1, 4 |
| Increased contaminants from imported honey products in the short term reduces demand for honey | #2, 4, 8 |
| Low yield/poor quality of pollination-dependent crops, for domestic and export markets | #1, 4, 8 |
| Lower levels of interstate trade (cross-border quarantine regulations) | #3, 4, 8 |
| Organisation and Management | |
| Inadequate knowledge of pests and diseases by both beekeepers and growers. | Reduced likelihood of early detection and response. |
| Awareness of and capacity for efficient management | #1, 4, 8 |

| Source of Risk (Refer Table 4.1 above) | Associated Impact (Numbers shown refer to Areas of Impact in Table 4.1 above) |
|--|---|
| of pollination services by beekeeper, grower, advisory, R&D and support services | |
| Resources, skills and processes to detect, identify and respond to an incursion | Reduced likelihood of containment and eradication |
| Effective management of an incursion | |
| Education and training arrangements in all aspects of beekeeping and pollination activities | #1, 4, 8 |
| Limited or no reference to pollination or biosecurity in QA programs | Reduced likelihood of containment and eradication |
| Structure of beekeeping industry with ongoing dominance of small, individual operations | Reduced likelihood of early detection and response |
| Inappropriate use of pest and disease control chemicals leads to the development of resistance and/or reduced effectiveness | #1, 4, 6 |
| Environment and Natural Events | |
| Climate change: <ul style="list-style-type: none"> ▪ impact on land and water use resulting in change in demand for pollination services ▪ impact on floral resources – availability, location, timing ▪ impact on epidemiology of pests and diseases | #1, 3, 4, 5 |
| Timing of demand for pollination services and competition between crops for pollination services | |
| Adequacy and accessibility of native floral resources to sustain a large increase in size of the bee population to match growth in demand for pollination services | |
| Vectors flying in from overseas (e.g. from Indonesia) | #1, 3, 4, 5 |
| Human Behaviour | |
| Deliberate or inadvertent breach of quarantine procedures | #1, 3, 4, 5, 7 |
| Willingness to report suspect incursion | |
| Acceptance of structural change including pollination service provision through brokers, by beekeepers | |
| Commercial and Legal | |
| Small size of the pollination industry and low pollination service prices unable to sustain a viable bee industry without adequate honey prices | #1, 3, 4, 5 |
| Relative economics of pollination and honey production | #1, 3, 4, 5, 7 |
| Grower and beekeeper rights and responsibilities in pollination contracts | #4 |
| Introduction of brokers to pollination industry | |
| Political | |
| Restrictions on access to native floral resources impacts the supply of pollination services | #1, 4 (reduced numbers of beekeepers) |
| Changed access to and allocation of water resources impacts the demand for pollination services | |
| Impact of Carbon Trading arrangements on both supply of and demand for pollination services. | |
| Free trade agreements impact the economics of honey | |

| Source of Risk (Refer Table 4.1 above) | Associated Impact (Numbers shown refer to Areas of Impact in Table 4.1 above) |
|---|---|
| and/or pollination-dependent crops | |
| Sabotage | |
| Deliberate introduction by a producer from an affected country if Australia gets trade advantage | #1, 3, 4, 5, 7 |
| Technology | |
| Development of pest or disease tolerant, resistant or avoiding bees | #1, 3, 4 |
| Breeding of a superior pollinating strain of bees | |
| Breeding of varieties of crops better suited to bee pollination | |
| Development of crop and orchard layouts better suited to pollination by bees | |
| Breeding of self pollinating or non-pollinating crops | |
| Development and selection of alternative pollinators or pollination methods not requiring honeybees | |
| Regulation and standards | |
| Availability of chemicals for use in emergency responses or containment and management programs | Reduced likelihood of containment and eradication |
| Regulation and labelling of chemicals that impact pollination | |
| Impact of regulations that affect the movement of bees to provide pollination services | 1, 4, 7 Pollination and honey circuits disrupted |
| Pollination issues in the scope and application of QA programs in beekeeping and horticultural industries | |
| Inefficient allocation and access to beekeeping sites impacts on the supply of pollination services. | |

Note: General comment on the impacts common to all disease incursions (specific diseases may have specific impacts in addition to these):

- increased costs of hive management and maintenance resulting in a reduction in beekeeper numbers and eventually to reduced numbers of hives
- reduced pollination capability, pollination services, increased cost of pollination services
- reduced productivity and yields from hives and pollination dependent crops
- reduced quality and quantity and increased prices of pollination-dependent produce ultimately impacting human health.

4.1.1.3 Risk analysis

Objectives:

- to separate acceptable risks from medium, high and extreme risks
- to provide data to assist in the evaluation and treatment of risks.

Process:

Analysis of risks requires:

- consideration of the **likelihood** that a risk will be realised (Table 4.4)
- determination of the **consequences** of that risk being realised Table 4.5).

The Australian Standard for Risk Management provides guidance on the conduct of these processes:

Table 4.4: Risk Likelihood

| L | Likelihood | Description |
|---|----------------|---|
| A | Almost certain | Is expected to occur in most circumstances |
| B | Likely | Will probably occur in most circumstances |
| C | Possible | Could occur at some time |
| D | Unlikely | Might occur at some time |
| E | Rare | May occur only in exceptional circumstances |

Table 4.5: Risk Consequences

| C | Consequence | Description |
|---|---------------|---|
| 1 | Insignificant | Minimal impact on honeybee population, low financial loss |
| 2 | Minor | Minimal impact on honeybee population, minor financial loss at enterprise level |
| 3 | Moderate | Moderate impact on honeybee population, moderate financial loss at enterprise / specific industry level |
| 4 | Major | Major impact on regional honeybee population, major financial loss in number of pollination industries |
| 5 | Catastrophic | Major impact on national honeybee population, major financial loss across all pollination industries |

4.1.1.4 Risk evaluation

Combining the likelihood and consequences of a risk being realised, allows the risk to be evaluated and compared with others that impinge upon the process or enterprise under consideration. The Australian Standard for Risk Management also provides a matrix for rating risks and an indication of the attention that must be paid to each risk with a particular rating.

Table 4.6: Risk Rating Matrix

| Combined Risk Rating (Likelihood & Consequence) | | | | | | |
|---|---|------------------------|---|---|---|---|
| | | C – Consequence rating | | | | |
| | | 1 | 2 | 3 | 4 | 5 |
| L - Likelihood Rating | A | M | M | H | X | X |
| | B | L | M | M | H | X |
| | C | L | L | M | H | H |
| | D | N | L | M | M | H |
| | E | N | N | L | M | H |

Table 4.7: Risk Evaluation Matrix

| Rating | | Response |
|--------|------------|-----------------------|
| X | Extreme | Urgent attention |
| H | High | Intervention required |
| M | Medium | Active management |
| L | Low | Ongoing monitoring |
| N | Negligible | Acceptable risk |

Table 4.8 below provides a consolidated summary of:

- the risks considered in this report
- the source of each
- the type of each according to the classification proposed by Cross²⁵
- an evaluation of each, including (where applicable):
 - a Likelihood and Consequence rating
 - an overall Risk Rating and Evaluation.

²⁵ Cross J, personal communication, January, 2008

Table 4.8 Summary of Risks and Risk Assessments

| Source of risk | Risk | Type of risk | Likelihood | Consequence for pollination industry | Risk Rating | Response |
|------------------------------------|---|--------------|----------------|--------------------------------------|-----------------|---|
| Pests and diseases | Pest or disease of bees that impacts cost and availability of the supply of pollination services (See Table 5.1 for detail) | 1 | Likely | Catastrophic | High to Extreme | Urgent attention or Intervention required |
| | Pest or disease of a major pollination crop that affects demand for pollination services | 1 | Likely | Moderate | Medium | Active Management |
| | Pest or disease of a key floral resource that impacts the non-pollination elements of beekeeping | 1 | Likely | Major | High | Intervention required |
| | Pest or disease of plants that is vectored by bees and results in restrictions on movement of bees | 1 | Possible | Moderate | Medium | Active Management |
| | Pest or disease of other plants or animals, the management of which restricts the movement of bees | 1 | Possible | Moderate | Medium | Active Management |
| Trade and economic | Significant change in honey price | 1 | Possible | Major | High | Intervention Required |
| | Significant change in economics of a key pollination crop | 1 | Possible | Moderate | Medium | Active Management |
| | Demand for pollination services results in bee population exceeding the capacity of available floral resources | 1/3 | Possible | Major | High | Intervention required |
| | Biosecurity issue that affects market access and economics of beekeeping | 2 | Not Applicable | Not Applicable | Medium | Intervention required |
| Organisation and management | Awareness of and capacity for efficient management of pollination | 3 | Not Applicable | Not Applicable | High | Intervention Required |
| | Resources, skills and processes to detect, identify and respond to an incursion | 3 | Not Applicable | Not Applicable | High | Intervention Required |
| | Effective management of an incursion | 3 | Not Applicable | Not Applicable | High | Intervention Required |
| | Education and training arrangements in all aspects of beekeeping and pollination activities | 3 | Not Applicable | Not Applicable | High | Intervention Required |

| Source of risk | Risk | Type of risk | Likelihood | Consequence for pollination industry | Risk Rating | Response |
|---------------------------------------|--|--------------|----------------|--------------------------------------|-------------|-----------------------|
| | Limited or no reference to pollination or biosecurity in QA programs | 3 | Not Applicable | Not Applicable | Medium | Active Management |
| | Structure of beekeeping industry | 3 | Not Applicable | Not Applicable | Medium | Active Management |
| Environment and natural events | Climate change: <ul style="list-style-type: none"> ○ Impact on land and water use ○ Impact on floral resources – ○ Impact on epidemiology of pests and diseases | 3 | Not Applicable | Not Applicable | High | Intervention required |
| | Timing of demand for pollination services and competition between crops for pollination services | 3 | Not Applicable | Not Applicable | Medium | Active Management |
| | Adequacy and accessibility of native floral resources | 3 | Not Applicable | Not Applicable | High | Intervention Required |
| Human behaviour | Deliberate or inadvertent breach of quarantine | 2 | Not Applicable | Not Applicable | High | Intervention Required |
| | Willingness to report suspect incursion | 2 | Not Applicable | Not Applicable | High | Intervention Required |
| | Acceptance of structural change including pollination service provision | 2 | Not Applicable | Not Applicable | Medium | Active Management |
| Commercial and legal | Relative economics of pollination and honey production change significantly | 1 | Possible | Moderate | Medium | Active Management |
| | Grower and beekeeper rights and responsibilities in pollination contracts | 3 | Not Applicable | Not Applicable | Medium | Active Management |
| | Introduction of brokers to pollination industry | 3 | Not Applicable | Not Applicable | Medium | Active Management |
| | Assistance to restructure apiary industry | 3 | Not Applicable | Not Applicable | Medium | Active Management |
| Political | Access to native floral resources | 3 | Not Applicable | Not Applicable | High | Intervention Required |
| | Access to and allocation of water resources | 3 | Not Applicable | Not Applicable | Medium | Active Management |
| | Regulation of land usage to maximise water resource use efficiency | 3 | Not Applicable | Not Applicable | Medium | Active Management |
| | Impact of Carbon Trading arrangements on pollination supply and demand | 3 | Not Applicable | Not Applicable | Medium | Active Management |

| Source of risk | Risk | Type of risk | Likelihood | Consequence for pollination industry | Risk Rating | Response |
|---------------------------------|--|--------------|----------------|--------------------------------------|-----------------|---|
| Technology | Development of pest or disease tolerant, resistant or avoiding bees | 1 | Likely | Moderate to Major | High to Extreme | Urgent Attention or Intervention Required |
| | Breeding of superior pollinating strains of bees | 1 | Likely | Moderate | Medium | Active Management |
| | Breeding of varieties of crops better suited to bee pollination | 1 | Likely | Minor | Medium | Active Management |
| | Development of crop and orchard layouts better suited to pollination by bees | 3 | Not Applicable | Not Applicable | Medium | Active Management |
| | Breeding of self pollinating or non-pollinating crops | 1 | Likely | Minor | Medium | Active Management |
| | Alternative pollinators or pollination methods not requiring honeybees | 1 | Likely | Moderate | Medium | Active Management |
| Regulation and standards | Pre-approval of chemicals for use in pest and disease response/management | 3 | Not applicable | Not Applicable | High | Intervention Required |
| | Regulation of use of chemicals that impact pollination | 3 | Not Applicable | Not Applicable | Medium | Active Management |
| | Regulations that affect movement of bees | 3 | Not Applicable | Not Applicable | High | Intervention Required |
| | Scope and application of QA programs | 3 | Not Applicable | Not Applicable | Medium | Active Management |
| | Allocation and access to beekeeping sites when in demand | 3 | Not Applicable | Not Applicable | High | Intervention Required |

5. Exotic pests and diseases and risks associated with their incursion and establishment

While exotic pests and diseases of bees constitute the primary focus of this study, there are other groups of pests and diseases that could have significant, but less direct impacts on the pollination industry in Australia. In total, four broad groups have been identified and will be considered in this study. These groups in no particular order of priority are:

1. Pests and diseases of honeybees that would impact upon the cost and availability of supply of pollination services.
2. Pests and diseases of major pollination crops or floral resources that would affect demand for, and provision of, pollination services.
3. Pests and diseases of plants that are vectored by bees and which, if they occurred in Australia, could result in restrictions on movement of bees, thus impacting upon the ability of beekeepers to provide pollination services.
4. Other pests and diseases of plants or animals that, if they occurred in Australia, could give rise to spill over effects that restrict the movement of bees.

Pests and diseases of honeybees

There is a group of pests and diseases of honeybees that is likely to have the most direct impact on the cost and availability of supply of pollination services in Australia. The impacts they might have are threefold:

- negative impacts on colony condition and survival that:
 - potentially decimate feral bee populations, obliging those requiring pollination services to rely entirely on managed colonies to provide these services,
 - reduce the condition and longevity of managed hives thereby reducing the proportion of available hives that are of the standard required to provide pollination services
 - from a pollination service user's perspective requires:
 - payment for hives to replace the loss of the contribution from feral bees
 - possible higher stocking densities of hives to offset the poorer condition of colonies
 - higher prices for pollination services resulting from the greater demand for managed hives (in the USA average almond pollination fees had increased from less than USD40 per colony in 1995 to about USD140 per colony in 2006²⁶, largely due to the impact of Varroa and other bee diseases in that country)

²⁶ Sumner & Boriss, 2006

- increase the costs of managing and maintaining managed colonies with:
 - the experience in New Zealand being that the labour and input costs required to manage apiaries increased significantly following the incursion and establishment of Varroa²⁷
 - a significant cause of the increased labour component of apiary management in the presence of Varroa being due to the higher annual rate of mortality amongst colonies within an apiary
 - replacement of these lost colonies contributing to the additional management input to beekeeping
 - consumers of pollination services being charged higher prices for pollination services to offset the higher operating costs that beekeepers incur to maintain colony numbers and strength
- specifically, during any emergency response to the detection of an exotic bee pest or disease results in:
 - the movement of hives being subjected to restrictions that could reduce the geographic range from which pollination service users in any location could draw supplies of hives to meet their needs and within which beekeepers could offer their services
 - consequential localised imbalances in supply and demand resulting in variations to the cost of services
 - where an incursion defeats attempts at eradication, maintenance of restrictions on movement to slow the spread of the pest or disease, with:
 - the severity and geographical boundaries of the restrictions likely to be different to those applying during the emergency response phase, but
 - the impacts likely to be of the same nature as described for the emergency response phase, if different in degree.

The **Biosecurity or Disease Risk Mitigation Strategy for the Australian Honeybee Industry** produced by AHBIC lists Exotic Diseases or Pests of concern to the Australian beekeeping industry²⁸. The risk analysis has adopted the **Strategy's** framework, which does not include *Nosema ceranae*, as the basis for the identification of pests or diseases of honeybees, listed and described as follows:

“Tropilaelaps Mite (*Tropilaelaps clareae*)

- **Means of spread**
 - mites are transmitted by drifting bees, interchange of infested brood combs, robbing and swarming bees, caged queens and on apiarist's clothing
 - the mites can be transferred between colonies and between apiaries through normal apiary management practices
 - adult mites are extremely active on the frames.
- **Survival**
 - the life cycle of the mite is synchronised with that of the host and they will only persist in a hive with adult bees and live brood
 - adult mites are not able to survive more than 2-4 days away from bee brood and have been observed to drop off adult *Apis mellifera* in swarms and packaged bees after two days away from the brood.

²⁷ Goodwin, M; personal communication, December, 2007

²⁸ AHBIC undated

- **Incubation period**
 - the life cycle commences when one or several female mites enter a brood cell containing a late instar worker or drone larva (3 days or older)
 - eggs are usually laid on the cuticle of the host larva
 - a developmental sequence of egg, larva, protonymph, deutonymph and adult occurs during the late larval and pupal development of the host bee.

Varroa Mite (*Varroa destructor*) is the greatest threat to beekeeping is the species of Varroa mite known as *Varroa destructor*.

- Australia is one of the few countries free from Varroa.
- Overseas experience suggests that when Varroa is established in Australia it will:
 - have already evolved a high degree of chemical tolerance
 - spread rapidly
 - within two to three years will kill most European Honeybee colonies, managed or feral, not being treated with an appropriate acaricide.
- Treatment is expensive both for the purchase of the acaricide and for the additional labour involved.
- Australia has plans in place to attempt to contain an outbreak should one occur and monitors bee colonies through the sentinel hive programme.
- **Means of spread**
 - Varroa may be spread when hive components containing infested brood or adult bees are interchanged during normal management practices
 - the movement of hives and queen bees by beekeepers is a very effective means of transmission
 - in Australia, the spread of infestation would be very quick due to the migratory nature of the beekeeping industry
 - the mites can attach themselves to other flower-visiting insects and there may be some transfer of mites to and from bees visiting the same flower
- **Survival**
 - without food, the mites die in about three days
 - they over winter between the sclerites of adult bees
- **Incubation period**
 - adult *V. destructor* females lay 2-5 eggs shortly before the brood cell is capped
 - eggs are laid on the bottom of the cells, on the walls and sometimes directly on the larvae
 - egg development takes 1-2 days
 - complete development (egg to adult) takes 8-10 days for females
 - mating occurs in the brood cell
 - young females will lay eggs in other cells after two weeks and usually live for two months
 - the adult female is very mobile and readily transfers between adult bees.

Varroa Mite (*Varroa jacobsoni*) is essentially restricted to its host, *Apis cerana* and whilst it can enter brood cells of *Apis mellifera* it is unable to reproduce there.

- **Means of spread**
 - Varroa may be spread when hive components containing infested brood or adult bees are interchanged during normal management practices
 - the movement of hives and queen bees by beekeepers is a very effective means of transmission
 - the mites can attach themselves to other flower-visiting insects and there may be some transfer of mites to and from bees visiting the same flower.

- **Survival**
 - without food, the mites die in about three days
 - they over winter between the sclerites of adult bees.
- **Incubation period**
 - adult *V. jacobsoni* females lay 2-5 eggs shortly before the brood cell is capped
 - eggs are laid on the bottom of the cells, on the walls and sometimes directly on the larvae
 - egg development takes 1-2 days
 - complete development (egg to adult) takes 8-10 days for females
 - mating occurs in the brood cell
 - young females will lay eggs in other cells after two weeks and usually live for two months
 - the adult female is very mobile and readily transfers between adult bees.

Braula Fly (*Braula coeca*) is currently found in Tasmania but not on mainland Australia.

- **Means of spread**
 - the spread of Braula is mainly by swarming colonies and through the interchange of hive components from apiary to apiary
 - colonies become infested by bees drifting from colony to colony, by strong colonies attacking and robbing weak colonies and by mechanical transport of infested materials (such as bees, combs, queen cages) as part of normal apiary management practices.
- **Survival**
 - they over winter as adults on adult bees and are able to survive in a bee colony without the presence of brood
 - they are not known to be able to survive in the absence of adult bees.
- **Incubation period**
 - development from egg to adult takes 16-23 days
 - the female Braula lays its eggs on the inner or outer surface of the wax cappings of honey cells and sometimes on the walls of cells, not in brood cells
 - subsequent development is beneath the cappings, where the larva makes a tunnel several cells in length using wax fragments which it gnaws from the cappings, which is thin at first and expands as the larva grows
 - the larva obtains food from pollen and possibly from wax and when fully grown it pupates in the tunnel
 - adult Braula flies emerge and attach firmly to adult worker bees, queen bees and occasionally to drones.

Tracheal Mite (*Acarapis woodi*)

- **Means of spread**
 - the main method is the interchange of hive components as practised in normal apiary management procedures
 - the introduction of mites into an apiary appears to be due to drifting bees robbing bees or by the introduction of infested colonies or queen bees.
- **Survival**
 - mite reproduction is normally limited to one complete generation per host bee regardless of the life span of the bee
 - female mite longevity has been estimated at 35 days
 - young mites begin dispersing from infested bees when the bees are approximately 14 days old

- **Incubation period**
 - female mites enter the tracheae of worker bees within 24 hours of the emergence of bees from their cells
 - male and female mites are present in the first pair of thoracic spiracles of adult bees and may be found in air sacs in the head and abdomen
 - a female mite lays 5-7 eggs within 3 or 4 days of entering the tracheae
 - eggs hatch after 3-4 days and develop into adult mites over the next 11-15 days
 - adult bees of all castes and of any age can become infested but bees older than 9 days are less susceptible
 - the susceptibility of bees to infestation diminishes rapidly from their first day of life.

Asian Bees

- There are three main species of Asian honeybees:
 - the Asian honeybee (*Apis cerana*)
 - giant honeybee (*A. dorsata*)
 - dwarf honeybee (*A. florea*)
- There are four recently identified species:
 - *Apis andreniformis*
 - *Apis koschevnikovi*
 - *Apis nigrocinta*
 - *Apis nuluensis*
- The Asian species are tropical species of honeybees closely related to the European honeybee (*A. mellifera*) used for commercial purposes in Australia.
- The Asian species exhibit behavioural traits that make them unsuitable for commercial management and it is possible for them to carry and transmit serious exotic diseases and pests, for example:
 - *Apis dorsata* carries *Tropilaelaps clareae*
 - *Apis cerana* carries *Varroa* spp.
- Limited data is available on the disease status of *A. andreniformis*, *A. koschevnikovi*, *A. nigrocinta* and *A. nuluensis*, but they could be expected to compete for food and nesting sites with Australian native bee species and *A. mellifera* and there could be issues with pollination of weed species.
- If feral populations of Asian bees became established in commercial beekeeping areas of Australia they could act as a source of infection of major bee diseases or pests to commercial apiaries of *A. mellifera*.
- Drones of *Apis cerana* are capable of mating with *A. mellifera* queens producing non-viable offspring.
- **Means of spread**
 - introduction of the Asian species of honeybees and the parasites and diseases normally present in their colonies is most likely to occur from swarms on sea cargo, air cargo and passenger flights from Asian countries or Papua New Guinea, arriving at Australian ports.
 - the possibility of the illegal importation of queen bees and escort bees into Australia for breeding purposes is of major concern.

- **Survival**
 - once established in Australia, the three species would spread quickly through areas with suitable climates
 - the species are reported to swarm up to 20 times each year with:
 - *A. dorsata* swarms reported to migrate over a distance of several hundred kilometres
 - *A. cerana* reported to be spreading at a rate of between 50 and 100 km each year in the highlands of Papua New Guinea with swarms having occurred on Torres Strait islands which lie in the Torres Strait Protected Zone, although they have not swarmed to islands further south and it is not expected that they will under natural conditions.
- **Incubation period**
 - this species is similar in most respects to *A. mellifera*.

Africanised and Cape Honeybees

Apis mellifera scutellata and its hybrids, *Apis mellifera capensis*.

- Whilst swarms of *A. mellifera scutellata* from boats can bring pests and diseases, a single swarm is unlikely to provide a sufficient gene pool to establish a population in Australia, thus it is unlikely that an Africanised bee population would become established at a single entry point.
 - In the event of a swarm of the Cape honeybee becoming established, the risk of it spreading within Australia is very high.
 - If a beekeeper undertook a mass queen rearing program using Africanised stock, however, the general local population would be at risk due to an increased drone population from the raised queens.
- The Cape Honeybee (*Apis mellifera capensis*) poses similar threats:
 - workers of *A. mellifera capensis* drift into, and are accepted by, colonies of other *A. mellifera* sub-species
 - laying *A. mellifera capensis* worker bees, mimic a mated queen bee so that the original queen is eliminated in preference for the *A. mellifera capensis* laying worker
 - the laying worker is able to lay eggs with a full complement of chromosomes without mating (thelytokous parthenogenesis), and an *A. mellifera capensis* queen reared from one of these eggs eventually takes over the hive
 - the relocation of *A. mellifera capensis* colonies from southern to northern South Africa has resulted in widespread deaths of managed *A. mellifera scutellata* colonies
 - it is expected that *A. mellifera capensis* would have a similar effect on the European sub-species of *A. mellifera* used in commercial beekeeping in Australia.
- Under the current AQIS supported National Sentinel Hive Program it would be possible to introduce a monitoring program based on sample collection of adult bees:
 - tests currently exist for *A. mellifera scutellata* but suitable tests would need to be developed for *A. mellifera capensis*.
- **Means of spread**
 - establishment of Africanised and Cape honeybees in Australia is likely to occur if a beekeeper imported one or more queen bees for breeding and assisted with their distribution by means of normal beekeeping management practices.

- **Survival**
 - once introduced Africanised bees could occupy all of the populated areas of mainland Australia with the exception of the cooler areas of the eastern highlands and desert areas of central Australia
 - *A. mellifera scutellata* readily hybridises with other honeybee subspecies, and
 - once Africanised bees become established in an area they are likely to persist.
- **Incubation period**
 - similar to European races of *A. mellifera*.

Small Hive Beetle (*Aethina tumida*) was identified in colonies near Sydney in 2002 and has since spread widely in South Eastern Australia.

- **Means of spread**
 - the pattern of infestation is poorly understood but the initial introduction into Australia will most likely come from soil containing pupae e.g. soil on heavy machinery/containers
 - another possible means is from the illegal importation of queens
 - further spread will be from the distribution of infected hive materials within and between apiaries and by placing hives on sites infested with hatching beetle pupae.
- **Survival**
 - adults live on average for over two months and appear to be able to survive for five days without food or water
 - soil conditions determine the resting period and survival of the pupae.
- **Incubation period**
 - the eggs hatch into larvae after 2-6 days and after feeding within the hive they pupate in the soil outside the hive, for a period depending on soil conditions and varying between 8-60 days
 - the duration from egg to adult is about 38-81 days.”

The **risks** represented by a number of the organisms described above and *Nosema ceranae* have been assessed and the results are summarised in Table 5.1

Table 5.1 Risk based prioritisation of key pests and diseases of honeybees

| Pest or Disease | Total impact score (%) | Likelihood of incursion | Impact | Combined risk rating | Comment |
|--------------------------|------------------------|-------------------------------------|--------------|----------------------|---|
| <i>Varroa destructor</i> | 73 | 0.3 > 0.7 Incursion is likely | Catastrophic | Extreme | Urgent attention required to address this disease |
| Tropilaelaps mite | 72 | 0.05 > 0.3 Incursion is possible | Catastrophic | High | Intervention is required to address this disease |
| <i>Nozema ceranae</i> | 66 | 1.0 Disease is present | Major | High | Intervention is required to address this disease |
| Africanised bees | 60 | 0.05 > 0.3 Incursion is possible | Major | High | Intervention is required to address this disease |
| Small Hive Beetle | 58 | 1.0 Pest is present | Major | High | Intervention is required to address this disease |

Table prepared using model developed by Hitchens, P.L.: 2004 (see Appendix 2 for detail of assessments)

A significant issue to be understood and considered by the pollination industry is that while every reasonable effort should be made to ensure early detection of *Varroa* and *Tropilaelaps* in particular, the experience with *Varroa* in the US²⁹ and New Zealand³⁰ and with SHB in Australia suggests that there is a high probability that these pests will be well established before they are detected.

In the event that this was the case, the nationally agreed emergency response arrangements provided for under the EADRP and AUSVETPLAN³¹ would cease to apply. In the absence of any pre-agreed national incursion management plan to be implemented in place of an emergency response plan, there could be a delay in the implementation of effective and efficient controls and outcomes that are less than optimal for the various interests in the Australian pollination industry.

While the experience in other countries that suffered an incursion of *Varroa* in particular, will be relevant and helpful to those charged with responding in Australia, it should be recognised that the widespread occurrence of feral bees, Australia's climatic conditions and its native floral resources could result in the dynamics of a *Varroa* incursion in Australia being significantly different to those experienced elsewhere.

The development of a *Varroa* simulation model, similar to the AHA bio-economic model for Screw-Worm Fly, could assist in understanding these differences, prioritising research and developing management strategies.

Colony Collapse Disorder (CCD) has not been considered in this study. The reasons are:

²⁹ Petiss, J, personal communication, January 2008

³⁰ Goodwin 2004

³¹ AHA 2006

- that specific causes of the disorder have not been defined, making any attempt to assign a probability or priority to its occurrence in Australia as pure speculation
- to the extent that it is understood, CCD commonly involves *Varroa* and until *Varroa* is detected in Australia, it is reasonable to assume that CCD cannot be present.

While CCD is unlikely to be present in Australia, beekeepers, researchers and advisers to the apiary industry consistently report annual losses of colonies of about 10 per cent and observe that losses of colonies:

- occur mainly in winter
- are usually associated with *Nosema apis* in some years and areas
- the losses can be significantly higher than 10 per cent³².

These losses impose a significant cost on the apiary industry and make preparation of colonies for early-season pollination services more difficult and uncertain. If the demand for early season pollination services grows, the impact of these losses could increase.

This pressure and the unknown, but probably detrimental, additional impact of the presence of *Nosema ceranae* in Australia will increase the importance of colony health and enhanced biosecurity to the Australian pollination industry.

5.2 Pests and diseases of major pollination crops or floral resources

Three species or groups of species of plants are presently, or potentially, of such significance to beekeeping in Australia that a major change in their availability or accessibility to beekeepers could severely impact beekeeping and the pollination industry in Australia. They are³³:

- native floral resources, mainly eucalypts and *proteacea* used by beekeepers as key sources of nectar and for preparing colonies for the provision of early season pollination services
- almonds - the major and rapidly growing source of demand for pollination services
- canola - a widely distributed agricultural crop in southern Australia that is highly favoured by beekeepers as an early season source of nectar and often more importantly, good quality pollen.

Eucalypts and *Proteaceae* are susceptible to the soil borne disease *Phytophthora cinnamomi* that has impacted large areas of native forest in south-western and southern Australia. The further spread of this disease could affect beekeeping in one of two ways:

- it could directly reduce the resources available to beekeepers
- efforts to retard the spread of the fungus usually involve restrictions on vehicle movements in native forests.

Such restrictions could affect the access of beekeepers to these resources.

A major concern for foresters and resource managers with an interest in eucalypts and the broader botanical family *Myrtaceae* - a key component of the Australian native flora - is the exotic Guava Rust fungus *Puccinia psidii* which occurs in Southern and Central America and has recently been detected in Hawaii. In Brazil and other locations, *P. psidii* has been demonstrated to be capable of infecting eucalypts and other genera of the *Myrtaceae*. In Brazil, this rust has devastated young plantation eucalypts causing losses of up to 90% of plantations³⁴.

³² Somerville, D;personal communication, October 2007

³³ Somerville, 2002

³⁴ Tommerup, 2002

Potentially, an incursion of *P. psidii* would have a serious impact on plantation and natural eucalypt forests, with the same indirect impact on the apiary industries as the spread of *Ph cinnamomi*. There is a further issue with *P. psidii*, in that bees under some circumstances collect the urediniospores of the rust as a substitute for, or along with, pollen and could be vectors of the fungus, a matter that is discussed below.

An outbreak of a serious disease of **almonds** could have a severe affect on the demand for pollination services and the developing structure of the apiary industry. The National Nut Industry Biosecurity Plan, version 1³⁵, lists seven diseases of medium or higher economic potential to almonds, two of which, Phomopsis canker (*Phomopsis amygdale*) and Almond leaf scorch, (*Xyella fastidiosa*), are rated as having medium to high economic importance and high spread potential.

Whilst the risk of either of these diseases causing a significant decline in the economic viability of the almond industry or the area under almonds, has not been assessed, it remains a possibility that an outbreak of one or another of these or some other disease, could result in a significant reduction in demand for pollination services.

A major disease that severely compromised the viability of the almond industry would have immediate and the most severe effects first on almond growers then on the apiarists who provide pollination services and particularly those servicing almond growers who would lose a key market.

In the short-term for other users of pollination services there would likely be a significant up-side risk (opportunity) in that there would be an oversupply of hives relative to the demand and prices would be expected to fall.

In the medium to longer term, however, if the disease effectively wiped out the almond industry, the apiary industry would undergo a significant downward structural adjustment likely to result in fewer apiarists offering fewer hives for the provision of pollination services.

Under these circumstances the remaining users of pollination services could find themselves paying higher prices as the industry settles at an equilibrium that lacks the economies of scale the almond industry could give rise to.

In the long term, in the event of the almond crop being wiped out by a pest or disease, the worst hit (apart from apiarists and almond growers), would most likely be the next largest pollination service using industry. Those users, that because of the timing of their demand (late spring and summer), had previously been in a position to take advantage of marginally priced second and third services from hives that had serviced the almond industry earlier in the season could be especially hard hit. These users could find themselves facing fully priced services from a small pool of supply.

The history of **Canola** production in Australia since 1970 demonstrates a risk facing the apiary industry. In the late 1960's, in Western Australia in particular, the area sown to Canola (then known as Oilseed Rape) grew rapidly to become a significant minor crop, covering 49,000 ha by 1972 at about the same time, the disease Blackleg (*Leptoshaeria maculans*) became established

³⁵ PHA, 2007a

and spread rapidly, causing losses of up to 80 per cent. The impact was that by 1974 the area sown to Canola in WA had fallen by almost 95 per cent, to just 3,000 ha³⁶.

The development of polygenic resistant varieties and their introduction in the mid-1980s resulted in the area sown to Canola in Australia growing to a peak of about 1.6 million ha in 2000³⁷ and remaining at, or about, these levels despite the less than favourable climatic conditions that have prevailed in eastern Australia, in particular, since that time³⁸. The attraction of Canola to beekeepers as an early season source of pollen and nectar, has resulted in its importance to the Australian apiary industry growing with the area sown to the crop.

The Blackleg fungus is genetically variable and diverse and maintaining resistance to it is a priority for Canola breeding programs in Australia and elsewhere³⁹. A breakdown of resistance to Blackleg that resulted in losses as severe as those experienced 35 years ago could result in a rapid decline in the area sown to Canola, with a significant impact on the apiary and pollination industries.

Whilst an assessment of the risks and impact of a breakdown of resistance to Blackleg in Canola is outside the scope of this project, the in-principle risk demonstrated by previous experience is worthy of recognition by the Australian pollination industry.

5.3 Bees as vectors of plant diseases

An area of concern is the prevalence of pests and diseases of plants that are vectored by bees. If such diseases occurred in Australia an outcome could be restrictions on movement of bees, impacting the ability of beekeepers to provide pollination services.

The Emergency Plant Pest Response Deed (EPPRD) managed by PHA, to which AHBIC is a respondent, documents one disease that is vectored by bees, the bacterial Fire Blight of Pome Fruit, amongst those specified as Emergency Plant Pests (EPPs).

The list of specified EPPs is not intended to be exclusive and the range of diseases for which bees may be vectors is extensive, Shaw (1999) reviewed the relationship between bees and fungi and listed some 18 different plant pathogenic species as being incidentally transported by bees and a further 40 or more species and varieties of fungal spores (mainly of rusts and mildews) collected by bees in lieu of pollen, including the Guava Rust.

In addition to these bacteria and fungi, bees can be vectors of pollen borne viruses, including plum pox⁴⁰.

In the event of an outbreak of **Fire Blight** in Australia it is almost certain that bees in at-risk areas would be subject to movement restrictions and could only be moved to 'clean' pome fruit areas after a period in quarantine in a region free of the disease and host plants. Whilst the evidence is that the period of quarantine required to render the bacterium 'un-infective' is only a few days, the requirement would impose a cost and inconvenience to beekeepers wishing to service pollination contracts, especially if those contracts were in areas where pome fruit is grown.

More serious could be an outbreak of **Guava Rust** in Australia. Eucalypt pollen can be contaminated with (guava) rust urediniospores and work conducted by CSIRO in Brazil has

³⁶ Colton and Potter 1999

³⁷ Nelson et al 2001

³⁸ Lawrance 2007

³⁹ Salisbury, P; personal communication, January 2008

⁴⁰ Turner, R; personal communication, December, 2007

demonstrated the viability and infectivity of rust spores in commercial pollen⁴¹. Were the Guava Rust fungus to emerge in Australia it is almost certain that, as part of response and management plans, access for bees to both plantation and natural stands of eucalypts would be restricted, excluding beekeepers from a most important floral resource and severely compromising a fundamental element of beekeeping in Australia. These circumstances, if realised, would inevitably have an impact on the pollination industry.

5.4 Spill-over effects

Other pests and diseases of plants or animals could give rise to spill-over effects that restrict the movement of bees, if they occurred in Australia.

A key element of an emergency response to the detection of almost any exotic plant or animal disease is to seek to limit the spread of the disease by restricting the movement of animals, materials and vehicles or equipment that might spread the particular disease.

If unqualified, such actions taken in response to (say) an outbreak of foot and mouth disease, could present difficulties for, and impose costs upon, unrelated rural industries, including beekeeping. In Australia, emergency response arrangements for plant and animal diseases are coordinated under arrangements managed by PHA and AHA respectively. AHBIC is a respondent to both sets of arrangements.

In both cases and particularly in the management of animal diseases, member industries not directly affected by the particular outbreak are represented on the consultative and/or decision making bodies determining and overseeing the implementation of response plans, specifically to ensure that as far as is consistent with the eradication of the outbreak, unaffected industries are not adversely impacted by the response arrangements.

If a disease becomes endemic, in the absence of a nationally agreed management plan, control would normally revert to individual state jurisdictions. Under this control, the representation of industries that are not directly affected is not institutionalised. The risk that unintended spill over impacts on pollination service providers or consumers may occur, would increase.

5.5 Conclusion

The range of exotic pests and diseases that have the potential to impact upon the pollination industry extends well beyond those that directly impact the health and condition of honeybee colonies.

The status of various pests and diseases may change with time and new threats and risks may arise. From time to time, separately and collectively, industries with an interest in the pollination industry need to establish dynamic processes by which the biosecurity environment is regularly scanned. The status of particular pests and diseases should be reviewed and updated and new threats assessed and determined, as appropriate.

Finally, the risk posed by a particular pest or disease must not be considered in isolation from the industry, regulatory and response management environment in which an incursion may occur. The methodology applied by Hitchens (2004) in the risk-based disease prioritisation model referred to here takes account of these 'environmental' factors. Some of these factors and their interaction with the risks posed by the diseases and pests identified above are explored in some detail in Chapter 6 - Other potential risks for the Australian pollination industry.

⁴¹ Glen, M; personal communication December, 2007; Tommerup, 2002; Hernandez, 2006

6. Other potential risks for the Australian pollination industry

The prime focus of this study has been defined to be the biosecurity risks facing the Australian pollination industry and these have been considered in detail in Chapter 5. This review of the pollination industry and consultation with stakeholders has identified a number of additional risks. These risks have the potential to either impact the supply or demand side of the pollination industry, thereby altering the context in which biosecurity threats are viewed or leading to an interaction with a biosecurity risk to exacerbate or ameliorate its effect on the pollination industry.

There are risks other than pests and diseases that are recognised by the AHA Risk Management framework. The ‘other’ risks identified in this study are grouped by Source of Risk as discussed in Chapter 5 and are outlined in the following sections.

Trade and economic

6.1.1 Economics of honey production

The price of honey is and is likely to remain the key driver for beekeeping in Australia. A significant change in the price paid to beekeepers for honey represents a risk to the users of pollination services.

A large drop in the price paid for honey could render many honey producing enterprises unviable, leading to:

- a reduction in the number of commercial beekeepers and the number of hives under management
- an absolute deficiency in the number of hives available to perform pollination services
- a more likely increase competition for the hives available
- an increase in the cost of pollination services to growers of pollination-dependent crops.

The coincidence of a decline in the price paid for honey and an incursion of a significant disease of honeybees would exacerbate this problem for users of pollination services as:

- the increased cost of management required to maintain colonies in the presence of the disease would cause even more beekeepers to withdraw from the industry, further reducing the supply of pollination services
- whilst the disease would progressively reduce the contribution to pollination from feral bees, thus increasing demand for paid services.

A high price for honey might not be without problems for the pollination industry. Whilst a high price might encourage more people into the apiary industry and those already in it to expand the number of hives they manage, it might also increase the opportunity cost of performing pollination services and require pollination service users to pay more for those services or face the prospect of the service provider deploying the colonies under their management to honey gathering activities.

The interaction between a high price for honey and the incursion of a serious disease of honeybees could have a number of outcomes:

- the cost of managing the disease could offset the attraction into the industry of new entrants and those that might otherwise be inclined to expand their enterprises
- the impact of the disease on feral populations could increase the floral resources available to beekeepers by up to 25 per cent⁴²
- those who did expand the number of colonies they operate might not be able to apply the level of management required to maintain the larger number of colonies in the condition required to perform pollination services and therefore deploy the hives to honey gathering.

As has been observed in the USA and New Zealand, these pressures would be resolved through the market place in the form of a higher price for the procurement of pollination services.

6.1.2 Economics of key pollination requiring industries

Whilst honey production and the price of honey dominate the supply side of the pollination industry, almond production is rapidly assuming a key role on the demand side. Currently pollination services for almond producers require more than 60,000 colonies to be available during flowering in July – August and the demand is expected to exceed 140,000 hives within five years⁴³.

This growth is, in itself beginning to change the dynamics of the apiary industry on the east coast, but Australian almond production is still not a driver of the world price for that commodity. A sudden negative change in the economics of almond production could cut the growth, with significant repercussions for the pollination service providers.

An improvement in the economics of almond production would, other things being equal, be likely to increase the rate of growth of the Australian industry. Although important to the apiary industry, strong growth would not be as dramatic an impact as a sudden decline due to the time lapse of three to four years between planting almonds and the requirement for pollination services⁴⁴. This is roughly the same as the time required by a beekeeper to effect a doubling in the number of colonies⁴⁵.

Such an increase could have other ramifications, as the additional colonies would have to be sustained for many months between one almond pollination service and the next pollination contract, and access to adequate floral resources would become critical to the balance between pollination demand and supply.

In New Zealand in 1990, it was predicted that there would not be enough hives to pollinate the rapidly increasing kiwifruit industry by 2000. The demand for hives was increasing much faster than the supply of hives. However, the shortfall did not eventuate as New Zealand kiwifruit growers were forced to pay higher prices for hives, which encouraged beekeepers to increase their hive numbers and new beekeepers to enter the industry. A shortfall would have occurred if kiwifruit growers could not have absorbed the higher prices to secure beehives.

⁴² Somerville, personal communication, October 2007

⁴³ Monson, T; personal communication, November 2007

⁴⁴ Tolson, M; personal communication, November 2

⁴⁵ Monson, T; personal communication, December 2007

6.1.3 Market access

The absence of some important bee diseases from Australia limits the access to the domestic market for honey and other apiary products from other countries. At the same time it gives Australian apiarists favoured access to some markets and to bee products of Australian origin.

A change in Australia's biosecurity status arising from the incursion of a bee pest or disease such as *Varroa* could reverse the market access balance for Australian beekeepers, such that

- bee products from countries that were previously excluded due to the presence of the pest or disease in that country would gain access to the Australian market
- Australian exports of bee products might not only lose their preferred status in other countries but might be excluded from markets where the pest or disease in question does not occur
- separately and together, these outcomes would have the effect of increasing the supply of honey and other bee products to the Australian market, reducing prices paid to beekeepers and impacting upon the viability of Australian apiarists and reducing the number of colonies available to perform pollination services.

Currently there is a small but growing market for Australian apiarists in supplying 'packaged' bees to the United States to supplement local hives in the provision of pollination services to the Californian almond industry. If a change in Australia's bee biosecurity status matched the regime in the USA, it could facilitate the 'shuttling' of hives between the two countries to service the counter-seasonal demand for almond pollination. However, this scenario can only be the subject of speculation. If realised, it could have an impact on the structure of the beekeeping industry in Australia.

6.2 Organisation and management

6.2.1 Awareness of and capacity for efficient management of pollination

Pollination has been an important factor in the production of grains, fruit and vegetables for millennia, but it is only since the late 18th Century that the role of bees in the pollination process has been understood⁴⁶. In Australia at present, it appears that only in small pockets of the apiary and cropping industries and research and advisory circles are the details and complexity of the process well known and well managed.

In intensive, high-cost, high-value enterprises such as hybrid seed production or glasshouse vegetable production where the cost of failing to ensure adequate pollination is high, pollination is managed to ensure that bees or other agents are present in abundance.

In larger scale open-air operations where the production is less intense and incidental pollination occurs in addition to any paid services, the level of understanding and related management are generally more rudimentary. They rely on rules of thumb and past experience rather than science-based understanding of the biological and economic processes that apply in a particular circumstance.

It is impossible to determine what the impact of this level of understanding and management has been in terms of the profitability of individual pollination-dependent enterprises and industries. It may be that management of other factors and inputs is so much more important, or that a particular crop is so insensitive to the 'amount' of pollination applied that any more effort

⁴⁶ Dadant 1992

expended to understanding and managing the pollination element would not provide sufficient reward by way of increased yield or reduced costs.

Information on the technical attributes of an effective paid pollination service is not widely known and the research on technical attributes has not been completed.

Better management of pollination may prove worthwhile as the management of other inputs is optimised and growers are obliged by a continuing cost-price squeeze to look for previously lower ranking opportunities to improve the performance of their business with technical advances allowing other factors to be measured and/or controlled.

This process will be hastened by the introduction of new, high capital cost pursuits, such as large-scale almond production where management of pollination is part of the 'imported' management package and where pollination is generally recognised as a key input to successful almond cultivation. Coincidentally, the new generation almond plantations are so large that they render feral bee activity as irrelevant to the pollination of the crops, except along the boundary of a plantation. A better understanding and improved management of pollination in a large-scale almond production could provide spin-off benefits for producers of other crops, as they apply and adapt the learnings of almond producers to their own circumstances.

The pressure to understand and optimise the use of paid pollination services would increase significantly if a pest or disease such as Varroa were to become established in Australia. As well as increasing the costs of managed pollination services, it is likely that Varroa would initially reduce the number of hives available to provide pollination services. More importantly, over time, Varroa would effectively eliminate the contribution of feral bees to the pollination of commercial crops.

These combined factors would drive providers and users of paid pollination services and their advisers and support services to focus on optimising the preparation, deployment and management of honeybees to provide pollination services.

Opportunities for improving the efficiency and effectiveness of paid pollination services lie in better understanding and optimising the following aspects of pollination management:

- colony strength
- hive density
- bee husbandry and breeding
- biosecurity management
- crop layout, access, nutrition and management
- the use of chemicals that might negatively impact the health and behaviour of bees.

An essential pre-requisite for any improvement in the management of pollination services is a much better understanding of the contribution of feral colonies to pollination in this country.

Effective application of best practice pollination management requires that all stakeholders involved in the process are aware of and/or are trained and educated in the best practice standards, consistent with the responsibilities of their role in the pollination process. Stakeholders in this case should be considered to include beekeepers and their employees, growers and their employees and contractors, pollination service brokers and government and private advisers

6.2.2 Resources, skills and processes to detect and identify an incursion

A risk identified during consultations with stakeholders is that associated with Australia's capacity for early detection and identification of an incursion of a pest or disease that might affect the pollination industry. As outlined in Chapter 5, such pests and diseases are not confined to those affecting honeybees but include some plant diseases, although the diseases and pests of honeybees are the primary concern of most stakeholders.

With regard to **pre-border** surveillance, it is important to continue contacts with, and visits to, relevant experts and practitioners in countries that have the pests and diseases of concern may be the source of an incursion into Australia.

Of greater concern is the risk posed by a failure **at-the-border** or **post-border**.

Facilities and processes

The quality of inspection of freight and passengers is generally acknowledged as consistent with the risk. Some stakeholders regard higher levels of inspection occurring for security reasons as having spill-over benefits to biosecurity and the apiary industry in particular. However, the impending closure of the Eastern Creek Quarantine Station in NSW which includes a facility for processing live bee imports, is perceived as a significant risk to the pollination industry and beekeeping in general. Arrangements to provide alternative facilities following the closure of Eastern Creek are the subject of current and continuing discussion and negotiation⁴⁷.

The Sentinel Hive program as it is applied at shipping ports in all States and Territories other than Tasmania and South Australia was the subject of a risk based review in 2005⁴⁸. The extent to which the recommendations made in this review have been implemented is unknown and consultations undertaken in the preparation of the report reveal continuing concerns regarding apparent inconsistencies in the application of the program between jurisdictions and whether the current, 'passive' sentinel hives should be supplemented or replaced with baited hives at some or all locations.

More recently, arrangements under which the program is coordinated and funded have been the subject of consideration with a view to:

- transferring responsibility for coordination of the program from Biosecurity Australia to AHA
- having industry rather than governments fund the program.

A business plan proposing such revised arrangements is currently in preparation⁴⁹.

No jurisdiction has a requirement for beekeepers to collect samples taken from hives and submit for inspection. In Tasmania as part of that State's registration scheme, apiarists are encouraged to take samples but are not compelled to do so. Queensland and Western Australia also have extensive but not compulsory hive monitoring initiatives.

Across the eastern States there is a requirement that hives being transported across borders are certified by authorities in the State of origin that the hives have been inspected and are free of SHB. It appears⁵⁰ that data is not collected on the frequency of detection of SHB or other diseases

⁴⁷ Ware, S; personal communication, January 2008

⁴⁸ Boland, 2005

⁴⁹ East, I; personal communication, January 2008

⁵⁰ Somerville, D; personal communication, December 2007

and pests that inspections might reveal. Such schemes could have a range of biosecurity benefits if applied nationally and utilised to their potential. The benefits include:

- increasing the chances of early detection of an exotic pest or disease
- providing a better understanding of the distribution and incidence of endemic pests and diseases
- improving the awareness and interest of apiarists in matters relating to biosecurity, as the experience in New Zealand has been that the closer attention to hives required to manage Varroa has resulted in better management of, and a reduction in, the impact of other diseases⁵¹.

Detection and identification of pests and diseases requires appropriate facilities in which to conduct necessary processes to identify and research potential or actual exotic pests and diseases. Numerically Australia's complement of facilities appears to be adequate but a risk exists in the individual and combined capability and condition of these facilities. Stakeholders question the practicality of sustaining an adequate capability in each jurisdiction and are concerned that economically rational decisions made in isolation by individual jurisdictions could lead to a deficiency in the national capability.

6.2.3 Human resources, awareness and expertise

Several honeybee industry leaders have expressed concern about future research capacity and the availability of experienced researchers, with several approaching retirement but with relatively few younger researchers coming through the pipeline.

It is recognised that the handling of bees requires particular skills, making it difficult for government authorities to 'multi-skill' regional personnel to provide support to apiarists as well as other primary producers. Coverage of the apiary industry at levels sought by beekeepers becomes difficult to justify in economic terms. Beekeepers are concerned that the higher level skills and expertise required to undertake the highly technical and specialised tasks involved in identifying, diagnosing and researching pests and diseases are in decline and represent a significant risk exposure for their industry.

In the absence of adequate numbers of regional apiary officers, beekeepers accept that maintenance and monitoring of sentinel hives falls to the industry and individual apiarists. To effectively fulfil this role, beekeepers require appropriate awareness raising activities and in some instances formal training and education.

The producers of pollination dependent crops can represent a risk to the pollination industry if they are inadequately informed or unaware of the biosecurity risks facing the various parties to the pollination process and the grower contribution to and responsibility for minimising risks and detecting anomalies that might indicate a biosecurity failure.

6.2.4 Effective implementation and management of a response to an incursion

Of at least equal importance to the detection and identification of an incursion by an exotic pest or disease is the capability to mount an effective response that is adequately resourced and appropriately managed. The experiences with SHB in Australia and Varroa in the USA and New Zealand indicate that the emergency response to an incursion and ongoing management of an established outbreak need to be considered.

⁵¹ Goodwin, M; personal communication, December 2007

6.2.4.1 Emergency response

Facilities and Processes

The same facilities that are required for detection and identification of pests and diseases would be required for an effective emergency response and the same risks in regard to these facilities as outlined above threaten the adequacy of a response to an incursion in Australia.

Both the plant and animal industries have well recognised and proven emergency response management processes represented by:

- the EPPRD and PLANTPLAN coordinated by PHA
- the EADRA and AUSVETPLAN coordinated by AHA.

The challenge presented by, and the risk to the pollination industry is that its representational resources are spread across both the plant and animal sector.

The need for appropriate articulation of these processes across the various interests represented within the pollination industry is recognised by both PHA and AHA but formal structures to address the risks arising from these interface issues do not yet exist.

Arrangements for managing emergency plant and animal disease responses in Australia rely on close coordination across the actions of State, Territory and Commonwealth Governments and affected industry sectors. There is a risk that the interface issues identified above could impact upon the effectiveness of response activities within individual jurisdictions where organisational arrangements often mirror those described above, with the interests of the supply side of the pollination industry represented by one structure and set of authorities within an agency and those of the demand side represented by another. The risks and potential inefficiencies appear to have been recognised in some jurisdictions but the extent to which they have been eliminated has not been tested.

A further set of process risks arises from the large number of industries represented amongst the users of pollination services encompassing their differing size and geographic coverage and the differences in their dependence upon pollination services. Achieving appropriate representation for such a diverse and complex set of interests, presents a particular challenge which if not addressed could compromise an emergency response. All of the industries are covered under the membership arrangements of PHA whether or not they are currently members of PHA.

Human resources, awareness and expertise:

The same risks relating to the availability of suitably competent human resources as were described as those applying to the detection and identification of exotic pests and diseases apply to the conduct of emergency responses to incursions.

By virtue of the longer history of AHA and membership of AHA by AHBIC, identification of the emergency response roles to be filled by the beekeeping industry in the event of an emergency bee pest or disease includes:

- development of competency training packages required to equip industry representatives to perform these roles
- the conduct of training for these roles being well advanced
- the number of individuals trained for each of the specified roles not yet meeting the level required to satisfy the National Animal Health Performance Standards.

Awareness of and training in emergency response processes and protocols on the demand side of the pollination industry is not as well advanced and constitutes a risk to the implementation of any response involving these industries. The diversity of interests represented amongst the users of pollination services, complicates the awareness raising and training tasks.

6.2.4.2 Containment or management programs

The potential impacts of an incursion of a pest such as *Varroa* dictate that strenuous efforts should be made to minimise the likelihood of an incursion and to ensure detection early enough to allow eradication. However, it is essential that all stakeholders recognise that, due to the cryptic nature of the pest, the long period between a colony becoming host and the consequences of the invasion becoming conspicuous, based on the experience in the United States and New Zealand where the pest appears to have been present for some years before being detected⁵² **it is more likely that when first detected in Australia, *Varroa* will be well established and beyond any reasonable attempt at eradication.**

Given this likely scenario, the complexity of the interests to be represented and the need of the pollination industry for the interstate transport of bees, it is most important that, as well as developing and maintaining emergency response plans and processes to effect eradication (if at all possible), pre-emptive actions are taken to ensure a smooth and rapid transition from a national response plan to a national containment and management plan.

A key pre-requisite for realising an expeditious, comprehensive and effective transition from national emergency disease response to a national disease management plan is the negotiation and formalisation of protocols including representation and cost-sharing, that address the areas of high risk that occur at the:

- plant – animal interface
- government – industry interface
- intra and inter-jurisdictional interfaces.

6.2.4.3 Simulations and exercises

The variety and complexity of interests that would be involved in either an emergency response or a disease management plan make the development and conduct of simulation and training exercises a priority action, particularly those that involve implementation of arrangements formalised to address the interfaces identified above.

However, due to the complexities referred to above, care should be taken initially to avoid scenarios that are so ambitious to confuse, confound and frustrate even the best trained and most experienced participants.

6.2.4.4 Identification and tracing of beehives

A key capability in any animal disease response or management plan is the ability to identify and trace the movement of, at-risk stock. Australia's cattle and dairy industries have implemented best practice individual animal identification and tracing arrangements through the National Livestock Identification System (NLIS).

The potential role of bees in the spread of the diseases listed in the chapter above, as well as other diseases not central to bee health and the migratory/nomadic nature of the beekeeping industry in Australia, dictates that a scheme equivalent to NLIS be implemented for the apiary industry in Australia.

⁵² Pettis J; personal communication, January 2008; Goodwin, M; personal communication December, 2007

Currently, state based registration schemes require that hives are identifiable as belonging to a particular registrant. These schemes locate all of the colonies registered to an individual or enterprise at the registrant's address and make no provision for tracing the movement of hives in time or space.

Such a scheme is clearly inadequate for the purposes of disease eradication or management, particularly given the frequent and unpredictable transport of hives in pursuit of honey flows and pollination contracts and the inter-mingling of bees belonging to one registrant with those belonging to others as well as with feral bees whilst located at an apiary site or on an orchard or grove.

Technological advances such as RF-tagging and GPS devices – the latter of which are widely used by apiarists - and the data management systems developed for NLIS, should make the development of a best practice hive identification and tracing scheme both administratively and financially more feasible than might have been the case even a few years ago.

Failure to upgrade the identification and tracing of beehives would severely compromise any and all other disease response and management plans.

6.2.5 Awareness, education and training arrangements for the pollination industry

As discussed in Chapter 3 **Pollination of commercial plant species in Australia**, the level of awareness of and skills required in the processes involved in the preparation and management of bees to provide pollination services is lower than might be expected.

These low levels of awareness and skills represent a two-fold risk to the pollination industry:

- the low levels are likely to result in a less than full appreciation of the issues at stake for apiarists and pollination dependent industries and as a consequence, an inappropriate regard for necessary biosecurity practices
- an inadequate ability to recognise **the required activities** to protect the biosecurity interests of pollination industry stakeholders.

There is also a need for awareness education and training at all levels within the pollination industries and related government and private regulatory and advisory agencies, with the awareness and competencies required in each instance being consistent with the role and responsibility the individual discharges.

There is the additional significant issue, if the demand for pollination services is to grow as anticipated, of recruiting people into the apiary industry to own and/or manage the additional colonies that will be required to meet the needs of the pollination industry.

Anecdotal evidence⁵³ suggests that the maximum effective workload in managing beehives is 500 colonies per labour unit. At this rate, about 300 additional fulltime apiarists would be required to manage the 150,000 hives needed to replace the contribution of feral bees to pollination in Australia, in the event of Varroa becoming widespread.

⁵³ McDonald, B; personal communication, January 2008

Education and training for the Australian pollination industry is the subject of a separate study and is not considered in any further detail in the present report.

6.2.6 Limited or no reference to pollination or biosecurity in QA programs

In the course of this study the following biosecurity and quality assurance plans have been reviewed:

- honeybee industry:
 - Biosecurity or Disease Risk Mitigation Strategy for the Australian Honey Industry (AHBIC 2004)
 - B-Qual (AHBIC)
- plant industries:
 - National Nut Industry Biosecurity Plan (Version 1, PHA September 2006)
 - National Vegetable Industry Biosecurity Plan (Version 1, PHA May 2007)
 - Freshcare⁵⁴
 - SQF 1000 & 2000⁵⁵
 - GlobalGAP/EuroGAP (Good Agricultural Practice)⁵⁶
- pollination industry:
 - Pollination Manual (RIRDC 2000).

The biosecurity plans reviewed address in detail the pests and diseases of individual plant species and bees in the case of the AHBIC document. However, none specifically address pollination or the biosecurity issues associated with the movement of hives into and off crops, despite the fact that pollination is an important input for many of the vegetable and nut species covered by these plans.

None of the three grower QA schemes, SQF (a requirement for suppliers to one of Australia's largest retail chains), Freshcare (a HAL project with some 4000 grower members) or GlobalGAP/EuroGAP (the standard applied by the European Union) has any specific reference to biosecurity or pollination.

The general requirement in most QA plans that incoming goods and services be subject to inspection or certification could be interpreted as applying to any pollination services a grower might use although it would seem that where feral bees or other insects have a role in pollination, they are beyond both inspection and certification.

Freshcare is subject to on-going development and plans for the next few years include the development and introduction of a Biosecurity Element⁵⁷.

B-Qual has a primary focus on quality assurance for honey and the coverage of pollination service provision is very limited.

The RIRDC Pollination Manual includes a general comment on the need for the beekeeper to provide healthy colonies and a specific requirement that colonies be free of American Foul Brood.

⁵⁴ Freshcare Ltd ,2004

⁵⁵ Food Marketing Institute 2005

⁵⁶ Global GAP 2006

⁵⁷ Hamilton-Bate, C; personal communication, January 2008

If industry associations intend to promote biosecurity plans and QA programs as the bases for sustainable production it would seem appropriate that:

- QA programs be extended to include biosecurity elements
- that these extended programs address the biosecurity and food quality aspects of pollination where pollination is a factor in the production of the crop in question.

To overlook pollination in these ‘best practice’ arrangements would be to discount the importance of pollination in the production process and overlook the risks to both the users and providers of pollination services associated with the practice.

6.2.6 Structure of the beekeeping industry

The recent and continuing growth in demand for pollination services has been generated mainly by investments in large-scale fruit, nut and vegetable growing operations. The investment risk represented by these large-scale operations is too great for managers to rely on the activities of feral bees or other incidental pollinators. Indeed the area covered by some of these operations is so great that incidental pollinators do not normally penetrate beyond the outer fringes of the plantations.

Achievement of sustainable returns from plantation investments requires, in part, that sufficient stocks of honeybee colonies, in a suitable condition are available and supplied at the time pollination services are required. Currently, the almond industry in the Mildura region requires almost 15 per cent of the total number of hives registered in Australia to service its pollination requirement. With colonies from WA and Tasmania excluded for logistical reasons and about 60 per cent of colonies in a condition suitable to meet the standard required at any point of time⁵⁸, the current demand from one regional area represents about 25 per cent of the qualified stock available.

Currently, a small proportion of the demand in the Sunraysia/Riverina areas is being met with hives drawn from southern Queensland to supplement those from Victoria and NSW. For the almond industry to grow as projected, a much higher proportion of the national stock will be required to participate in seasonal pollination and the total stock of available hives will need to grow.

There are aspects of the beekeeping industry in Australia that are not entirely consistent with the developing demand for pollination services and which have the potential to put continuation of the recent rapid growth of pollination dependent industries at risk without taking account of the incursion of Varroa.

The prevalence of small operators

Beekeeping in Australia has traditionally been a part-time pursuit for many participants and as much a lifestyle as a business for those involved in it on a full-time basis. Further, most of the full-time businesses are relatively small operations conducted by sole-operators and family partnerships.

The focus of the industry has been on honey production from native floral resources. The geographic spread of these resources and the inconsistent and unpredictable honey-flows they produce have made the lifestyle of the beekeeper more nomadic than migratory.

⁵⁸ Monson, T; personal communication, December 2007

Servicing pollination contracts has only been a serious consideration for a small number of beekeepers who have specialised in this aspect of beekeeping. For the rest there is some resistance to participation in the pollination industry. The rigid timing and fixed locations associated with servicing pollination contracts do not fit well with the vagaries in the timing and location of the major native honey-flows or the unpredictability of the condition of colonies to which these vagaries give rise.

Meeting the colony condition standards required by pollination service users and the need to progressively increase then reduce the number of hives as the flowering of the crop to be pollinated progresses are demands that for many beekeepers are inconsistent with being 'one's own boss', often an attraction of the beekeeper's lifestyle.

On the other hand it may be the nature of the industry, and in particular the isolation and extensive travel demands, that will make the recruitment of the new owners, managers and operators required to service an increased demand for pollination services, difficult.

Scale

As the Australian apiary industry is comprised largely of small stock-holdings⁵⁹, the limit for effective maintenance and management of the stock is probably about 500 hives per labour unit⁶⁰.

With individual operations requiring 5,000 to 15,000 hives the developing almond industry introduces a new and larger level of scale to the Australian pollination industry. One, two or three labour-unit beekeeping operations are only relevant to the large scale almond grower if the delivery, management and removal of the hives are coordinated with that of stock from many other similar sized beekeeping operations.

Undertaking this coordination task is not consistent with the primary management responsibilities of either the almond grower or the beekeeper. **For the average or smaller beekeeping operation to be recruited to the large scale pollination industry of the future, which is where the growth in demand is likely to be generated, the role of Pollination Brokers must increase.**

The alternative structures that might satisfy the future needs of large scale cropping operations such as the almond industry, but which would not be without their own risks, are either the consolidation of the apiary industry into fewer, much larger, operations or some entity associated with the major pollination service users, franchising or 'share-farming' with, beekeepers whom they assist with the capital costs of establishing an apiary on the condition that hives are made available to service the pollination industry, at a specified level of quality.

While other pollination-dependent enterprises such as fruit and vegetable growing and pasture seed production will progressively increase in size, the increase in the scale of most of these operations in the medium term is unlikely to be so great as to disrupt current direct relationships with pollination service providers and to require the involvement of pollination brokers in these industries.

Based on practices in the USA and developments in Australia, in the large scale pollination market such as the almond industry where the role of the pollination broker is necessary and relevant, the relationship between the three parties, in contrast to that represented in Table 3.4, is as indicated in Table 6.1 below:

⁵⁹ RIRDC, 2007

⁶⁰ McDonald, B; personal communication, January 2008

Table 6.1 Management of Factors influencing the effectiveness and efficiency of pollination service delivery when a Pollination Broker is involved⁶¹

| <u>Factors within the control of the beekeeper</u> | <u>Factors within the control of the pollination broker</u> | <u>Factors within the control of the grower</u> | <u>Factors which are outside the control of either</u> |
|--|---|--|--|
| <ul style="list-style-type: none"> ▪ price per bee colony ▪ timing of delivery and removal ▪ strength status | | | <ul style="list-style-type: none"> ▪ weather conditions during pollination ▪ attractiveness and quality of nectar and pollen ▪ outbreak of pest or disease of bees, ▪ quarantine restrictions or barriers ▪ presence and nature of non-target species outside property boundary |
| | <ul style="list-style-type: none"> ▪ stocking rate ▪ price per bee colony ▪ timing of delivery and removal ▪ use of agricultural chemicals ▪ availability and quality of water for bees ▪ farm activities during pollination ▪ precise location, aspect and configuration of hives | | |
| <ul style="list-style-type: none"> ▪ access to sites ▪ attractiveness of crop and strategies to keep bees working target crop | | | |
| <ul style="list-style-type: none"> ▪ strength and condition of colony on delivery ▪ pest and disease status colony on delivery | <ul style="list-style-type: none"> ▪ checks to ensure compliance with contract | <ul style="list-style-type: none"> ▪ choice of crop, fruiting and pollinating cultivars ▪ planting arrangement of crop, fruiting and pollinating cultivars ▪ compatibility of fruiting and pollinating cultivars ▪ crop hygiene and condition of plants ▪ suitable areas for bee sites ▪ presence and nature of non-target species | |

Demographics

While reliable demographic statistics have not been identified, it is understood that the average age of operators in the apiary industry is increasing and numbers are declining⁶². Recruitment to the industry appears to be low and (anecdotally) is either from within families with established apiary interests or occasionally hobbyists who move to full-time beekeeping.

Training courses in beekeeping are attended mainly by those who intend to take up beekeeping as a hobby or on a part-time basis⁶³.

⁶¹ Monson, T; personal communication, January 2008

⁶² Somerville, D; personal communication, October 2007

⁶³ Martin, G; personal communication, January 2008

The implications of these trends are that ‘conversions’ to the pollination industry are likely to be less than might otherwise be expected due to:

- **older, well-established apiarists** being less likely to change from familiar routines especially as aspects of the management of colonies for pollination services are different to those for honey production
- **new recruits** into a family business being likely to be influenced by previously established routines and practices
- **established hobbyists** expanding to full-time involvement being more likely to stay with honey production
- **new graduates** from courses where there is exposure to a current and positive view of the pollination industry being unlikely to be significant contributors to the provision of pollination services if they are operating as hobbyists.

The compounding effect of an incursion of *Varroa* in the context of the industry demographics would probably be a hastened departure of older producers and the smaller scale operators and hobbyists due to the increased cost and management time required to maintain productive colonies. A 20 per cent increase in the management effort required in the presence of *Varroa* would reduce the manageable stockholding per labour unit from 500 hives to 400, thereby changing the economic viability of average and smaller holdings.

In contrast, developments in pollination-dependent industries are strongly geared towards larger corporate entities taking the place of family based enterprises, with the owners generally not involved in day-to-day decision-making operations and professional managers with specialist education and training being accountable for the performance of the operations.

There is evidence⁶⁴ that established beekeepers that have traditionally been honey-producers can be recruited to provide pollination services if they are supported with advice and assistance in making the transition.

The recruitment of sufficient new beekeepers to the apiary industry and particularly to the provision of pollination services to meet the potential demand for these services is a significant issue facing the pollination industry in Australia.

6.3 Environment and natural events

6.3.1 Climate change

Climate change has serious implications for the types of crops that are grown, their location and the season of pollination. It has consequences for the flowering patterns of the eucalypts on which the honeybee industry depends for hive strengthening prior to pollination assignments, influencing the capacity to supply pollination services and as a source of honey flow. Climate change may also affect the pattern and prevalence of honeybee pests and diseases.

The effects of changing weather patterns may be direct consequences of changes in rainfall levels and patterns, temperatures and other aspects of the weather or the indirect effects of government regulations and incentives introduced to manage the direct impacts.

⁶⁴ Monson, T; personal communication, November 2007

Impact on land and water use resulting in change in demand for pollination services

These impacts could be **direct**, due to changes in climatic conditions:

- rendering areas that are currently suited to a particular crop to be no longer so due to changes in rainfall and its seasonal patterns, or conversely
- rendering areas that are currently unsuited to become more favourable, resulting in a change in the types of crops able to be grown in a particular area.

The impacts could also be **indirect**, such as government imposed constraints on the availability of irrigation water resulting in the substitution of high water use crops such as rice which has no pollination requirement, for a lower use crop such as almonds which have a high pollination requirement.

The impacts could prospectively be the consequence of future carbon-trading arrangements that will favour the growing of perennial tree crops over annual cereals, with a spill-over effect upon the demand for pollination services or the availability of floral resources for honey production.

Impact on native floral resources

Whilst not fully understood, the pattern of flowering of key nectar producing native species, including many species of *Myrtaceae* and *Proteaceae*, is related to seasonal conditions. If, and as, the conditions change, the quantum, timing and location of honey-flows is also likely to change and the risks to the pollination industry are self evident.

If the changes result in increased and/or reliable and/or more accessible honey-flows, the opportunity cost to apiarists of servicing pollination contacts will increase as will the cost of pollination services, even if the improvement in circumstances results in the total number of hives under management increasing.

Conversely, a decline in the availability of native floral resources would reduce the number of colonies that could be maintained when not performing pollination services, thereby reducing the supply of pollination services available to users, with the resultant increase in competition for available supplies increasing the cost of services to the user.

Impact on the distribution of pollination agents, especially honeybees

A change in climatic conditions might change the distribution of pollination agents and in particular the areas and times of the year where and when they can operate effectively. For honeybees, a warming would see the range shift south, but if in northern Australia conditions would become unsuited to honeybees and favour other bee species currently confined to Asia.

Impact on epidemiology of pests and diseases

A warming of conditions in southern Australia would alter the range of pests and diseases of bees and the crops that they service. If, as appears to be the case, *Nosema apis* has its greatest effect during the colder, wetter months⁶⁵, a warming might result in the depredations from this disease being reduced, but may result in other diseases becoming more damaging.

⁶⁵ Somerville, 2007

6.3.2 Timing of demand for pollination services and competition between crops for pollination services

Table 3.2 indicates that a peak in the demand for pollination services occurs in the months of August and September when 15 or 16 of the species listed, including some of the larger and more highly pollination-dependent crops require services. A secondary peak occurs in December and January when 10 or 11 of the listed species require pollination.

Whilst it may be possible for a colony that has serviced the August/September peak to be prepared for the December/January peak, the competition between growers for pollination services during these peak periods could become a significant issue, especially if honey prices and/or honey flows are insufficient to sustain the total number of hives.

The August/September peak represents a challenge for beekeepers as it necessitates particular management of the colonies over the three or four previous months to ensure that they are in a condition suitable to perform the service. It is likely that a smaller proportion of the stock of hives will meet the required standard during the summer months than might be the case across the winter / spring period.

6.3.3 Adequacy and accessibility of native floral resources to sustain a large increase in the size of the bee population to match growth in demand for pollination services

A major risk for the pollination industry is the prospect that the growth in demand for pollination services results in the population of managed bees exceeding the capacity of available floral resources to sustain colonies in non-pollination periods. These circumstances could arise if:

- the number of managed hives grows beyond the available resources
- if changes in climatic conditions reduce the available floral resources
- if beekeepers are excluded from accessing sufficient, available resources to sustain the total population of hives.

Under any one of these circumstances, beekeepers might be forced to provide supplementary feeding to maintain the condition of their colonies – generally a more costly and less satisfactory means of managing the hives⁶⁶ and one that is likely to increase the cost of pollination to users, particularly those requiring the services in the late-winter/early spring peak.

With some exceptions, notably **The Floral Resources of NSW**⁶⁷ there does not appear to be adequate information available on this crucial natural resource to allow informed management of the national apiary industry, which could compromise the future of the pollination industry.

6.4 Human behaviour

6.4.1 Deliberate or inadvertent breach of quarantine

There always exists the possibility that an individual may deliberately or inadvertently breach Australia's quarantine restrictions, regardless of how stringent the surveillance and the sanction, introducing a pest or disease that subsequently impacts on the pollination industry.

The requirement for individuals wishing to import live bees to place them in a quarantine facility serves two positive purposes:

⁶⁶ Somerville, 2005

⁶⁷ RIRDC; 1999

- reducing the chances that a pest or disease will be imported and escape into the environment
- serving as a declaration that the biosecurity of the bee industry is important and is worthy of protection.

6.4.2 Willingness to report a suspect incursion

More difficult than the requirement for citizens to observe quarantine arrangements, is the obligation on individuals to report suspect incursions of pests and diseases. The difficulties arise where the person detecting the possible incursion has an interest in the industry that is at risk, generally a producer within that industry. Such individuals face the dilemma of the moral and legal obligation to report a suspect case and the potential consequences for their operations as:

- a report is likely to cause inconvenience and possible cost associated with an inevitable period of quarantine arising from the investigation of the report and the likely destruction of stock and facilities if the incursion is confirmed
- the possible reaction of fellow producers who may be similarly affected by the discovery of an exotic pest or disease⁶⁸.

The EADRA and the EPPRD have provisions that are intended to encourage producers to report disease incursions and to ensure that those making a report are not disadvantaged.

The benefits of early detection are so great and the costs of a delay so severe as to reinforce the significance of the effort to ensure that all suspect cases are reported as soon as they are detected. An important element in ensuring reporting of suspect incursions is industry confidence that a report will be treated seriously and investigated diligently and expeditiously.

6.4.3 Acceptance of structural change including pollination service provision

For those with a long history in the pollination industry, the prospect of change can be daunting and confronting.

As discussed above, provision of paid pollination services has not been a major consideration for most Australian beekeepers and the continued growth of the pollination-dependent industries will require recruitment of an increasing proportion of the industry to the task. A failure to address the interests and concerns of those who might be uncomfortable with the changes to their management practices and routines could be detrimental to the pollination industry.

6.5 Commercial and legal

6.5.1 Relative economics of pollination and honey production

As emphasised elsewhere in this report the major opportunity cost facing beekeepers that provide pollination services is the honey production that they have to forego in preparing and deploying colonies for the pollination task.

Honey production has a higher risk profile than the provision of pollination services. The price paid to beekeepers for the honey produced is subject to variation as is the supply of nectar from which the bees produce the honey.

⁶⁸ Manning, R; personal communication December 2007

When honey prices are high and/or nectar flows are strong, the opportunity cost of providing pollination services increase and pollination service users face the prospect of either paying more for the services they require or having access to fewer hives to perform the service.

As a cadre of apiarists develops for whom the provision of pollination services is their core business and honey production is an incidental side production stream, the risk to the pollination service user from this source will diminish.

6.5.2 Grower and beekeeper rights and responsibilities in pollination contracts

With the demand for pollination services growing and the size of the apiary industry stagnating or declining under pressure from modest honey prices and recent poor seasonal conditions; it is in the interest of pollination service users to ensure that the conditions of pollination service contracts are not too onerous.

It is reasonable that service users require that colonies be of appropriate strength and that deliveries are made when required. In the particular context of this study it is also reasonable and appropriate that both parties to the contract respect the biosecurity interests of the other to minimise the risk of diseases becoming established and spreading.

A grower is likely to host hives from more than one apiarist and an apiarist is likely to move hives on to a number of properties during the course of a year. The biosecurity risks posed by each party to the other can be significant and both warrant reasonable protection under the provisions of the contract that governs their commercial relationship.

The beekeeper should have a reasonable expectation that other hives located on the same property will be disease free and the grower should have a reasonable expectation that the beekeepers equipment will not be vectors for diseases of the crop being pollinated.

6.5.3 Introduction of brokers to the pollination industry

For reasons outlined above, the introduction of pollination brokers to the industry should be beneficial for commercial, operational and biosecurity reasons.

Commercially, a broker can remove some of the risks to the grower and the beekeeper:

- for the grower a broker reduces the risk that hives will not be available as and when required
- for the beekeeper, the broker provides certainty of payment.

Operationally, the broker removes from both parties the need to apply their management time and skills to coordinating arrangements for the supply and delivery of colonies to service the contact.

From a biosecurity perspective, the broker can be the independent third party that ensures that the grower and the beekeeper meet their biosecurity obligations to the other party.

It is possible to conceptualise even broader roles for the broker that include coordination of access to floral resources for colonies when they are not servicing pollination contracts. It is also conceivable that the operations of the Trade Practices Act and other legislation may be applied to pollination brokerage to limit the ability of a broker to exert undue market power by controlling access to specific tracts of pollination ready crops or orchards, or the utilisation of specific hives that are required for pollination purposes.

6.6 Political

6.6.1 Access to native floral resources

A key issue for the continued expansion of industries based on growing highly pollination-dependent crops is the availability and accessibility of adequate floral resources to support the preparation of honeybee colonies for pollination services and maintaining the colonies for the remainder of the year when the pollination service has been completed. The bulk of honey produced in Australia currently comes from native floral sources, so restrictions on access would place additional pressure on the extent of honey production that currently underpins the viability of paid pollination services. Supplementary feeding of honeybees as a substitute for native flora ‘over wintering’ has not proved cost effective at current honey and pollination service prices, but may change with a restructuring of demand patterns.

It is broadly accepted that Australia’s native floral resources could comfortably support a population of managed honeybees sufficient to meet the demand for pollination services if beekeepers are not denied access to resources growing on Crown and other publicly owned land.

There is a view that as honeybees are an introduced species with a potential to ‘damage’ native flora and compete with native insects and birds, hives should be excluded from native forests on public lands. This view has prevailed in Queensland where, from 2020, beekeepers will no longer be able to access these resources⁶⁹ and in Victoria managed bee colonies are already excluded from some public forests and land adjacent to them⁷⁰. Politicians in other states continue to receive representations seeking similar exclusions.

The strength of the case for such exclusions is not a matter that can be considered further in this report as there is a need for further research on the matter, including consideration of the impact of the issues of concern in the event of a disease or pest incursion that significantly reduced feral bee populations in native forests.

The risk posed to a significantly expanded pollination industry by a total exclusion from native floral resources on public lands warrants an assessment of the position and rationale of those who propose such exclusions, followed by the development and promotion of an alternative point of view. There is a need to develop an evidence base to deal with the concerns of environmental commentators and decision makers and the adoption of an appropriate R&D strategy is an advisable pathway to follow.

In addition, there is a case for the pollination industry to promote the inclusion of suitable floral resource species in any large scale revegetation/re-afforestation schemes that are undertaken, including the development of plantation timbers to avoid the utilisation of old growth forests for timber.

6.6.2 Access to and allocation of water resources

As outlined above, political responses to the impacts of climate change are likely to result in changes to land and water use in various parts of Australia.

⁶⁹ Warwick Lee, Qld DPI, personal communication, December 2007

⁷⁰ Linton Briggs, Victorian Apiarists’ Association Inc – A Case for the Review of Victorian Land Reference Areas Beekeeping Policy (year unknown)

The impact of such changes on the various interests represented within the pollination industry are impossible to anticipate but should be the subject of continuing evaluation by those involved in the industry.

6.6.3 Impact of Carbon Trading arrangements could affect both supply of and demand for pollination services

Predicting the consequences for the pollination industry that arise from the operation of carbon trading schemes is beyond the scope of this study, but could be significant. Potentially beneficial outcomes could arise from the planting of species that qualify for carbon credits and provide floral resources for beekeepers or require pollination services.

It is in the interests of stakeholders in the pollination industry to monitor the development and implementation of proposed carbon trading schemes to anticipate their impact and influence the outcomes.

6.6.4 Trade agreements that impact honey and/or pollination-dependent crops

Beekeepers are concerned that their (relatively) small industry and their interests may be 'bargained away': in trade negotiations that deliver benefits to larger interests within the Australian economy. One such trade-off that could impact the broader pollination industry is that which allowed greater access to the Australian market for honey producers in other countries.

The two-fold concerns of the honeybee industry are:

- that the relaxation of biosecurity arrangements necessary for this to be effected would result in the incursion and spread of exotic pests and diseases
- that the economic impact would lead to a decline in the price paid to Australian producers for their honey which could lead to beekeepers exiting the industry and reducing the stock of colonies available to perform pollination services.

6.7 Technology

6.7.1 Development of pest or disease tolerant, resistant or avoiding bees

A clear widespread benefit for the pollination industry would be the development of strains of honeybees that have:

- all the desirable characteristics of honeybees currently available to Australian apiarists
- additional characteristics that enable honeybees to tolerate, resist or avoid one or more of the major pests and diseases of currently available strains of bees in Australia.

Equally clear is the fact that Varroa should be a target for efforts to breed new strains of honeybees.

Recently, researchers in New Zealand have reported the selection of a line of honeybees that are not as severely affected by Varroa as are common strains in that country⁷¹. However, the genetic stability in the field of the trait that bestows the advantage on bees is uncertain⁷².

⁷¹ Goodwin 2007

⁷² Clarke, M; personal communication, December 2007

In Australia, the CSIRO believes that it has identified a characteristic of the Varroa mite that could be exploited by bees with certain genetic characteristics, to render the mite harmless to colonies with the appropriate genetic and behavioural make up⁷³.

Whilst neither of these developments is conclusive in themselves, they do give cause for some optimism in regard to the development of strains of bees that are not adversely affected by Varroa and should encourage stakeholders with an interest in the pollination industry to support the research necessary to further test and develop these lines of enquiry.

6.7.2 Improvements in the efficiency of pollination

There are a number of potential opportunities to improve the efficiency of pollination using best practice crop management and various technologies, including breeding and selecting varieties of bees and plants that are better suited to the interactions that result in pollination.

In each case, investment in the pursuit of such up-side risks would only be warranted once the research and development necessary to better understand and optimise the effectiveness and efficiency of current bee strains and plant varieties had been completed and was being applied. Without this preliminary work the cost–benefit equation for any technological improvement to pollination efficiency could not be estimated in advance or evaluated in practice.

6.7.3 Breeding of superior pollinating strains of bees

Especially in the circumstances where Varroa becomes established as a widespread endemic disease in Australia and the cost of pollination services becomes as high as it is currently in the USA, it may be in the interests of pollination service users to support research to develop strains of bees that are more efficient pollinators, so that the number of hives required to pollinate any given area is kept to a minimum.

6.7.4 Breeding varieties of crops better suited to bee pollination

There is clear evidence in the literature⁷⁴ that within a single species of plant there are some varieties that are ‘easier’ for bees to pollinate or which are more attractive to bees. Factors that might contribute to these advantages include flower colour, flower shape and configuration and the quantity and quality of nectar and pollen.

6.7.5 Pollination of genetically modified crops

A specific biotechnology-related issue is the adoption of genetically modified (GM) crops. All GM crops approved for commercial release in Australia, including the GM Canola that may be deployed in cropping systems in the near future, have been assessed to have no effect on honeybee foraging behaviour or health by the independent national Gene Technology Regulator.

However, there is the possibility that bees may vector GM pollen into non GM crops and compromise the integrity of non GM crops, although the spread of such genes is estimated to be so low as to be negligible⁷⁵. It is also possible that a beekeeper who wants to sell “GM-Free” honey would have this status compromised if the colony has access to a GM crop.

⁷³ Anderson, D;personal communication. December, 2007

⁷⁴ e.g. Somerville 2002a

⁷⁵ genetech.csiro.au/faqs.htm

6.7.6 Development of crop and orchard layouts better suited to pollination by bees

It is well known⁷⁶ that there are certain ways of arranging a crop that requires pollination and locating the hives within that crop that are more effective in achieving pollination. The extent to which preferred layouts are used is unknown and is likely to be low in circumstances where the grower relies on incidental pollination by insects other than managed honeybees.

With the marked increases in the size of operations requiring pollination in some industries, it is possible that arrangements that worked well for smaller areas may not be optimal for the very large areas being planted. In the event of feral bees being decimated by a pest or disease such as Varroa, operations that have previously relied on pollination by feral bees may need to be re-designed to make them more amenable to pollination by managed bees.

New information and spatial technologies could enable research and development in this area that may not have been possible in before these technologies became available.

6.7.7 Breeding of self-pollinating or non-pollinating crops

The ultimate in pollination efficiency might be a plant that requires no external agent to effect pollination. There are many plant species that are self-pollinating and even amongst those that currently require pollination there are varieties where the degree of dependence on pollination is less than others.

Whilst the development of self-pollinating varieties of plants that currently require pollination may not be attractive to beekeepers, provided the other benefits of cross-pollination are not lost, it would provide efficiencies and remove a number of risks to the operations of the growers of those crops. These gains would be reinforced in the circumstances where the Varroa mite becomes established and adversely affect the cost and availability of pollination services.

6.7.8 Best practice crop management

As well as crop and orchard layout, other crop management practices that can impact pollination efficiency include:

- crop nutrition where, for example, a boron deficiency can reduce pollen and nectar production resulting in less and weaker pollen and a lesser attraction of bees to the flowers⁷⁷
- use of agrichemicals including seed treatments; the impacts of insecticides on bees causing a growing concern about the less obvious compounds and treatments, with a group of particular interest being the nicotoids^{78 79}.

6.7.9 Alternative pollinators or pollination methods not requiring honeybees

The evidence from the USA and New Zealand would suggest that:

- the incursion of a pest or disease such as Varroa will not eliminate honeybees or the honeybee industry from Australia
- such an incursion would be likely to add significantly to the cost of pollination services in this country

⁷⁶ Somerville 1999b

⁷⁷ Holmes, 1960

⁷⁸ Jones, W; personal communication, December 2007

⁷⁹ BourkeL; personal communication, December 2007

- it is not immediately apparent in Australia or any other country that there is currently an alternative pollinator that matches the honeybee across the whole of the broad range of applications currently serviced by honeybees in terms of pollination efficiency and effectiveness
- even in the presence of Varroa, it is unlikely that an existing alternative pollinator would be superior to the honeybee in any but a few specialist and pollination tasks.

The challenge and dilemma in the event of a Varroa incursion or some other serious pest or disease of honeybees is whether it is better to:

- put research resources into seeking to identify and develop alternative pollination agents or technologies
- to apply the same funds to improving the efficiency of pollination by honeybees even in the presence of the pest or disease
- to seek a means of reducing or eliminating the impact of the pest or disease on honeybees.

It is unlikely that there is an absolute preference for either of these options. The most appropriate decision will involve a balanced distribution of the available resources across the options. A problem for the pollination industry in trying to determine the point of balance between the competing interests remains the poor understanding of the details and dynamics of the pollination process in Australia as it currently applies.

Without a reasonably clear benchmark of efficiency and effectiveness against which to measure any proposed alternative, researchers and advocates for either of the options must rely on speculation.

There is no doubt that alternative pollinators, particularly native Australian insects, warrant continuing research and development, especially in specialist applications where native bees have relevance in the relatively short-term⁸⁰. However, in the absence of the better understanding of pollination by honeybees in the broader Australian context, any suggestion that alternative pollinators are a viable alternative across the full range of pollination tasks is fanciful.

6.8 Regulations and standards

6.8.1 Availability of chemicals for use in emergency responses or containment and management programs

On the balance of probabilities and given the experience in other countries, when Varroa is first detected in Australia it will have been present for an extended period of time and be beyond eradication. However, there is no reason why Australia should not have in place arrangements, including ready access to appropriate chemicals, to initiate an appropriate and effective response.

Not taking such an action would put the pollination industry at risk, regardless of the status of the pest. If, against the probabilities Varroa is detected before it is beyond eradication, the cost/benefits of its elimination, even if a further incursion that results in Varroa becoming established is likely, dictate that all reasonable effort to eradicate expeditiously should be made and rapid access to appropriate chemicals would be critical to a successful program.

⁸⁰ Tolson, M; personal communication, November 2007; Dollin, 2007

If the higher probability outcome involving a rapid progression from detection to managing an endemic pest occurs, the evidence from New Zealand⁸¹ is that there is great benefit in slowing the spread of the pest.

In Australia it is highly likely that large and important elements of the geography used by beekeepers and pollination users are likely to be free of Varroa or another pest at the time it is first detected. Indeed following an initial detection on the east coast of mainland Australia, it is probable that Western Australia and Tasmania at least will be demonstrated to be free of Varroa. Conversely if the first detection is made in WA, it is equally likely that South Australia, the eastern seaboard states and Tasmania would be found to be free of the pest. Even within the jurisdiction that the first detection occurred in it is likely that large areas would be found to be free.

Given these likely scenarios and despite the fact that once established it is almost inevitable that the pest would slowly spread throughout the country, there would be great benefit in implementing actions that would retard the spread. Any such actions, however, should be planned and managed to ensure that they do not severely constrain the major movements of bees required to sustain the beekeeping or pollination industries. Ready access to appropriate chemicals would assist efforts to eradicate, contain or retard the spread of high impact pests and diseases.

AHBIC has negotiated an arrangement with the Australian Pesticides and Veterinary Medicines Authority for emergency permits for the import and use of a key chemical, Apistan, in the event of an incursion of Varroa being detected⁸². AHA has, on behalf of its various members, put in place arrangements for emergency access to vaccines for foot and mouth disease and anthrax in the event of an incursion of either of those diseases and the pollination industry might seek similar arrangements as a means of risk minimisation.

6.8.2 Regulation of use of chemicals that impact pollination

A common concern of beekeepers providing colonies for pollination services and the reason for much of the resistance to becoming a pollination service provider is the risk that the bees will be exposed to the deleterious effects of chemicals used on the property where the hives are deployed or on adjacent properties.

Appropriate labelling of chemicals commonly applied to or around pollination-dependent crops would seem to be warranted as a means of reducing this risk. Combined with an appropriate recognition of pollination in relevant Quality Assurance and Biosecurity Plans and identification of the risks posed to pollinating agents by the untimely or inappropriate use of agricultural chemicals, labelling of these chemicals could reduce the risk even further.

One such chemical is the seed treatment compound, Fripinol, one of the nicotoid family that are believed by some to disturb the bee's orientation and navigation capabilities and result in more aggressive behaviour⁸³. Unconfirmed reports indicate that the French government has banned the sale of Fripinol as a result of such concerns⁸⁴.

6.8.3 Regulations that affect movement of bees

In the event of an outbreak of an exotic disease, including one of bees, restrictions on the movement of hives would adversely affect the pollination industry.

⁸¹ Goodwin 2004

⁸² Ware, S; personal communication, November 2007

⁸³ Bourke, L; personal communication, December 2007

⁸⁴ Ware, S; personal communication, December 2007

A likely scenario would be where a disease was detected in one jurisdiction and was found to be beyond eradication, resulting in other States and/or Territories closing their borders to the movement of bees without providing for movements that may be crucial to the timely provision of pollination services within either the affected or the pest-free jurisdiction.

It is recommended elsewhere in this report that this risk can best be minimised by the development (in advance) of protocols that ensure that there is an immediate and seamless transition from the national coordination that would apply to an emergency response plan under the EADRA or EPPRD while the disease or pest is considered to be exotic, to the national coordination of a management plan if and when the outbreak is determined to be beyond eradication.

6.8.4 Scope and application of QA programs

Issues relating to biosecurity and pollination are notable for their absence from relevant industry Quality Assurance plans. These deficiencies represent a risk to the pollination industry in that they devalue these important issues and increase the likelihood that they will be overlooked in the management of bee hives and the crops that they service.

Arrangements whereby the QA programs of the apiary industry and the pollination user industries are closely articulated with each other would ensure that the biosecurity interests of all parties to the pollination industry are covered.

6.8.5 Allocation and access to beekeeping sites when demand exceeds supply

In all jurisdictions the allocation of rights to beekeeping sites reflects the fact that the number available exceeds the demand. Currently there is no restriction on the number of sites an apiarist can secure, other than the total available number of sites and the apiarist's willingness to pay the prescribed fees. There is no requirement for an apiarist to use the sites for which they have rights to and their rights are retained for as long the apiarist is prepared to pay the annual renewal fee.

In practice, an active, informal scheme of 'sub-letting' rights to sites operates amongst apiarists, whereby an apiarist with a short-term requirement for access to a site in an area where they have inadequate or no access in their own right, can arrange access and use with another who has no requirement to use the sites for which they hold rights.

These arrangements appear to work given the current number and range of sites available and the demand from apiarists for their use. However, under a scenario where either or both the number of sites decreased, the current arrangements might not prove to be an efficient and equitable means of matching access to sites with the demand for their use.

Hence, the pollination industry faces the risk that colonies required to provide pollination services may not be available. Alternatively, they may not be in a suitable condition, to perform as the apiarist could not access suitable sites to maintain and prepare the colonies to perform the service, although suitable sites may have been unoccupied during the period that they would have been required.

While not a current, urgent requirement, it would be in the interest of the pollination industry to have arrangements for the allocation of, and access to, beekeeping sites reviewed and revised to allow for the efficient and equitable use of available sites. This will become important in circumstances where an increase in the demand for pollination services resulted in the requirement for access to sites exceeds the number that are available.

7. Development of biosecurity risk management strategies for the pollination industry

7.1 Context

The context for the sixth step specified in the Australian Standard for Risk Management is the requirement arising from the Honeybee Linkages Workshop April 2007 for the development of risk management strategies that:

- reduce the likelihood of incursions of exotic pests and diseases
- prepare for cost-effective responses to incursions to minimise damage to the industry
- mitigate the impact of these pests and diseases if they become established.

In addition it has become apparent during the course of the present study that as part of a comprehensive risk management plan the pollination industry also needs to implement strategies that:

- improve awareness and understanding of pollination processes in Australia, optimise the efficiency of the management of pollination services and establish best practice standards for the biosecurity of the pollination industry in Australia
- secure the availability and efficient allocation of floral resources to sustain an apiary industry capable of servicing the pollination requirements of Australia's horticultural industries.

7.2 Objective

For each of the risks that are common across the pollination industry and are categorised as medium, high or extreme using the risk evaluation process outlined above, the objective of this project is to develop and cost standard management strategies and identify variations to generic management strategies for use by Pollination Alliance constituents.

7.3 Process

The process that is followed to achieve this is as outlined below:

- propose and evaluate - using the risk evaluation process outlined above - various treatment strategies
- compare the residual risk that would exist were these treatments to be applied, with that prevailing where existing controls are applied, to determine whether:
 - existing controls and systems are adequate
 - proposed treatments result in a lower risk than applies under existing controls, and
 - proposed treatments are adequate
- in the event that, even with the application of the proposed treatments the risk remains unacceptable, explore other mechanisms to deal with the risk
- assess the cost of the proposed treatment against the benefits arising from the treatment.

7.4 Strategies:

Strategy 1: Minimise the risk of incursion of exotic pests and diseases

Strategic Objective

The objective is the cost effective risk minimisation of an incursion of exotic pests and diseases that jeopardise the viability of the pollination industry.

Strategic Actions

Surveillance

- Finalise arrangements for future funding and coordination of the national Sentinel Hive program.
- Update the Boland risk-based technical review of the Sentinel Hive program to determine whether recommendations have been addressed and to ensure that the intensity of surveillance reflects the current risk.
\$10,000 - \$50,000
- Evaluate the case for establishing and monitoring Baited Hives at higher risk locations as part of the revised Sentinel Hive Program.
\$10,000 - \$50,000
- Introduce a hive monitoring and sampling and reporting element to B-Qual and consider differential registration fees as an incentive for participation in B-Qual and the proposed sampling element.
\$100,000 - \$200,000 per year

Quarantine

- Identify and evaluate options for the establishment of a live bee quarantine facility to replace the Eastern Creek facility and complete the evaluation and select the preferred option by 31 July 2009.
\$10,000 - \$50,000
- Progress the establishment of a replacement facility to ensure that it is in operation before the closure of the Eastern Creek site.
\$500,000 - \$750,000 to establish: \$50,000 - \$100,000 per year
- Maintain current levels of inspections of international cargoes and travellers
- Undertake a national honeybee biosecurity skills audit to identify current capabilities in relevant areas of:
 - higher level expertise
 - pest and disease identification management and research
 - bee breeding and selection skills
 - determine future requirements and develop and implement a National Skills Development and Maintenance Plan**\$10,000 - \$50,000**

Biosecurity Planning

- Review the Biosecurity Plans of the honeybee industry and all pollination-dependent plant industries to ensure they all specifically recognise the particular biosecurity issues associated with the provision and use of pollination services and that all are updated at least every two years.
\$10,000 - \$50,000 for initial review then part of ongoing maintenance

Research and development

- Progress research and development into the biology and epidemiology of Varroa to identify particular risks and control methods.
as per R&D Study
- Maintain links with international researchers to monitor developments in the management of Varroa and other diseases.
as per R&D Study
- Undertake a study to determine the feasibility and cost of developing a bio-economic simulation model (similar to the AHA Screw worm fly model) for Varroa incursions in Australia.
\$10,000 - \$50,000 for feasibility study
- Continue research to develop Varroa tolerance, avoidance, resistance or immunity in honeybees.
as per R&D Study
- Progress research to understand the potential impacts of Guava Rust on native floral resources and the potential role of honeybees in the transmission and establishment of the disease.
as per R&D Study

Strategy 2: Management of incursions of pests and diseases

Strategic Objective

Cost effective emergency response to exotic pest and disease incursions and nationally coordinated management of established pests and diseases that recognises the particular requirements of the pollination industry.

Strategic Actions

Emergency Response Planning

- Formalise arrangements to ensure effective representation and timely coordination of the activities of AHA and PHA and their relevant members in the event of a disease of significance to the pollination industry.
part of ongoing PHA/AHA relationship
- Review the relevant elements of AUSVETPLAN and PLANTPLAN to ensure consistent and comprehensive coverage of matters pertaining to the pollination industry.
part of ongoing maintenance

National disease containment and management protocol

- Initiate consultative processes involving pollination user and provider interests and relevant jurisdictional authorities and agencies, to develop and agree on arrangements that ensure the development and implementation of nationally coordinated management plans in the event that a current exotic disease of significance to the pollination industry becomes established in Australia.
\$10,000 - \$50,000
- Develop and implement a national awareness plan that ensures that all parties with an interest and involvement in the conduct of a disease management plan understand the interests and requirements of the other parties.
as per Education and Training study

Bee hive identification and tracing

- Propose and introduce a real-time hive identification and tracing scheme based on the model of the National Livestock Identification Scheme (NLIS).
establishment: \$100,000 - \$550,000 plus \$3.00 per hive, annual: \$10,000 - \$50,000

Disease response and management training and simulations

- Revise role descriptions and training courses to reflect any changes made to AUSVETPLAN and PLANTPLAN as a result of the review of those plans as recommended above.
\$10000 - \$50,000
- Develop the role descriptions, competency requirements and training courses arising from the negotiation and establishment of the National Disease Containment and Management Protocol proposed above.
\$50,000 - \$100,000
- Undertake a pest and disease response and management skills audit of parties to the pollination industry, including relevant government authorities, to identify current capacities to fill the emergency response and disease management roles required to sustain the emergency response and pest and disease management plans referred to above.
\$10,000 - \$50,000
- Develop and implement within the honeybee and pollination dependent industries, recruitment and training plans to address any deficiencies in pest and disease response and management capabilities identified by the skills audit
cost to be determined as part of audit in item above.
- Develop disease incursion and management scenarios and undertake a simulation exercise to test the effectiveness of response and management plans and arrangements for the coordination and representation of the range of interested parties and to develop the skills of key industry and government personnel.
 - A preliminary two-day desk-top exercise is recommended with:
 - the location of the scenarios including the cross border regions abutting the Murray River in New South Wales, Victoria and South Australia, with a focus on the almond industry
 - day one addressing the early stages of the emergency response following initial detection of an incursion
 - day two addressing the transition from emergency response to disease management following a determination that the incursion is beyond eradication.**development of scenario: \$10,000 - \$50,000, conduct of exercise \$50,000 - \$100,000**

Strategy 3: Enhance the capability and performance of the pollination industry.

Strategic Objective

To improve the understanding of and expertise in the management of pollination processes in Australia and to establish best practice pollination management standards for both service providers and users with an emphasis on the biosecurity implications of best practice pollination management.

Strategic Actions

Optimise efficiency of pollination management in Australia

- Develop and implement a national pollination industry research and development plan to establish benchmarks for the efficient application of current pollination agents, technologies and processes.
as per R&D Study
- Develop and maintain best practice pollination manuals for service providers and users.
\$10,000 - \$50,000
- Identify and research priority opportunities to improve pollination efficiency.
as per R&D Study

Pollination awareness training and education plan

- Develop awareness, training and education courses and resources relevant to the requirements and responsibilities of the various users and providers of pollination services.
as per Education and Training Study
- Ensure that all training and education courses include an appropriate pollination biosecurity element.
as per Education and Training Study

Coordination and articulation of pollination industry biosecurity and Quality Assurance plans

- Review the biosecurity and quality assurance plans of pollination user and provider industries to ensure that biosecurity plans provide adequate coverage of the issues associated with the pollination process.
\$10,000 - \$50,000
- Ensure that QA plans include provisions that address biosecurity issues and, in particular, those relating to the pollination process.
part of ongoing development of plans
- Ensure consistency and adequate articulation between the QA plans for pollination service providers and user industries, especially with regard to biosecurity management
 - compliance with B-Qual should require that hives are only placed on properties that are certified under that industry's QA scheme . Compliance with the pollination service user's QA scheme should require that only colonies from a B-Qual certified beekeeper are used for the provision of pollination services.
part of review proposed above

Strategy 4: Secure necessary floral resources

Strategic Objectives

- To ensure that beekeepers have secure access to sufficient floral resources to enable them to meet the pollination service requirements of Australia's horticultural industries.
- To ensure the efficient utilisation of available floral resources.
- To minimise the biosecurity risks associated with the use of floral resources.

Strategic Actions

Supply and demand for floral resources

- Develop a national inventory of floral resources, with the inventory published by the NSW DPI⁸⁵ being the model and standard applied.
\$50,000 - \$100,000
- Investigate the opportunities for floral resource species to be included in forestation programs arising from climate change, carbon-trading and land and water conservation initiatives and, where appropriate, seek to have such species included in plantings and ensure access for beekeepers.
\$10,000 - \$50,000.

Access to and allocation of floral resources

- Establish a pollination industry taskforce to investigate and address the issues behind the decisions of the Victorian and Queensland Governments to exclude beekeepers from native forests on public lands and to develop strategies to assure continued access in other jurisdictions.
\$50,000 - \$100,000
- Review arrangements for the allocation of rights to use floral resources to identify and remove inefficiencies that might compromise the ability of the apiary industry to meet the service requirements arising from continued strong growth of pollination dependent industries.
\$10,000 - \$50,000

Biosecurity of floral resources

- Investigate and prioritise the biosecurity risks to trees and bees, arising from the use of floral resources by beekeepers.
\$50,000 - \$100,000
- Develop biosecurity management plans for the use of floral resources by beekeepers and assess the case for making an enhanced B-Qual certification a pre-requisite for using apiary sites on public lands.
\$10,000 - \$50,000

⁸⁵ Somerville 1999c

Strategy 5: Additional pollination options

Strategic Objective

To identify, evaluate and develop pollination agents and methods to supplement the activities of managed honeybees especially in the event of an incursion of a debilitating disease of honeybees into Australia.

Strategic Action

Native insect pollinators

- Progress research into the biology and management of native Australian insect species that may have a role in servicing pollination requirements and niche applications in particular.

as per R&D Study

Table 7.1: - Strategic scorecard

In this table the proposed strategies are reconciled against the risks to the pollination industry.

The symbol ▲ indicates that the 'Strategic Action' relates to the risk

| Source of risk | Risk | Risk rating | Strategies | | | | | | | | | | | | | | | | |
|--------------------|---|-----------------|-------------------|-------------|----------------------|--------------------------|-----------------------------|-----------------------------|--------------------------------------|----------------------------------|---------------------------------|----------------------------------|---------------------------|--|-----------------------------|---------------------------------|---------------------------|---|---|
| | | | 1 | | | 2 | | | 3 | | | 4 | | 5 | | | | | |
| | | | Strategic actions | | | | | | | | | | | | | | | | |
| | | | Surveillance: | Quarantine: | Biosecurity Planning | Research and development | Emergency Response Planning | National disease management | Bee hive identification and tracing: | Response and management training | Optimise pollination management | Awareness training and education | Biosecurity and QA plans. | Supply and demand for floral resources | Access to floral resources. | Biosecurity of floral resources | Native insect pollinators | | |
| Pests and diseases | Pest or disease of bees that impacts cost and availability of the supply of pollination services (See Table 3.1 for detail) | High to Extreme | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | | ▲ | ▲ | | | ▲ | ▲ |
| | Pest or disease of a major pollination crop that affects demand for pollination services | Medium | ▲ | | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | | ▲ | ▲ | | | | | ▲ | |
| | Pest or disease of a key floral resource that impacts the non-pollination elements of beekeeping | High | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | | ▲ | ▲ | ▲ | ▲ | ▲ | | ▲ | |
| | Pest or disease of plants that is vectored by bees and results in restrictions on movement of bees | Medium | ▲ | ▲ | ▲ | | ▲ | ▲ | ▲ | ▲ | | ▲ | ▲ | | | | | ▲ | ▲ |
| | Pest or disease of other plants or animals, the management of which restricts the movement of bees | Medium | ▲ | | ▲ | | ▲ | ▲ | ▲ | ▲ | | ▲ | ▲ | | | | | | |

| | | | | | | | | | | | | | | | | | | |
|---------------------------------------|--|--------|---|---|---|---|---|---|---|---|--|---|---|---|---|---|---|---|
| Trade and economic | Significant change in honey price | High | | | | | | | | | | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | |
| | Significant change in economics of a key pollination crop | Medium | | | | | | | | | | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | |
| | Demand for pollination services results in bee population exceeding the capacity of available floral resources | High | | | | | | | ▲ | | | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | |
| | Biosecurity issue that affects market access and economics of beekeeping | Medium | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | | | ▲ | ▲ | | | ▲ | ▲ |
| Organisation and management | Awareness of and capacity for efficient management of pollination | High | | | | | | | | | | ▲ | ▲ | ▲ | ▲ | | ▲ | |
| | Resources, skills and processes to detect, identify and respond to an incursion | High | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | | | ▲ | | | | ▲ | |
| | Effective management of an incursion | High | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | | | | | | | ▲ | |
| | Education and training arrangements in all aspects of beekeeping and pollination activities | High | ▲ | | | | | | | | | | ▲ | ▲ | ▲ | | | ▲ |
| | Limited or no reference to pollination or biosecurity in QA programs | Medium | | | ▲ | | | | | | | | ▲ | ▲ | ▲ | | | ▲ |
| | Structure of beekeeping industry | Medium | | | | | | | | | | | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ |
| Environment and natural events | Climate change: <ul style="list-style-type: none"> ▪ Impact on land and water use ▪ Impact on floral resources – ▪ Impact on epidemiology of pests and diseases | High | ▲ | ▲ | | | | | | | | | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ |
| | Timing of demand for pollination services and competition between crops for pollination services | Medium | | | | | | | | | | | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ |
| | Adequacy and accessibility of native floral resources | High | | | | | | | | | | | | | | ▲ | ▲ | ▲ |
| Human behaviour | Deliberate or inadvertent breach of quarantine | High | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | | | ▲ | ▲ | | | ▲ | |
| | Willingness to report suspect incursion | High | ▲ | ▲ | ▲ | | | | | | | | ▲ | ▲ | | | ▲ | |
| | Acceptance of structural change including pollination service provision | Medium | | | | | | | | | | | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ |
| Commercial and legal | Relative economics of pollination and honey production change significantly | Medium | | | | | | | | | | | ▲ | ▲ | ▲ | ▲ | | ▲ |
| | Grower and beekeeper rights and | Medium | | | | | | | | | | | ▲ | ▲ | ▲ | | | |

| | | | | | | | | | | | | | | | | | |
|---------------------------------|--|-----------------|---|--|---|---|---|---|---|---|---|---|---|---|---|---|--|
| | responsibilities in pollination contracts | | | | | | | | | | | | | | | | |
| | Introduction of brokers to pollination industry | Medium | | | | | | | | | ▲ | ▲ | ▲ | ▲ | ▲ | | |
| | Assistance to restructure apiary industry | Medium | | | | | | | | | ▲ | ▲ | ▲ | | ▲ | | |
| Political | Access to native floral resources | High | | | | | | | | | | | | ▲ | ▲ | ▲ | |
| | Access to and allocation of water resources | Medium | | | | | | | | | ▲ | ▲ | ▲ | | | | |
| | Regulation of land usage to maximise water resource use efficiency | Medium | | | | | | | | | ▲ | ▲ | ▲ | | | | |
| | Impact of Carbon Trading arrangements on pollination supply and demand | Medium | | | | | | | | | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | |
| Technology | Development of pest or disease tolerant, resistant or avoiding bees | High to Extreme | | | ▲ | ▲ | ▲ | | | | ▲ | ▲ | ▲ | | | | |
| | Breeding of superior pollinating strains of bees | Medium | | | | | | | | | ▲ | ▲ | ▲ | | | | |
| | Breeding of varieties of crops better suited to bee pollination | Medium | | | | | | | | | ▲ | ▲ | ▲ | | | | |
| | Development of crop and orchard layouts better suited to pollination by bees | Medium | | | | | | | | | ▲ | ▲ | ▲ | | | | |
| | Breeding of self pollinating or non-pollination requiring crops | Medium | | | | | | | | | ▲ | ▲ | ▲ | | | | |
| | Alternative pollinators or pollination methods not requiring honeybees | Medium | | | | | | | | | ▲ | ▲ | ▲ | | | | |
| Regulation and standards | Pre-approval of chemicals for use in pest and disease response/management | High | | | ▲ | ▲ | ▲ | ▲ | | ▲ | | | | | | | |
| | Regulation of use of chemicals that impact pollination | Medium | | | | | | | | | ▲ | ▲ | ▲ | | | | |
| | Regulations that affect movement of bees | High | | | ▲ | | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | | ▲ | ▲ | |
| | Scope and application of QA programs | Medium | ▲ | | ▲ | | | | ▲ | | ▲ | ▲ | ▲ | | | ▲ | |
| | Allocation and access to beekeeping sites | High | ▲ | | ▲ | | | | | | | ▲ | | ▲ | ▲ | ▲ | |

8. Consultation

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- Delia Dray, Department of Primary Industries, NSW
- Iain East, Department of Agriculture, Fisheries and Forestry, Canberra
- Peta Hitchens, Epidemiologist, Tasmania
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- Stephen Ware, Australian Honeybee Industry Council
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- Ryan Wilson, Plant Health Australia

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10 Appendices

Appendix 1 – Queensland DPI risk assessment

Appendix 1 Queensland DPI Risk Assessment

| | | | |
|----------|-------------|---------------|----------------------------|
| Date | 17.12.07 | Risk Assessor | Apiary Officer Hamish Lamb |
| Time | | Participants | |
| Location | Nambour Qld | | |

| | | C - Consequence Rating | | | | |
|---------------------|---|------------------------|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| L-Likelihood Rating | A | M | M | H | X | X |
| | B | L | M | M | H | X |
| | C | L | L | M | H | H |
| | D | N | L | M | M | H |
| | E | N | N | L | M | H |

Rating Consequence

- 1 Insignificant
- 2 Minor
- 3 Moderate
- 4 Major
- 5 Catastrophic

L Likelihood

- A Almost certain
- B Likely
- C Possible
- D Unlikely
- E Rare

Combined Likelihood and Consequence Risk Rating

Level of Risk Rating

- X - Extreme
- H - High
- M - Medium
- L - Low
- N - Negligible

Response

- Urgent attention
- Intervention required
- Active management
- Ongoing monitoring
- Acceptable risk

Appendix 1 continued

| Risk No. | Main risks (from preliminary brainstorm) | Risk treatment | L | C | R R | Comment |
|----------|--|--|---|---|--------|--|
| 1. | Varroa Mite Incursion | Current Border quarantine Surveillance training | A | 4 | X | |
| | | Proposed Enhanced surveillance Increased preparedness: <ul style="list-style-type: none"> • Undertake strategic R&D to reduce impact of Varroa – consider production of resistant honeybees, alternate pollinators, economic modelling of economic impact of combined risks on agricultural products • Preparing for recovery • Faster registration system for chemicals • Increased training across the industry • Improved hygiene and management of beehives and pollination crops Improved “awareness” of AusVet Emergency Response plans - there is a need for a response plan that integrates responses to the honeybee industry and the associated pollination industries | B | 4 | H | Risk Rating could be reduced to M – Medium – if effective R&D results could be achieved. |

Appendix 1 continued

| Risk No. | Main risks (from preliminary brainstorm) | Risk Treatment | L | C | R R | Comment |
|----------|--|--|---|---|--------|--|
| 2. | Asian honeybee incursion | Current Border quarantine Port Surveillance | A | 4 | H | |
| | | Proposed Increased surveillance <ul style="list-style-type: none"> Quarantine service increase inspections north areas Chemical registration for area abatement feeding of feral and established cerana Increase log hives and empty hives. Increase sweep-netting around key ports | A | 4 | H | Regulation of data base of beekeepers important Pheromone research? |
| 3. | Tropilaelaps incursion | Current Border quarantine Surveillance training | A | 4 | X | |
| | | Proposed Enhanced surveillance Increased preparedness: <ul style="list-style-type: none"> Undertake strategic R&D to reduce impact of Tropilaelaps – consider production of resistant honeybees, alternate pollinators, economic modelling of economic impact of combined risks on agricultural products Preparing for recovery Faster registration system for chemicals Increased training across the industry Improved hygiene and management of beehives and pollination crops Improved “awareness” of AusVet Emergency Response plans - there is a need for a response plan that integrates responses to the honeybee industry and the associated pollination industries | B | 4 | H | Regulation of data base of beekeepers important |

Appendix 1 continued

| Risk No. | Main Risks (from preliminary brainstorm) | Risk Treatment | L | C | R R | Comment |
|----------|--|---|---|---|--------|---|
| 4. | Varroa not detected until well established | Current Industry surveillance Education program | B | 5 | H | |
| | | Proposed <ul style="list-style-type: none"> • Increased industry surveillance • Increased education program to industry participants | C | 5 | H | Regulation of data base of beekeepers important |
| 5. | Tracheal mite incursion | Current Examination of surveillance hive adult bees | C | 3 | M | |
| | | Proposed Enhanced surveillance Increased preparedness: <ul style="list-style-type: none"> • Undertake strategic R&D to reduce impact of Acarapis – consider production of resistant honeybees, alternate pollinators, economic modelling of economic impact of combined risks on agricultural products • Preparing for recovery • Increased training across the industry • Improved hygiene and management of beehives and pollination crops • Improved “awareness” of AusVet Emergency Response plans - there is a need for a response plan that integrates responses to the honeybee industry and the associated pollination industries | C | 2 | M | Regulation of data base of beekeepers important |

Appendix 1 continued

| Risk No. | Main Risks (from preliminary brainstorm) | Risk Treatment | L | C | R R | Comment |
|----------|---|--|---|---|--------|--|
| 6. | Incursion of European Honeybees with Africanised genes attack | Current Quarantine | C | 5 | M | (Risk to Qld M) |
| | | Proposed Include testing/i.d in surveillance of feral bees in port areas Increase surveillance and quarantine | C | 5 | M | <ul style="list-style-type: none"> • Regulation of data base of beekeepers important • Training of local (State entomologists for fast id) |
| 7. | Reduced access to National Parks/Forest reserves for beekeepers | Current Apiaries supplied with pollen and nectar resources for build/nutrition and honey production | A | 4 | H | |
| | | Proposed <ul style="list-style-type: none"> • No access beyond 2020 for beekeepers in native forest on crown lands • Alternative unused useful land identified • Organised administered payment of remaining floral resources on private land • Re-forested lands of melliferous flora • Seek alternative supplementary feed solutions | A | 4 | H | |

Appendix 1 continued

| Risk No. | Main risks (from preliminary brainstorm) | Risk treatment | L | C | R R | Comment |
|----------|--|---|---|---|--------|---|
| 8. | Varroa becomes endemic | Current | C | 5 | H | |
| | | Proposed <ul style="list-style-type: none"> • No beekeepers prepared to pay increased price for service • Varroa resistance bee research • Alternative chemical or natural product use Education programs to industry and wider rural enterprises | C | 4 | M | Regulation of data base of beekeepers important |

Appendix 2 – Bee pest and disease risk prioritisation assessments

AFRICANISED HONEYBEES (AHB)

18 December 2007

**Assessed by:
Dr RC Keogh**

Risk Assessment Profile: Major risk to the bee industry.

Recommendation: Intervention is required to address this risk.

Total Impact Score: 60/100, major impact to the industry.

Likelihood Assessment: $p = 0.05 > 0.3$ Incursion is possible.

JUSTIFICATION

Cost / Benefit Analysis: NPV > 1, benefits of program exceed costs of program.

Stakeholder Commitment: This disease is nationally notifiable in Australia.

Cost / Benefit Analysis: NPV < 1, benefits of a program are less than the costs of program.

Stakeholder Commitment: This condition is notifiable in Australia. There is commitment from both government and industry to respond to an incursion of AHB.

Economic Impact: European honeybees that interbreed with AHBs may become harder to manage as pollinators and may produce less honey because of a high propensity to swarm and abscond, which results in nests with low populations that are not suitable for honey production or pollination purposes.

Further, AHBs display aggressive reproductive behaviour involving the invasion of managed and feral honeybee colonies. In addition to the public health risk that these aggressive bees pose to the community, they could also introduce Acarine mites, Varroa and European Foul Brood disease.

An economic impact assessment has not been completed.

Public Health & Social Impact: The venom of an AHB is no more poisonous than that of their European counterparts. However, they are more defensive if provoked and more easily provoked. The stinging response of AHBs is 10 times greater than that of European honeybees. When provoked, the bees will wander as far as a quarter mile from their nest to chase an intruder.

Epidemiology: The (AHB) is a result of mating between African bees and European honeybees. In 1956, a geneticist brought African queens to Brazil with the idea of developing a superior honeybee, more suited to tropical conditions. Bees from 26 experimental colonies headed by African queens swarmed near Sao Paulo, Brazil. The bees interbred in the wild with the European honeybees, resulting in "Africanized" offspring.

As well as occurring in their native Africa AHBs have spread throughout most of South and Central America to Mexico and southern parts of the USA.

Once Africanised bees become established in an area they are likely to persist because they have higher reproductive rates than European subspecies. AHBs will build nests in the ground, in cavities in trees or buildings.

Two colonies of AHB (one alive) were detected on cargo vessels at Fremantle in February 1994 and February 1997, both were destroyed. Africanised bees could occupy all the populated areas of mainland Australia, with the exception of the cooler areas of the eastern highlands.

Likelihood of Achieving Program Outcomes: As the experience in Western Australia demonstrates, if detected early an incursion of AHB could be eradicated. Once established in a country, the overseas experience suggests that AHB would be exceedingly difficult to eliminate.

Nature of Contribution: Provision of both in-kind services and cash will be required to effect an eradication or management program.

NOSEMA CERANAE

10 December 2007

Assessed by:

Ms Peta Hitchens

BAppSc (Equine), MVPHMgt, PhD Candidate

Risk Assessment Profile: Major risk to the bee industry.

Recommendation: Intervention is required to address this disease.

Total Impact Score: 66/100, major impact to the industry.

Likelihood Assessment: $p = 1$, the pest is already endemic.

JUSTIFICATION

Cost / Benefit Analysis: NPV > 1, benefits of program exceed costs of program.

Stakeholder Commitment: This disease is nationally notifiable in Australia. There is commitment from both government and industry to continue management of *Nosema ceranae*.¹

Economic Impact:

- *Nosema apis* is considered the most economically important disease of adult honeybees in Australia and the world, however not much is yet known about the impact of *N. ceranae*.⁴
- Both types of Nosema can be treated using Fumagillin. Treatment is effective and cheap.⁶
- Some researchers speculate that it has contributed to colony collapse disorder. However, it is likely that a number of factors such as the Varroa mite (which Australia does not have), not just *N. ceranae*, contribute to colony deaths.⁶
- Australia has not experienced colony collapse disorder, and the unknown nature and gradual spread of the disorder means it will be hard to eradicate or to control if there is an incursion. The impact this disorder has had on the US means any incursion into Australia is likely to significantly cost the industry and horticulture and agriculture industries that rely on pollination from honeybees.⁵

Public Health & Social Impact: None of the diseases of bees found in Australia are transmissible to humans. They present no threat to public health, however an increased use of pesticides could lead to the presence of residues in honey.¹

Epidemiology: Nosema disease is the most widespread adult bee disease in the world. There are no classic signs of the disease, and hence it frequently goes undetected. Heavily infected bees live only half as long as non-infected bees. *N. ceranae*, a similar parasite to *N. apis*, was found in Asian honey bees (*Apis cerana*) in 1996. In 2005 it was found in *Apis mellifera* in Taiwan, and since in Europe, North America and Australia. The disease is far more prevalent during winter and early spring, with its lowest levels over summer.³

Likelihood of Achieving Program Outcomes: Research & Development continues into the control of the disease. A control and management program should be implemented/continued.

Nature of Contribution: Provision of both in-kind services and cash will be offered if it is decided to implement/continue a management program.

SMALL HIVE BEETLE

7 December 2007

Assessed by:

Ms Peta Hitchens

BAppSc (Equine), MVPHMgt, PhD Candidate

Risk Assessment Profile: Moderate to major risk to the bee industry.

Recommendation: Active management is required to address this pest.

Total Impact Score: 58/100, moderate to major impact to the industry.

Likelihood Assessment: $p = 1$, the pest is already endemic.

JUSTIFICATION

Cost / Benefit Analysis: NPV = 1, benefits of program breakeven with costs of program.

Stakeholder Commitment: This disease is nationally notifiable in Australia. There is commitment from both government and industry to continue management of SHB.¹

Economic Impact:

- It has been agreed that SHB can not be eradicated from Australia.⁵
- Potential for high economic impact due to restrictions to export of live bees, impact on pollination and honey production.¹
- An economic impact assessment has not been completed.

Public Health & Social Impact: None of the diseases of bees found in Australia are transmissible to humans. They present no threat to public health, however an increased use of pesticides could lead to the presence of residues in honey.

Epidemiology: SHB was first identified in NSW and Queensland in 2002. In August 2007 it was detected in north-west Victoria.⁴ However, the severity of its impact has varied greatly (between and within apiaries)⁵ and no signs of SHB damage have been found in Australian stingless native bee nests in a survey taken near Sydney.⁶

Originally from South Africa, these beetles spread to the USA in 1998 and have now become widely established across the eastern half of the USA. In the first two years following their introduction, these beetles caused the loss of 20,000 commercial honey bee hives. Australia's climate and commercial honey bee varieties are similar to those of USA, and therefore the impact may be similar.⁶

Likelihood of Achieving Program Outcomes: The Small Hive Beetle National Management Plan was implemented in October 2003, however has since been discontinued. Research & Development continues into the control of the pest. A control and management program should be continued.

Nature of Contribution: Provision of both in-kind services and cash will be offered if it is decided to implement/continue a management program.

TROPILAEELAPS MITE (*Tropilaelaps clareae* and *koenigerum*)

7 December 2007

Assessed by:

Ms Peta Hitchens

BAppSc (Equine), MVPHMgt, PhD Candidate

Risk Assessment Profile: High risk to the bee industry and industries reliant on pollination.

Recommendation: Intervention is required to address this risk.

Total Impact Score: 72/100, catastrophic impact to the industry.

Likelihood Assessment: $0.05 > p > 0.3$, the event would possibly occur.

JUSTIFICATION

Cost / Benefit Analysis: NPV > 1, benefits of program (either control or eradication) exceed costs.

Stakeholder Commitment: Under the EADRA, *Tropilaelaps* mite is classified as Category 2. Category 2 diseases are those for which costs will be shared 80% by government and 20% by industry. There is full commitment from both government and industry to eradicate or control *Tropilaelaps* mite if it enters into or establishes in Australia.¹

Economic Impact:

- Result in widespread losses of honey bee colonies, causing serious economic hardship to apiarists and growers of crops that require honey bee pollination to achieve viable production.¹
- The mite would be expected to cause major economic losses within the beekeeping industry should they enter into Australia.⁵

Public Health & Social Impact: None of the diseases of bees found in Australia are transmissible to humans. They present no threat to public health, however an increased use of pesticides could lead to the presence of residues in honey. Job losses may also be expected in the industry and related industries relying on pollination.

Epidemiology: *Tropilaelaps* mite has been found as far west as Iran and as far east as Papua New Guinea. The mite is thought to be restricted to tropical or sub-tropical regions of Asia, however the exact geographical range is unknown and is emerging.⁶ It has not been detected on brood or adult bees in *A. cerana* colonies in those areas of Papua New Guinea where the mite exists in *A. mellifera* colonies. The mite has never been detected in Australia.¹ *Tropilaelaps* mites are mobile and can readily move between bees and within the hive. *Tropilaelaps* is unlikely to survive where there is complete brood interruption during the winter. The warmer winter temperatures, with more colonies continually rearing brood, could increase the potential for *Tropilaelaps* spread and impact.⁶

Likelihood of Achieving Program Outcomes: Detection is by visual examination of hive debris or brood, or by application of a “knock-down” treatment. Unlike the *Varroa* mite, *Tropilaelaps* can not feed on adult bees and depends on the developing brood for food. *Tropilaelaps* is therefore less well adapted for survival in hives where there are long broodless periods.⁶ It is likely that the rate of transfer between foraging bees is low. The mites can be transferred between colonies and between apiaries through normal apiary management practices.⁵ A control and management program would be necessary.

Nature of Contribution: Provision of both in-kind services and cash will be offered to implement an eradication or management program.

VARROA MITE

Assessed by:
Ms Peta Hitchens

BAppSc (Equine), MVPHMgt, PhD Candidate

Risk Assessment Profile: Extreme risk to the bee industry and industries reliant on pollination.

Recommendation: Urgent attention is required to address this risk.

Total Impact Score: 73/100, catastrophic impact to the industry.

Likelihood Assessment: $0.3 > p > 0.7$, the event would be likely to occur.

Overseas experience suggests that, should Varroa become established in Australia, it may spread rapidly killing most colonies within 3 years if not managed appropriately.⁴

JUSTIFICATION

Cost / Benefit Analysis: NPV > 1, benefits of program (either control or eradication) exceed costs.

Stakeholder Commitment: Under the EADRA, *Varroa jacobsoni* is classified as Category 4 and *Varroa destructor* as Category 2. There is full commitment from both government and industry to eradicate or control Varroa if it enters into or establishes in Australia.¹

Economic Impact:

- The cost of Varroa would be felt by the honeybee industry and other industries with crops that rely on honeybees for pollination.^{4,5}
- The MAF economic impact assessment estimated that the impact would be between \$198 and \$433 million on the South Island (over a 35 year period).⁶
- Since discovered in New Zealand in 2000, Varroa has had an immense economic impact.⁵
- In Australia, the gross value of production is estimated as being about \$65 million per annum, of which \$49 million comprises honey production.⁵
- The pollination benefits to Australia have been valued at \$1.2 - \$1.8 billion.⁵
- Exports of queen bees and package bees could be affected.⁵
- Treatment is expensive.

Public Health & Social Impact: None of the diseases of bees found in Australia are transmissible to humans. They present no threat to public health, however an increased use of pesticides could lead to the presence of residues in honey. Job losses may also be expected in the industry and related industries relying on pollination.

Epidemiology: Varroa is established in most beekeeping regions around the world, including New Zealand and the Torres Strait Islands, but are not present in Australia. Once established they spread rapidly.^{1,2,4}

Likelihood of Achieving Program Outcomes: Apiarists would be required to repeatedly treat their hives to ensure their survival.² Due to the rapid spread of Varroa, once it has established in Australia it is unlikely that it will be eradicated (based on the New Zealand experience).⁶ The Apistan test, although the most sensitive available, will not reliably detect very low levels of Varroa infestation.³ A control and management program would be necessary.

Nature of Contribution: Provision of both in-kind services and cash will be offered to implement an eradication or management program.