Import risk analysis:

Honey bee hive products and used equipment.

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Wellington
New Zealand

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Approved for general release

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ANIMAL IMPORT RISK ANALYSIS: HONEY BEE HIVE PRODUCTS AND USED EQUIPMENT

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DEFINITIONS OF BEEKEEPING TERMS USED IN THIS RISK ANALYSIS

artificial insemination equipment – Devices used to artificially inseminate queen honey bees

bee-collected pollen - Pollen removed from the pollen baskets of honey bees

Beekeeping clothing and gloves – Includes bee suits, veils, gloves and boots

bees' wax- A waxy secretion from worker honey bees, used by them to make comb for food storage and rearing brood

comb - Pieces of completed wax cells, used for brood rearing or the storage of food

comb honey - Honey complete with the wax comb which it was stored in by the bees

containers used for transporting bees - queens cages, and packages

extracted honey- Honey removed from the comb, usually by removing the wax cappings and spinning in a centrifugal honey extractor

feeder – A device designed to feed sugar syrup or honey to bees within a beehive

floor boards - The base of a hive that supers are stacked on

foundation - A thin sheet of beeswax, imprinted with the hexagonal shape of worker cells

hive parts - Including comb, queen excluders, propolis mats, supers, hive lids, hive mats and floorboards

hive tool - Metal tool with a flat end, that is used to prize apart pieces of the hive

honey - The fluid, viscous or crystallized substance produced by honey bees from nectar of blossoms which bees collect, transform or combine with substances of their own and store in honeycombs

honeydew - The fluid, viscous or crystallized substance produced by honey bees from the secretions (other than from flowers) from living plants, or insects feeding on plants, which bees collect, transform or combine with substances of their own and store in honeycombs

honey extracting equipment – Includes a machine for removing honey from the comb, equipment for uncapping frames, honey pumps, filters, tanks, wax spinners, wax melters etc

packages - Screened containers designed for transporting bees. Typically 1-2 kg of worker bees and a queen

pollen - The spore like structures produced by flowers to fertilize ovules

pollen dispensers - Devices designed to coat bees with pollen as they leave their hives to aid their pollinating activities

pollen traps - Device containing mesh or small holes that removes pollen pellets from the pollen baskets of worker bees

propolis - Resinous substance collected by bees (usually from plants), modified and used to seal holes inside the hive

propolis mats - Screens designed to be placed on a hive to collect propolis

queen cages – Cages designed for transporting adult queen bees

queen excluder- A screen with holes that are large enough to allow worker bees to pass through it but not queens

royal jelly - Food given to larval queens, produced in the hypopharyngeal and mandibular glands of nurse bees

smokers – Hand held metal device used for producing smoke to help calm bees down

supers - The boxes placed on hives that contain frames of comb

used beekeeping equipment - Includes hive parts, comb, feeder, hive mats, queen excluder, pollen traps, pollen dispensers, clothing and gloves, smokers and hive tools, honey extracting equipment, containers used for transporting bees, artificial insemination equipment, varroa floors, and any other equipment coming into contact with bees, beehives or their products

varroa floors – Mesh floors for beehives

INTRODUCTION

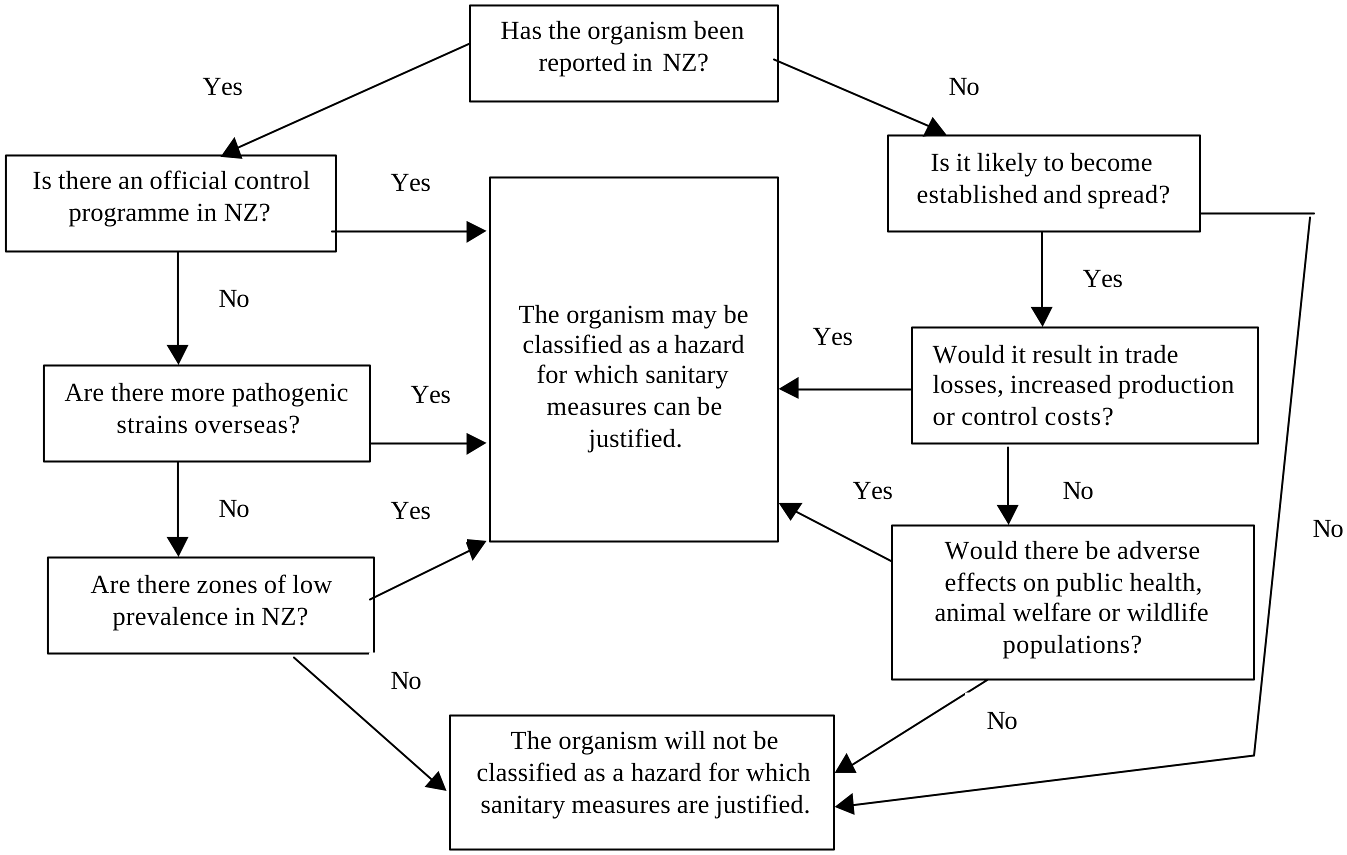
The objective of this risk analysis process is to identify and appropriately manage the disease risks posed by the importation of honey bee commodities. The intention is to ensure that a balance is achieved between New Zealand's need to minimise the likelihood of disease incursions and their consequences, and the need to fulfil obligations under international trade agreements.

Risk analysis consists of a series of steps. The first is to identify those organisms that could potentially be introduced into New Zealand and whether they should be classified as a hazard for which a risk assessment is required. To achieve this, it is necessary to determine:

1. if the organisms have been reported in New Zealand (pest and disease status);
2. if any strains in New Zealand are different from those in the exporting country and show variations in pathogenicity;
3. if the organisms are subject to official control or eradication in New Zealand;
4. if introduced, is the organism likely to:
   - spread or become established;
   - result in losses associated with:
     - trade;
     - production;
     - control or eradication cost;
   - cause adverse effects on public health, animal welfare or wildlife populations.

Honey bees were introduced to New Zealand and are, therefore, not classed as wildlife and, as they are invertebrates, they are not usually included in animal welfare discussions. Of the pests and diseases discussed in this risk assessment, only causative agents of stonebrood are known to affect animals other than honey bees. Consequently, the remainder are not considered to be animal welfare or wildlife issues.

For ease of interpretation, the decision-making pathway is outlined below.



For each organism that is classified as a hazard, a risk assessment will be completed. The risk assessments consist of the following steps.

1. <u>Release assessment</u>

   Examine the potential for the organism to be imported in the commodity.

2. <u>Exposure assessment</u>

   Examine the probability of the establishment of the organism if it were to be imported.

3. <u>Consequence assessment</u>

   Examine the consequence of honey bees becoming infected.

4. <u>Risk estimation</u>

   A conclusion is drawn on the risk posed by the organism based on the release, exposure and consequence assessments.

The final step after the risk assessment is the formulation of appropriate risk management recommendations, which will reduce the risk to a level considered manageable. Measures selected should be those offering an appropriate level of protection whilst ensuring that negative effects on trade are minimised.

In risk analyses dealing with specific exporting countries, it is usual to include whether or not each biological agent has been reported in the exporting country and, if so, to what extent. However, in a generic risk analysis such as this, the analysis is conducted on the assumption that the agent is present.

Many honey bee diseases have not been subjected to extensive investigation. It is, therefore, necessary to make several assumptions in this risk assessment. The first is that if there are few reports of problems associated with a pathogen, it will be assumed not to be a major disease-causing organism. The second is that, if there are no reports of strain differences with respect to pathogenicity, it will be assumed that there are none. Although this assumption is not covered in the Office International des Épizooties (OIE) guidelines for risk analysis, it is implied in the Ministry of Agriculture and Forestry's policy on animal import risk analysis. If there have been reports of strain differences for organisms already present in New Zealand, it will be assumed that the strains present here are no more or less pathogenic than those elsewhere unless there are data available to prove this.

As the commodities considered for importation are not currently imported in their raw form, it is not possible to accurately determine the extent of the potential trade.

Commodities considered in the risk analysis

The commodities considered in this risk analysis are:

i) honey (which includes honeydew)

ii) bee-collected pollen

iii) royal jelly

iv) propolis

v) bees' wax

vi) used beekeeping equipment

- hive parts, including comb, feeder and queen excluder
- pollen traps and pollen dispensers
- clothing and gloves
- smokers and hive tools
- honey extracting equipment
- containers used for transporting bees
- artificial insemination equipment
- varroa floors

This risk assessment does not include live or dead honey bees, honey bee semen, or bee-collected pollen used for artificial pollination.

Bee venom

Bee venom is not included in the individual sections of this risk analysis on each honey bee pathogen or pest, but is dealt with separately here. A literature search could find no information to suggest that bee venom has been tested for honey bee pathogens, or that their ability to survive in venom had been investigated. Bee venom is collected using a range of methods. As these are usually performed in the apiary, rather than in sterile conditions (e.g. an electrified grid that fits in the hive under the brood frames), it is possible that venom could be contaminated with honey bee pathogens.

A literature search was unable to find any information describing the attractiveness of venom to bees as a food source. This is to be expected as venom does not contain sugars. However, the presence of venom will elicit stinging behaviour in bees (thus the likelihood of multiple bee stings in the same body part).

The venom itself is likely to be a negligible disease risk. However, venom is added to other bee products for sale in New Zealand, e.g. honey, which would be attractive to bees. Thus venom should be imported only in retail packs or in bulk packs for medical use as these packaging methods are unlikely to be accessible to bees.

Honey, pollen, royal jelly, propolis and bees' wax are traded in a variety of forms, from unprocessed product to heavily manufactured products.

Honey:

- bulk honey in drums
- packed honey
- comb honey
- a component of marinades, sauces and glazes
- a component of a range of manufactured products, e.g. breakfast cereals, biscuits, sweets, etc.

Pollen:

- bulk, to be used for human consumption
- packaged in capsules for human consumption
- a component of pollen supplements for feeding to bees

Royal jelly:

- pure product in bulk
- retail containers
- added to retail containers of honey and other products

Propolis:

- raw product
- a range of health foods and nutritional supplements

Bees’ wax:

- bulk unprocessed
- foundation, to be used in hives
- foundation, often coloured, to be used for candles
- a component of cosmetics

The discussion around these commodities will deal with the raw products only. The large variety of manufactured products make it impossible to deal with each one individually as the risk of each will depend on the processes used in manufacturing and whether the commodity remains attractive to bees.

Pest and disease status of
New Zealand honey bees (*Apis mellifera* L.)

The current disease status of New Zealand honey bees is presented in Table 1.

Table 1: Hazard list for the import risk analysis of honey bee products

(Superscript numbers in the Table refer to the references at the end of each chapter)

1. (a)Honey bee pests, predators or diseases and beekeeping pests not reported to be present in New Zealand. Only those organisms that are recorded as unwanted organisms are listed under 'Status in New Zealand' in this table.

Disease or condition	Agent	Type of agent	Status in New Zealand
Varroosis	*Varroa underwoodi*	external parasitic mite	**Unwanted organism**
Varroosis	*Euvarroa sinhai*	external parasitic mite	**Unwanted organism**
Mite infestation	*Tropilaelaps clareae*	external parasitic mite	**Unwanted organism**
Mite infestation	*Tropilaelaps koenigerum*	external parasitic mite	**Unwanted organism**
Acariasis	*Acarapis woodi*	internal parasitic mite	**Unwanted organism**
European foulbrood	*Melissococcus pluton*	bacterium	**Unwanted organism**
	Paenibacillus alvei	bacterium	
	Thai sacbrood virus [1]	virus	
	Deformed wing virus [1]	virus	
	Slow paralysis virus [1]	virus	
	Arkansas bee virus [1]	virus	
	Berkley bee virus [1]	virus	
	Apis iridescent virus [1]	virus	
	Egypt bee virus [1]	virus	
	Chronic paralysis associate virus [1]	virus	
		spiroplasmas	
		gregarines	
Stonebrood	*Aspergillus* spp.	fungus	
Small hive beetle	*Aethina tumida*	beetle	
Bee louse	*Braula coeca*	fly	**Unwanted organism**
Africanised honey bee	*Apis mellifera scutellata* and its hybrids	bees	**Unwanted organism**
Honey bees	*Apis* spp. other than *A. mellifera*	bees	**Unwanted organism**
Hornet	*Vespa mandarinia*	hornet	**Unwanted organism**
Oriental hornet	*Vespa orientalis*	hornet	**Unwanted organism**

1. (b) Honey bee pests, predators or diseases present in New Zealand

Disease or condition	Agent	Type of agent	Status in New Zealand
American foulbrood	*Paenibacillus larvae larvae* [13]	bacterium	**Under official control**
Chalkbrood	*Ascosphaera apis* [13]	fungus	Not under official control
	Malphighamoebe mellificae [2 13]	amoeba	Not under official control
Nosemosis	*Nosema apis* [3]	protozoan	Not under official control
	Bee virus X [3]	virus	Not under official control
	Bee virus Y [3]	virus	Not under official control
	Black queen cell virus [3]	virus	Not under official control
	Chronic bee paralysis virus [3]	virus	Not under official control
	Acute bee paralysis virus [3]	virus	Not under official control
	Cloudy wing virus [3]	virus	Not under official control
	Filamentous virus [7]	virus	Not under official control
	Kashmir bee virus [3]	virus	Not under official control
	Acarapis externus [10]	mite	Not under official control
Varooasis	*Varroa destructor*	external parasitic mite	**Under official control**
	Acarapis dorsalis [10]	mite	Not under official control
Sacbrood	Sacbrood virus [3 13]	virus	Not under official control
Greater wax moth	*Galleria mellonella* [14]	moth	Not under official control
Lesser wax moth	*Achroia grisella* [14]	moth	Not under official control

Evidence for disease-free status

The list of honey bee diseases, predators and pests not present in New Zealand is derived from a number of surveys. As the reliability of any survey decreases with the time that has elapsed since it was conducted, only those surveys conducted in the last 5 years will be discussed. Since 1994 there has been an active exotic disease surveillance programme. In 1994, the programme consisted of visually examining 338 at-risk apiaries for the presence of exotic honey bee diseases by MAFQuality Management. Samples were taken and analysed in MAFQuality Management laboratories for external and internal mites, and European foulbrood. A further 542 samples of bees submitted from beekeepers exporting live bees were also tested for mites[4]. Beekeepers were also required under the Apiaries Act to inspect all their colonies for clinical European foulbrood signs. The surveillance programme continued in this form till 1998[5 6 8]. The targeting component of the surveillance programme was removed in 1998[8] along with the visual examination of colonies and the requirement for beekeepers to inspect their colonies for European foulbrood. The testing is carried out by the MAF reference laboratory. Samples of bees are now submitted for testing for mites, and honey is tested for European foulbrood.

Internal and external mites

New Zealand’s claim to be free of *Tropilaelaps* and tracheal mites is based on the surveillance programme outlined above.

European foulbrood

The claim to be free of European foulbrood (EFB) is based on testing 500 honey samples for *Melissococcus pluton* (1999) and inspecting approximately 500 hives each year for clinical EFB signs (1989–1998)(M Ried 2001 pers comm.). EFB is also a notifiable organism for which beekeepers have been required under the Apiaries Act (pre-1998) to inspect all their hives each spring for clinical EFB signs and to sign a statuary declaration reporting the results of these inspections (this is, however, not very effective). New Zealand bees suffer a syndrome termed ‘half moon syndrome’. Larvae suffering from this syndrome often exhibit signs identical to those of EFB. Because of this, only a very small percent of colonies with larvae exhibiting EFB signs are ever sampled and subject to laboratory examination.

Paenibacillus alvei

Paenibacillus alvei has not been part of any surveillance programme in New Zealand. It has, however, not been recorded from any of the larval smears collected and examined for either *Paenibacillus larvae larvae* or *Melissococcus pluton*.

Viruses

The list of viruses from which New Zealand is reported to be free needs to be treated with caution. It is based on a survey of only 70 colonies conducted 13 years ago. The results of the survey have not been published in the scientific literature[3]. The recent introduction of *Varroa*, presumably on live bees, may have further increased the number of viruses present in New Zealand.

Spiroplasmas and gregarines

Spiroplasmas and gregarines have not been reported to infect honey bees in New Zealand. It is, however, not clear if their presence has ever been investigated. New Zealand’s freedom from these organisms should, therefore, be treated with caution.

Stonebrood

Stonebrood has not been reported in New Zealand. It has not been included in any surveillance programme, so its apparent absence needs to be treated with caution. Its status in New Zealand will be discussed more fully elsewhere.

Varroa

The South Island claim to be free of *Varroa destructor* and New Zealand’s claim to be free of *Varroa underwoodi* and *Euvarroa sinhai* is based on an extensive surveillance programme[9].

Small hive beetle

The small hive beetle has not been specifically targeted in any surveillance programme so its reported absence should be treated with caution. It is, however, probably safe to assume that if it were present here and causing problems similar to those reported from North America, its presence would have been recorded.

Braula coeca

New Zealand's claim to be free of *Braula coeca* is based on the results of an annual surveillance programme that has tested adult bees from approximately 500 hives each year for the last 10 years. Smith and Caron[15] have incorrectly interpreted the worldwide distribution maps of Nixon[12] and reported it as being present in New Zealand.

Africanised honey bees

Africanised honey bees have also formed part of the surveillance programme where 500 colonies were examined and any that were considered to be abnormally aggressive were tested for africanisation using morphometric analysis.

Other honey bee and wasp species

Other honey bee (other than *A. mellifera*) and wasp species (*Vespa mandarina* and *Vespa orientalis*) have not been reported here. As they are relatively conspicuous, it is likely that they are not present.

RECOMMENDED SANITARY MEASURES

A summary of the recommendations made in this risk Assessment on which of the above pests and diseases justify sanitary measures, and for which commodities, is presented in Table 2

Table 2 Summary of which commodities require sanitary measures for each disease (Yes = Sanitary measures recommended, No = No measurers recommended, N/P = not to be imported unless area freedom can be certified.

Common and species name	Bulk honey	Packed honey	Comb honey	Royal jelly	Bee pollen	Bee's wax	Propolis	Used beekeeping equipment
American Foulbrood *Paenibacillus larvae larvae*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
European Foulbrood *Melissococcus pluton*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Acariasis *Acarapis woodi*	No	No	No	No	No	No	No	Yes
Varooasis *Varroa destructor* + other spp	No	No	No	No	Yes	Yes	Yes	Yes
Tropilaelaps clarae and *Tropilaelaps koenigerum*	No	No	No	No	No	No	No	Yes
Bee louse *Braula coeca*	No	No	Yes	No	No	Yes	Yes	Yes
Vespa orientalis and *Vespa mandarina*	No	No	No	No	No	No	No	Yes
Africanised bees *Apis mellifera scutella*	No	No	No	No	No	No	No	Yes
Other Apis species	No	No	No	No	No	No	No	Yes
Small hive beetle *Aethina tumida*	N/P	No	N/P	No	Yes	Yes	Yes	Yes

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VIRUSES

HAZARD ASSESSMENT

A total of 17 viruses have been identified from, or shown to infect, honey bees[3]. Of these, 10 have been reported in New Zealand (Table 1). Although varying strains of some of the viruses have been reported (e.g. Kashmir bee virus [5 11]), the relative pathogenicity of these strains is unknown. As these viruses are also currently not under official control in New Zealand, they will not be classified as a hazard and, therefore, will not be included in this risk assessment.

The following seven viruses have not been reported from New Zealand. Their reported worldwide distribution needs, however, to be treated with caution. The location where particular viruses have been recorded represents the location of individual research workers rather than necessarily representing the distribution of the virus[2]. Also, relatively few New Zealand bees have been tested for viruses in the last 10 years. The testing that has been carried out in this country has been on only a relatively small number of colonies[2].

Description

Thai sacbrood virus

Thai sacbrood virus has been reported causing severe brood mortality in *Apis cerana*[14]. Although it has been found to multiply in *A. mellifera* in the laboratory, it has not been reported to cause disease signs in localities where both *A. mellifera* and *A. cerana* coexist[1].

Apis iridescent virus

Apis iridescent virus causes signs of clustering disease in *A. cerana* colonies, and readily multiplies in *A. mellifera* in the laboratory[4]. However, clustering disease has not been reported in *A. mellifera* in nature and *Apis iridescent* virus has not been reported from *A. mellifera*.

Deformed wing virus

Deformed wing virus has been recorded in *A. mellifera* from many European, Middle Eastern, North African and Asian countries, Britain, and South Africa. It has not been reported from North or South America, the South Pacific, Australia or New Zealand[2].

Although it has been reported to kill honey bees in the absence of the parasitic mite *Varroa jacobsoni* (probably actually *Varroa destructor*) in Britain and South Africa, the virus is usually found in *A. mellifera* colonies infested with *Varroa jacobsoni*, where it is associated with mortality of both adult bees and brood[2]. Pupae infected with deformed wing virus at the white-eye stage of development survive to emergence but have poorly developed wings and soon die[3].

Little information is available on the incidence of the virus in the absence of *Varroa*. The virus was, however, detected serologically in 69% of dead bee samples collected from *Varroa*-infested colonies in midsummer in Poland[13]. *Varroa* has also been implicated in the spread of deformed wing virus. The virus has been detected in *Varroa jacobsoni* and the ability of *Varroa* to transmit the virus has been demonstrated experimentally[9].

The size or frequency of these bee kills in the absence of *Varroa* has not been reported, so it will be assumed that bee kills are small and infrequent.

Egypt virus

Egypt virus has been isolated from dead bees from Egypt[5] and France[10]. Its epidemiology is unknown[2]. Young pupae injected with the virus die in about 7 or 8 days[2].

Slow paralysis virus

Slow paralysis virus has been recorded in Britain, Fiji and Western Samoa[2]. It has not been associated with a disease by itself[7] but has been associated with adult bee mortality in colonies infested with *Varroa jacobsoni*[8] (probably *Varroa destructor*). Nothing more is known of its natural history or distribution[8].

Arkansas bee virus

Arkansas bee virus has been reported from Arkansas and California but has not been detected in bees outside the USA. Nothing is known about its epidemiology[6]. It has, however, been isolated from honey bee pupae infected with Berkley bee virus[12].

Berkley bee virus

Berkley bee virus was identified at the same time as Arkansas bee virus and, as with the latter, it has not been detected in bees outside the USA. Nothing is known about its epidemiology[6].

Chronic paralysis virus associate

Chronic paralysis virus associate depends on chronic bee paralysis virus for its replication and may be of some significance in the defence mechanisms of honey bees against chronic bee paralysis virus.

Hazard determination

Likely establishment

All that is known about the means of spread of these viruses has been presented above. Although little is known, there is no reason to assume that they could not establish and spread if they were to be introduced into honey bee colonies in New Zealand.

Losses associated with trade

As deformed wing virus already has a wide distribution, it is unlikely to cause difficulties with trade. Slow paralysis virus, Egypt virus, Berkley bee virus, and Arkansas bee virus appear to have a much more limited distribution. However, as there is no information to suggest that they are important pathogens of bees, their presence in New Zealand would not be expected to result in restrictions on trade. Nevertheless, countries without these viruses could cite their presence to give them a market advantage. As slow paralysis virus has caused adult bee mortality in colonies infested with *Varroa*[8], it might be used as justification to exclude bees from some markets.

Losses associated with production

Thai sacbrood and *Apis iridescent* viruses have not been reported from *A. mellifera* and are, therefore, very unlikely to cause production losses. Egypt virus, Arkansas bee virus and Berkley bee virus have very limited distributions, have not been associated with production losses, and are, therefore, unlikely to do so if they were to be introduced. Both deformed wing virus and slow paralysis virus are not reported to cause significant production losses by themselves but in other countries have been reported doing so in association with *Varroa*.

Control or eradication costs

As there is no surveillance programme for honey bee viruses in this country, it is unlikely that any of these viruses would be detected until they were established. Even then they might not be detected. As there are no control programmes for honey bee viruses in New Zealand (or anywhere else in the world), it would be very unlikely that any would be embarked upon if one of these viruses were detected here.

CONCLUSION

There are no strain differences reported for these viruses. They are not part of the current surveillance programme and are unlikely to be the subject of a control programme. There is no indication that they would have any major detrimental effect on production or trade, except in association with *Varroa*. Although both deformed wing virus and slow paralysis virus could be considered to be a hazard now that *Varroa* is in New Zealand, the evidence that they are not already here is insufficient to attempt to justify specific sanitary measures to keep them out. Viruses will, therefore, not be considered further in this risk analysis.

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AMERICAN FOULBROOD

HAZARD ASSESSMENT

Description

American foulbrood disease (AFB) is caused by the spore-forming bacterium *Paenibacillus larvae* subsp. *larvae*. *P. larvae larvae* attacks the larvae of honey bee queens, workers and drones[2,20]. Larvae become infected by ingesting spores contaminating their food[20]. The number of spores required to infect a larva increases with larval age. As few as ten spores may infect 24 hour old larvae, whereas larger numbers are need to infect larvae over 2 days old[20,21]. The spores germinate soon after they enter the larval gut and penetrate the body cavity through the gut wall[2]. The infected larvae then quickly die and about 2,500 million spores form[19]. Additional larvae are infected by bees performing house-cleaning duties[2]. *P. larvae larvae* spores may remain viable for at least 35 years[10].

Distribution

AFB has been found on all continents and in most beekeeping countries, including New Zealand[14].

Hazard determination

AFB is present in New Zealand and is subject to an official control programme under the Biosecurity (National American Foulbrood Pest Management Strategy) Order 1998. Because of this, *Paenibacillus larvae larvae* will be classified as a hazard.

RISK ASSESSMENT

Release assessment

Honey

P. larvae larvae spores are frequently found in extracted honey. A total of 8.5% of 82 honey samples from USA and Canada[18], 62% of 68 Austrian honey samples[4] and 56% of 131 honey samples[9] from a range of countries tested positive for *P. larvae larvae* spores.

Royal jelly

There do not appear to be any published reports of royal jelly being tested for *P. larvae larvae* spores. However, as worker larvae may be infected by being fed contaminated food[16], it would be surprising if royal jelly did not also become contaminated.

Bee-collected pollen

P. larvae larvae spores have been reported in pollen trapped from honey bee colonies. This pollen has been shown to cause infections when fed to other colonies[6 11]. It has been suggested that the pollen may become contaminated by bees regurgitating contaminated honey to aid the packing of pollen in their pollen baskets and by housekeeping bees dropping small pieces of diseased larvae or dried scales into the pollen trap drawer[11].

Propolis

There are no specific reports of propolis being contaminated with *P. larvae larvae*. However, as the inside of the wooden supers can become contaminated, it is reasonable to assume that the propolis covering these surfaces might also become contaminated. Propolis scrapings often have a wax component, which may also contain *P. larvae larvae* spores.

Bees' wax

P. larvae larvae spores have been reported in bee cappings wax after they have been washed to remove the water[5].

Used beekeeping equipment

As pollen in traps and the surfaces of supers can be contaminated with *P. larvae larvae* spores[5], it is likely that other hive components might also become contaminated. This is also likely to be the case with equipment that comes into contact with infected hives or bees, including gloves, smokers, cages for shipping bees, artificial insemination equipment and, possibly, clothing. As honey extracting equipment is likely to carry residues of honey wax and propolis, it may also become contaminated.

Exposure assessment

Honey and royal jelly

Honey is attractive to honey bees and they actively seek it. Retail containers of honey that are discarded without being washed will be attractive to bees, which may collect the remaining honey. Honey that is used to feed birds is also attractive to bees. Honey is also occasionally fed to bees to avoid waste or to prevent starvation. The honey will be taken back to beehives and some fed to developing larvae. Royal jelly is similarly attractive to bees and poses a similar risk if partially-filled containers are discarded. The attractiveness of these products will depend on other available food sources.

Pollen

Pollen packed into pellets is less attractive to bees than pollen available on flowers, although they will be attracted to such pellets if there is little other pollen to collect. Bees will be more attracted to the pollen dust that frequently accompanies pollen pellets. Pollen pellets may also be fed directly to honey bee colonies to supplement what they are collecting naturally[13]. Pollen taken from *P. larvae larvae* infected colonies and fed to other colonies has been shown to be capable of infecting them[11].

Propolis

Propolis is unlikely to be attractive to bees or be fed to colonies.

Bees' wax

Bees' wax may attract honey bees, especially if it has residues of honey. Bees' wax may be made into foundation, which could be placed into beehives.

Used beekeeping equipment

Hive parts are likely to be used in conjunction with honey bee colonies, e.g. comb, pollen traps, pollen dispensers, clothing, gloves, smokers, hive tools, containers used for transporting bees, and artificial insemination equipment.

Honey extracting equipment is unlikely to come in contact with bees unless it is coated with residues of honey or wax, which would make it attractive to bees. It is possible that spores could be transferred from honey combs that are placed in an extractor, then returned to a hive. The honey passing though an extractor may also pick up spores and later be consumed by bees.

Consequence assessment

As AFB is already present in New Zealand, and there are no reports of strains with differing pathogenicity, there are no direct consequences of importing *P. larvae larvae* into New Zealand. There are, however, strains that are reported to have varying resistance to Terramycin® (oxytetracycline)[1]. New Zealand has, for the last 50 years, had a policy of not feeding antibiotics for AFB control and it is currently not permitted by the Biosecurity (National American Foulbrood Pest Management Strategy) Order 1998. The goal of the strategy is to eliminate AFB from New Zealand by the destruction of infected colonies and reducing the spread. It is unlikely that oxytetracycline will be fed in New Zealand for AFB control. As long as New Zealand does not feed oxytetracycline, the importation of these strains should have no consequences.

The only consequence would be to any New Zealand colonies that might be infected by contaminated product. This would only have a negative effect on control efforts if imported commodities were contaminated at higher levels and frequency than *P. larvae larvae* contaminated commodities are produced in New Zealand.

Risk estimation

All of the commodities considered have the ability to be contaminated with *P. larvae larvae* spores and all, except propolis, have a high probability of coming into contact with bees.

P. larvae larvae spores are not particularly infective. The lowest concentration of spores that have been fed to colonies and reported to become infected is 50 million spores/L of syrup[8 19]. The lowest number to create an infection is 5 million spores (fed in 100 mls of sugar solution)[8]. In one study of honey from a range of countries, 56% of 131 samples tested positive for *P. larvae larvae* spores[9]. 37 (28%) had concentrations of spores higher than 170 million spores/L and therefore could create an infection if fed to a honey bee colony. The number of spores required to be on other commodities to create an infection is unknown. However, it has been assumed that equipment from colonies with AFB is capable of transmitting the disease[15].

RISK MANAGEMENT

As *P. larvae larvae* spores can be carried in the commodities, there is a high risk of exposure to honey bees with the possibility of infection, and as *P. larvae larvae* is under official control in New Zealand, risk management measures are justified. There are a range of sanitary measures that can be used with *P. larvae larvae*-contaminated commodities.

Heat

Placing hive parts in paraffin wax at 160^{o}C for 10 minutes has been shown to deactivate *P. larvae larvae* spores[7].

Chemical disinfectants

Vircon® (90% for 10 minutes) or sodium hypochlorite (1% for 30 minutes) have been shown to deactivate *P. larvae larvae* spores[7]. They have contact activity only, so any material must be completely clean of wax and propolis before being treated.

Ethylene oxide fumigation is also effective at deactivating *P. larvae larvae* spores[3]. Ethylene oxide does not, however, penetrate honey, which must be extracted before treatment.

Irradiation

Exposure of hives infected with *P. larvae larvae* to 10kGy from ^{60}Co has been shown to inactivate *P. larvae larvae* spores[12 17]. The exposure required to deactivate *P. larvae larvae* spores in honey has not been reported.

Spore concentrations

Diluting contaminated honey so that the spore concentration is lower than the lowest infection threshold should eliminate the risk of imported honey infecting New Zealand colonies. The lowest reported concentration required to create an infection is 50 million spores/litre[19]. Allowing for a suitable safety margin, concentrations of 50,000 spores/litre are unlikely to be infective.

Sanitary measures recommended

The choice of sanitary measures is based on the need to restrict the likelihood that an infective dose of *P. larvae larvae* spores will be introduced with honey bee commodities rather than to attempt to eliminate any possibility of this occurring.

All commodities can be imported without further sanitary measures if they come from an area that is free of *P. larvae larvae* and this area freedom is supported by appropriate monitoring and quarantine measures.

All commodities can be imported without further sanitary measures if they come from hives certified to be free of signs of AFB within the year previous to the commodities being harvested. Freedom from visual signs of AFB is the same standard as that used in New Zealand. If this certification has not been provided, the following sanitary measures are recommended:

Honey and royal jelly

Should:

a) have fewer than the equivalent of 50,000 *P. larvae larvae* spores per litre,

or

b) be imported in a form that is not attractive to bees (such as capsules)

Bees' wax

Should:

a) have the comb exposed to 10kGy from ^{60}Co,

or

b) be in a form that would not be made into foundation.

or

c) be processed so that it is free of pollen and honey

Propolis

Should be processed so that it is free of pollen, honey and wax.

Bee-collected pollen

Should:

a) be exposed to 10kGy from ^{60}Co,

or

b) be packed in capsules or tablets for human consumption,

or

c) be in a form that would not be attractive to honey bees.

Used beekeeping equipment

- Clothing, smokers, artificial insemination equipment and honey extractors should be free of wax and have been washed in hot water to remove adhering spores.

- Hive parts, excluding comb and plastic components, should be:
  a) heated to 160^{o}C for 10 minutes in paraffin wax,

  or

  b) exposed to 10kGy from ^{60}Co.

- Comb should be exposed to 10kGy from ^{60}Co.

- Plastic hive components (including plastic comb) should:
  a) have all wax and propolis removed and the components submerged in a 1% solution of sodium hypochlorite for 30 minutes,

  or

  b) be exposed to 10kGy from ^{60}Co.

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EUROPEAN FOULBROOD

HAZARD ASSESSMENT

Description

European foulbrood (EFB) is a disease of honey bee larvae caused by the bacterium *Melissococcus pluton*[2]. An infection is established when larvae ingest contaminated food and the bacteria grow vigorously within the gut[4]. The larvae usually die when they are 4-5 days old[4]. Some infected larvae survive and the bacteria are discharged with the faeces on the wall of the brood cells[3]. The bacteria are then removed by house-cleaning worker bees, which contaminate larval food[4]. Colonies are usually more seriously affected in the spring and early summer[20 21].

Distribution

EFB is found on all continents, including Australia[16], but has not been reported to occur in Western Australia. EFB has not been reported from New Zealand.

Hazard determination

Colonies can be destroyed, or seriously crippled, by EFB[4]. In the United States, EFB has been reported to cause problems when colonies are used for pollination[19]. As similar problems are likely to occur in New Zealand, *M. pluton* will be classified as a hazard.

RISK ASSESSMENT

Release assessment

Honey

M. pluton bacteria have been found in honey from infected hives. One study showed that 6% of bulk honey samples had *M. pluton*[13].

Royal jelly

In December 2001 *M. pluton* was isolated from a consignment of royal jelly imported into New Zealand from China. *M. pluton* was isolated from three of the ten samples. The bacterium was identified (at the National Centre for Disease Identification) by cultural characteristics on selective media, Gram stain, slide agglutination test and PCR. Previous to this case, tests on 325kg of royal jelly were negative [5].

Bee-collected pollen

Bee-collected pollen does not appear to have been tested for *M. pluton*. *P. larvae larvae* spores have, however, been reported in pollen trapped from bee colonies and this has been shown to cause infections when the pollen has been fed to other colonies[7 9]. *P. larvae larvae* and *M. pluton* are both bacterial infections of honey bee larvae and thus are likely to have similar mechanisms of infectivity. It can, therefore, be assumed that bee-collected pollen is likely to be contaminated with *M. pluton* when collected by infected colonies. Although no data have been provided, the feeding of bee-collected pollen to colonies has been suggested as a factor involved in the spread of EFB in western Canada[14].

Propolis

There are no reports of propolis being contaminated with *M. pluton*. However, as the interior of the wooden supers can become contaminated with *P. larvae larvae*, it might be assumed that the propolis covering these surfaces could also be contaminated with *M. pluton*. Propolis scrapings often have a wax component, which may also contain *M. pluton* bacteria. Propolis has antibiotic properties which may reduce the survival of *M. pluton*. This has, however, not been tested.

Bees' wax

Wax has not been tested for *M. pluton*,. However, as *P. larvae larvae* spores have been reported in cappings wax[6], it can be assumed that wax could also be contaminated by *M. pluton*.

Used beekeeping equipment

With the exception of used brood combs, which have tested positive for *M. pluton*[8], hive equipment does not appear to have been tested for contamination with *M. pluton*.

As pollen in traps and the surfaces of supers can be contaminated with *P. larvae larvae* spores[6], it is likely that all hive components could also become contaminated with *M. pluton*. This is also likely to be the case with equipment that comes into contact with infected hives or bees. As honey extracting equipment is likely to carry residues of honey wax and propolis, it may also become contaminated.

Exposure assessment

Honey and royal jelly

Honey is attractive to honey bees and they actively seek it. Retail containers of honey that are discarded without being washed will be attractive to bees, which may collect the remaining honey. Honey that is used to feed birds is also attractive to bees. Honey is also occasionally fed to bees to avoid waste or to prevent starvation. The honey will be taken back to beehives and some fed to developing larvae. Royal jelly is similarly attractive to bees and poses a similar risk if partially-filled containers are discarded. The attractiveness of these products will depend on other available food sources.

Pollen

Pollen packed into pellets is less attractive to bees than pollen available on flowers, although they will be attracted to such pellets if there is little other pollen to collect. Bees will be more attracted to the pollen dust that frequently accompanies pollen pellets. Pollen pellets may also be fed directly to honey bee colonies to supplement what they are collecting naturally [15].

Propolis

Propolis is unlikely to be attractive to bees or to be fed to colonies.

Bees' wax

Bees' wax may attract honey bees, especially if it has residues of honey. Bees' wax may be made into foundation, which would be placed into beehives.

Used beekeeping equipment

Hive parts are likely to be used in conjunction with honey bee colonies, e.g. comb, pollen traps, pollen dispensers, clothing, gloves, smokers, hive tools, containers used for transporting bees, and artificial insemination equipment.

Honey extracting equipment is unlikely to come in contact with bees unless it is coated with residues of honey or wax, which would make it attractive to bees. It is possible that bacteria could be transferred from frames that are placed in an extractor, then returned to a hive. The honey passing though an extractor may also pick up bacteria and later be consumed by bees.

Consequence assessment

Colonies can be destroyed or seriously crippled by EFB[4]. Nevertheless, in areas with uninterrupted nectar flows, the infection usually remains slight[4] and colonies can cope with the infection without assistance[19]. However, as EFB is a major problem for hives used for pollination[19], it would have implications for the more than 70,000 colonies used for kiwifruit pollination. Beekeepers in Australia find it necessary to feed antibiotics to control EFB and this would be necessary if the disease were introduced to New Zealand. This has implications for the American foulbrood (AFB) Pest Management Strategy, which relies on beekeepers being able to diagnose clinical signs of

AFB. Feeding antibiotics has been reported to suppress AFB disease signs, thus making it more difficult to control[17].

Although the presence of EFB would probably not have any trade implications, the feeding of antibiotics would. Some countries would probably require that honey be tested to ensure it does not contain antibiotic residues.

Risk estimation

The commodities considered are capable of carrying *M. pluton* bacteria and most are likely to be either attractive to honey bees or to come into contact with them. The minimum infective dose of *M. pluton* is unknown. It is, therefore, not possible to determine the risks involved in the bacterial concentrations reported from the few honey bee commodities that have been tested, but it will be assumed that they are high.

RISK MANAGEMENT

As there is a high risk of the honey bee commodities being contaminated with *M. pluton* if they come from an infected hive, and a high probability that honey bees in New Zealand could come in contact with the bacteria if they were imported, sanitary measures are justified.

The possible sanitary measures are:

Heat

Two trials have been conducted to determine the thermal death point of *M. pluton*.[22 23] There are however differences between the two studies (Table 1).

Table 1 Thermal death points for *M. pluton* in honey calculated in two studies

Temp (^{o}C)	Study 1[22]	Study 2[23]
50	48h	47h 30min
60	8h	12h 38min
70	3h 30 min	2h
80	1h	17min

The Thermal death points are reasonably consistent except at 80^{0}C where the estimates range between 17min and 1 hour. It has been suggested [22] that honey type may affect thermal death point of *M. pluton* although this has yet to be established.

Storage

It has been reported that *M. pluton* is rendered inactive in honey that has been stored for 7 months[21]. This observation needs to be repeated and needs to include a variety of honey types as only one honey type was tested and the trials did not have an appropriate control.

Fumigation

It has been suggested that combs and other material can be fumigated with acetic acid[4 11] or formaldehyde[4] to deactivate *M. pluton*. There do not, however, appear to be any reports in the scientific literature as to the effectiveness of these treatments.

Irradiation

Exposing honey to gamma radiation of 14kGy from ^{60}Co has been demonstrated to inactivate *M. pluton*[10]. However, exposing combs to 8kGy was insufficient[18]. The dose required to decontaminate hive parts has not been determined[12].

Sanitary measures recommended

All commodities can be imported without further sanitary measures if they come from an area that is free of *M. pluton* and this area freedom is supported by appropriate monitoring and quarantine measures.

If area freedom cannot be certified, the following sanitary measures are recommended:

Honey and royal jelly

Should be:

a) gamma irradiated with 14kGy from ^{60}Co,

or

b) in a form that would not be attractive to honey bees such as capsules.

or

c) heated to the highest minimum temperatures for the highest minimum times reported to kill *M. pluton.* Core samples from bulk honey must be tested to ensure the appropriate temperature is reached before timing begins.

Temperature (^{o}C)	Time
50	48h
60	12h 38min
70	3h 30min
80	1h

Bees' wax

Should be:

a) exposed to 14kGy from ^{60}Co,

or

b) in a form that would not be made into foundation.

Propolis

Should be processed so that it is free of pollen, honey and wax.

Bee-collected pollen

Should be

a) exposed to 14kGy from ^{60}Co,

or

b) packed in capsules for human consumption,

or

c) in a form that would not be attractive to honey bees such as pollen tablets.

Used beekeeping equipment

- Clothing, smokers, artificial insemination equipment and honey extractors should be cleaned and free of wax and honey.

Hive parts excluding comb and plastic components should be heated at 160^{o}C for 10 minutes in paraffin wax,

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PAENIBACILLUS ALVEI

HAZARD ASSESSMENT

Description

Paenibacillus alvei is not a pathogen of honey bees, rather it is a secondary invader of larvae killed by other pathogens[1].

Distribution

P. alvei is an aerobic spore-forming opportunistic saprophyte which has been isolated from a variety of sources[4] in diverse geographic sites: in Arizona from both feral and managed bee colonies and wax moth cultures[5], three cases of human infection have been attributed to *P. alvei*; two were cases of neonatal meningitis and one an infection of a hip prosthesis in an immune compromised patient[13], from mosquito larvae in India[3], from milk in India[11], in soil from Egypt[6] and in ewe's milk cheese from Spain[14].

The distribution of *P. alvei* in honey bees worldwide has not been recorded, although it is frequently associated *Melissococcus pluton*[1] (the cause of European foulbrood) and its distribution is probably very similar. *M. pluton* is found in most beekeeping countries but has not been reported from New Zealand or Western Australia [9, 12]. *P. alvei* was found in 46% of 120 samples of bees taken from hives in Australia[8] and in 16% of 505 honey samples from Australia[7].

P. alvei's status in New Zealand is unknown. There has been one unconfirmed report of *P. alvei* being detected in New Zealand in 1980 (pers. comm. B. Ball IACR-Rothamsted 2002) but no further reports are known.

Although no surveys have been carried out looking for *P. alvei* in New Zealand, a large number of suspect larvae have been examined for EFB. *M. pluton* or *P. alvei* have not been detected in any of the samples submitted. Each year for the last five years, New Zealand laboratories have tested 300-500 bee and honey samples for *P. larvae larvae*, the cause of American foulbrood (AFB). They have not reported the problems that have been experienced in Australia where *P. alvei* overgrows culture plates being used for culturing *P. larvae larvae*[7]. This suggests that if *P. alvei* is present in New Zealand, it is at least at a low prevalence in beehives or, without *M. pluton* the presence of *P. alvei* may remain undetected unless active surveillance is undertaken (pers. comm. Hornitzky, 2002).

Hazard determination

As *P. alvei* is a microbe with wide geographic distribution and has not been the subject of active surveillance, its status in New Zealand is unknown.

P. alvei is not a primary pathogen but an opportunistic saprophyte. Laboratory experiments[2] indicated that 10^5 cells of *P. alvei* fed to individual honey bee larvae caused no mortality. When the same concentration of bacterial cells was fed with sacbrood virus less than half of the larvae failing to pupate contained *P. alvei*. Thus, even when ingested in large amounts with a primary pathogen, bacterial multiplication does not always occur.

A. Alippi (pers comm. CIDEFI Argentina, 2002) reports that *P. alvei* has been found on dead remains of larvae killed by sacbrood virus, and that *P. alvei* has been associated with larval remains killed by AFB disease. However, Alippi points out that as both EFB and AFB are now endemic diseases in Argentina, it is possible that a colony affected by EFB and recovered can be affected later by AFB. Thus mixed bacterial spore populations of *P .larvae larvae* and *P. alvei* are possible.

Michael Hornitzky (pers. comm. 2002, Elizabeth MacArthur Agricultural Institute) believes that there is no evidence to suggest that *P. alvei* proliferates (under natural conditions) in honeybee larvae that have not been infected with *M. pluton*. Brenda Ball (pers. comm. 2002, IACR-Rothamsted) states that there is nothing to suggest that *P. alvei* either alone or in association with a primary pathogen produces characteristic clinical syndromes. Thus, it seems unlikely that *P. alvei* would cause significant problems in AFB control under the Pest Management Strategy unless *M. pluton* was also introduced (pers. comm. M. Horntizky, 2002).

As *P. alvei* is a saprophyte which appears to have a widespread distribution and its status in New Zealand is unknown, and any complication that the presence of *P. alvei* may cause in the diagnosis of AFB under the Pest Management Scheme is uncertain in the absence of *M. pluton*, *P. alvei* will not be regarded as a hazard for this risk analysis and sanitary measures are not justified.

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SPIROPLASMA

HAZARD ASSESSMENT

Spiroplasmas are bacteria belonging to the class Mollicutes[2]. After they are ingested by adult bees they multiply in the haemolymph[3]. Twelve strains have been isolated from honey bees[4].

It has been suggested[1] that the spiroplasmas infecting honey bees are plant-derived. The spiroplasma infecting tulip poplar (*Liriodendron tulipifera*) nectar has been demonstrated to kill honey bees and was used to explain the spiroplasmosis discovered in bees in the United States[2].

Distribution

Spiroplasmas of bees have not been widely studied so there is limited information available on their distribution. Spiroplasma-infected bees have been reported from France[7], North America, Hawaii[2] and South America[8].

Hazard determination

Spiroplasmas are reported to cause 'May disease' in France[6 7]. They have also been reported to cause production losses and, therefore, will be classed as a hazard.

RISK ASSESSMENT

Release assessment

The mechanism of spread of spiroplasma between bees and between colonies is unknown. It may be through soiled comb, as occurs with *Nosema apis.* If this is the case, the organism has the potential to contaminate all other bee commodities. The survival of spiroplasma in these commodities is not reported. However, as they are reported to be able to survive in nectar[2], this suggests that they could survive in honey and royal jelly. How well they would survive dry conditions on used beekeeping equipment is not reported.

Exposure assessment

Honey and royal jelly

Honey is attractive to honey bees and they actively seek it. Retail containers of honey that are discarded without being washed will be attractive to bees, which may collect the remaining honey. Honey that is used to feed birds is also attractive to bees. Honey is also occasionally fed to bees to avoid waste or to prevent starvation. The honey will be taken back to beehives and some fed to developing larvae. Royal jelly is similarly attractive to bees and poses a similar risk if partially-filled containers are discarded. The attractiveness of these products will depend on other available food sources.

Pollen

Pollen packed into pellets is less attractive to bees than pollen available on flowers, although they will be attracted to such pellets if there is little other pollen to collect. Bees will be more attracted to the pollen dust that frequently accompanies pollen pellets. Pollen pellets may sometimes be fed directly to honey bee colonies to supplement what they are collecting naturally [5].

Propolis

Propolis is unlikely to be attractive to bees or be fed to colonies.

Bees' wax

Bees' wax may attract honey bees, especially if it has residues of honey. Bees' wax may be made into foundation, which would be placed into beehives.

Used beekeeping equipment

Hive parts are likely to be used in conjunction with honey bee colonies, e.g. comb, pollen traps, pollen dispensers, clothing, gloves, smokers, hive tools, containers used for transporting bees, and artificial insemination equipment.

Honey extracting equipment is unlikely to come in contact with bees unless it is coated with residues of honey or wax, which would make it attractive to bees. It is possible that spiroplasmas could be transferred from frames that are placed in an extractor, then returned to a hive. The honey passing though an extractor may also pick up spiroplasmas and later be consumed by bees.

Consequence assessment

The consequence of having honey bee-infecting spiroplasma in New Zealand, assuming they are not already here, is unclear. However, if they are enzootic in bees, there may be consequences of them being present in New Zealand.

A disease caused by spiroplasmas occurs each year in honey bees in the south of France. The disease is referred to as May disease and results in large numbers of dead or moribund adult bees appearing in the front of hives. The bee-infecting spiroplasma in the United States is reported to be capable of destroying as many as 40% of foraging bees during the nectar flow[2]. There is not enough information to predict how seriously the disease would manifest if the spiroplasma were introduced into New Zealand. There are few reports of significant problems with spiroplasma in the literature. They are unlikely to affect exports as they are not controlled elsewhere. Thus the consequence of introducing spiroplasmas will be considered to be low.

Risk estimation

There is not enough information available to reliably predict the likelihood of spiroplasmas being introduced into New Zealand with the honey bee commodities being considered or the consequences if they were introduced. They have only been reported to impact on bees in southwest France and in the United States and their economic impact has not been quantified. The consequence of introducing spiroplasmas is considered to be low.

RISK MANAGEMENT

The infrequent reports of spiroplasmas causing significant problems to honey bees indicate that sanitary measures cannot be justified.

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GREGARINES

HAZARD ASSESSMENT

Description

Gregarines (*Leidyana* species) are protozoan parasites. They attach themselves to the gut epithelium of honey bees where they encyst[6] destroying the epithelial cells. The spores are then passed through the bee in the faeces[3].

Distribution

Honey bees parasitised by gregarines have been reported from Venezuela, North Africa, North America, France, Italy and Switzerland[3 6].

Hazard determination

As it has been suggested that gregarines may cause serious damage to infected colonies[7], they will be classed as a hazard.

RISK ASSESSMENT

Release assessment

The mechanism of spread of gregarines between bees and between colonies is not known. Suggested methods include package bees[7], contaminated water[7], bumble bees[3], cockroaches[6], and contaminated comb[3]. Although not discussed in the literature, if colonies can become infected through contaminated comb, they could potentially be infected through contaminated honey, royal jelly, propolis, wax, pollen and used beekeeping equipment.

Exposure assessment

Honey and royal jelly

Honey is attractive to honey bees and they actively seek it. Retail containers of honey that are discarded without being washed will be attractive to bees, which may collect the remaining honey. Honey that is used to feed birds is also attractive to bees. Honey is also occasionally fed to bees to avoid waste or to prevent starvation. The honey will be taken back to beehives and some fed to developing larvae. Royal jelly is similarly attractive to bees and poses a similar risk if partially-filled containers are discarded. The attractiveness of these products will depend on other available food sources.

Pollen

Pollen packed into pellets is less attractive to bees than pollen available on flowers, although they will be attracted to such pellets if there is little other pollen to collect. Bees will be more attracted to the pollen dust that frequently accompanies pollen pellets. Pollen pellets are sometimes fed directly to honey bee colonies to supplement what they are collecting naturally[4].

Propolis

Propolis is unlikely to be attractive to bees or be fed to colonies.

Bees' wax

Bees' wax may attract honey bees, especially if it has residues of honey. Bees' wax may be made into foundation, which would be placed into beehives.

Used beekeeping equipment

Hive parts are likely to be used in conjunction with honey bee colonies, e.g. comb, pollen traps, pollen dispensers, clothing, gloves, smokers hive tools, containers used for transporting bees, and artificial insemination equipment.

Honey extracting equipment is unlikely to come in contact with bees unless it is coated with residues of honey or wax, which would make it attractive to bees. It is possible that gregarines could be transferred from frames, which are placed in an extractor, then returned to a hive. The honey passing though an extractor may also pick up gregarines and later be consumed by bees.

Consequence assessment

The damage gregarines cause to honey bees is unclear. Reported infection rates have varied between 2-300 per bee in the USA[3] and 3000 per bee in Venezuela[6]. Although gregarines do cause pathological changes in the cells where they attach[7], there is little evidence that they cause measurable damage to infected bees[1 5]. The economic importance of gregarines has yet to be determined[5], but bees infested by gregarines may not be able to work efficiently and may die prematurely[7]. On the other hand, it has also been suggested that there is little reason to control gregarine infections in temperate climates[2] as bees are less likely to be infected than those in tropical regions[3]. Warm climates are probably more favourable to gregarines, as they are killed by freezing[6].

Risk estimation

As the mechanism by which gregarines spread between colonies is unclear, so the importance of the honey bee commodities considered in this risk analysis is also unknown. Although it has been suggested that gregarines are likely to be of little economic importance in temperate regions, there is not enough information on their distribution to be able to conclude that they would not cause some problems in the northern North Island of New Zealand.

RISK MANAGEMENT

As gregarines are not controlled and are not considered to be a significant problem to honey bees in temperate regions, sanitary measures cannot be justified.

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CHALKBROOD

HAZARD ASSESSMENT

Description

Chalkbrood is caused by the fungus *Ascosphaera apis*. Larvae ingest spores, which germinate in the lumen of the gut, probably activated by CO_2 from the tissues[13]. Larval infection has also been suggested to occur from surface inoculation of the larval cuticle[6]. Diseased larvae die and become mummified.

Distribution

Chalkbrood is present in New Zealand[18]. However, strains of *A. apis* with varying virulence[8 20] have been reported elsewhere. The virulence and the number of strains present in this country have not been investigated. There was, however, an introduction of what appeared to be a more virulent strain in 1984.

Hazard determination

The effects of *A. apis* have been reported to range from ‘transient and not considered serious’ to ‘persistent and damaging’[3]. Decreases in honey production of 5%[11] to 37%[21] have been recorded. Chalkbrood has been reported to sometimes kill colonies overseas[2] but not in New Zealand[19]. It often weakens colonies so they are unable to produce a surplus honey crop or sufficient food for winter[5]. However, as these observations relate to naturally infected colonies, it is difficult to assess whether there is a causal relationship between losses of brood and production and chalkbrood infections, or whether there are other factors causing the production loss.

As strain differences are reported for *A. apis*, and significant damage to production is recorded, chalkbrood will be classed as a hazard.

RISK ASSESSMENT

Release assessment

Honey

A. apis spores have been detected in retail packs of honey. In one study, the fungus was detected in 12 out of 16 retail packs[1].

Royal jelly

There do not appear to be any published reports of royal jelly containing *A. apis* spores. However, as worker jelly becomes contaminated with *A. apis*, it would be surprising if royal jelly could not also become contaminated.

Bee-collected pollen

Bee-collected pollen has been demonstrated to become contaminated with *A. apis* spores[17], which can remain viable in the pollen for at least 12 months[10].

Propolis and bees' wax

There do not appear to be any reports of propolis or bees' wax having been tested for *A. apis* spores although there is no reason to assume that they could not become contaminated.

Used beekeeping equipment

The distribution of *A. apis* spores in used beekeeping equipment does not appear to have been investigated. However, as pollen in pollen traps and the surfaces of supers can be contaminated with *P. larvae larvae* spores[9], it is likely that all other hive components to which honey bees have access can also become contaminated with *A. apis* spores. This is also likely with equipment that comes into contact with infected hives or bees, including gloves, smokers, cages for shipping bees, artificial insemination equipment and, possibly, clothing. As honey extracting equipment can carry residues of honey, wax and propolis, they may also become contaminated.

Exposure assessment

Honey and royal jelly

Honey is attractive to honey bees and they actively seek it. Retail containers of honey that are discarded without being washed will be attractive to bees, which may collect the remaining honey. Honey that is used to feed birds is also attractive to bees. Honey is also occasionally fed to bees to avoid waste or to prevent starvation. The honey will be taken back to beehives and some fed to developing larvae. Royal jelly is similarly attractive to bees and poses a similar risk if partially-filled containers are discarded. The attractiveness of these products will depend on other available food sources.

Pollen

Pollen packed into pellets is less attractive to bees than pollen available on flowers, although they will be attracted to such pellets if there is little other pollen to collect. Bees will be more attracted to the pollen dust that frequently accompanies pollen pellets. Pollen pellets are also fed directly to honey bee colonies to supplement what they are collecting naturally[14]. Pollen taken from *A. apis* infected colonies has been shown to be capable of infecting other colonies when they are fed this pollen[15].

Propolis

Propolis is unlikely to be attractive to bees or to be fed to colonies.

Bees' wax

Bees' wax may attract honey bees, especially if it has residues of honey. Bees' wax may be made into foundation, which would be placed into beehives.

Used beekeeping equipment

Hive parts are likely to be used in conjunction with honey bee colonies, e.g. comb, pollen traps, pollen dispensers, clothing, gloves, smokers hive tools, containers used for transporting bees, artificial insemination equipment.

Honey extracting equipment is unlikely to come in contact with bees unless it is coated with residues of honey or wax, which would make it attractive to bees. It is possible that spores could be transferred from frames, which are placed in an extractor, then returned to a hive. The honey passing though an extractor may also pick up spores and later be consumed by bees.

Consequence assessment

Twenty-fold differences between the virulence of some strains have been reported[7]. However, as the virulence of strains present in New Zealand has not been investigated, it is not possible to determine the consequences of having further strains introduced. As the resistance of bee stocks[16] and environmental conditions[4] both effect the severity of chalkbrood infections, it is not possible to conclude that differences in reported severity of the disease in different countries is due to *A. apis* strain differences without supporting experimental evidence. It is, however, possible that the strains reported outside New Zealand are more virulent.

Chalkbrood does not appear to cause the problems in New Zealand that have been reported in Israel[21]. The disease was reported to have a very low incidence in Israel between 1984-1990. However, in the following year, chalkbrood was reported in almost every apiary. Colonies with clinical chalkbrood signs in a single apiary produced 37% less honey than hives with no clinical signs. Although there is a range of possible explanations for this increase in severity of the disease, the appearance of a more virulent strain cannot be ruled out even though no morphological evidence for this was found.

Risk estimation

Viable chalkbrood spores have the potential to be carried in all the commodities considered. With the exception of propolis, the commodities are either very attractive to honey bees or likely to be used in conjunction with beehives, so there is a high probability that honey bees will become infected.

If more virulent strains than that in New Zealand do exist and were introduced, it is likely to adversely affect production and the pollinating efficiency of the colonies. It is not possible to assess the size of any adverse effects. There are, however, unlikely to be trade implications or additional control costs as chalkbrood is not usually controlled except by re-queening colonies with more resistant stock[12].

RISK MANAGEMENT

As chalkbrood is already present in New Zealand and there is no information available that indicates that the strain present here is any less virulent than those found elsewhere, no sanitary measures for risk management are recommended.

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ACARIASIS

HAZARD ASSESSMENT

Description

Acariasis is caused by the tracheal mite (*Acarapis woodi*), which infests the tracheae of honey bees[1]. Female mites enter the first thoracic spiracle of an adult bee, which is usually less than 3 days old[8]. Once inside the tracheae, the female lays between five and seven eggs, which hatch over 3 or 4 days[6]. The mite goes through a six-legged larval stage followed by a pharate nymphal stage, developing into an adult male in 12 days or a female in 15 days[2].

Distribution

A. woodi has been reported from all continents. The only significant beekeeping countries where it has not been reported are Australia and New Zealand[5]. Since it was first reported in colonies in the United States, beekeepers have lost tens of thousands of colonies and millions of dollars[8].

Hazard determination

As tracheal mites kill colonies they will be classed as a hazard.

RISK ASSESSMENT

Release assessment

Honey, bee-collected pollen, royal jelly, propolis, bees' wax and used beekeeping equipment

Tracheal mites are true obligate parasites that cannot exist for more than a few hours off an adult honey bee[4,8]. Honey, pollen, royal jelly, propolis, bees' wax and used beekeeping equipment are therefore unlikely to be factors in the spread of tracheal mites.

Exposure assessment

There would be no exposure unless equipment contained live bees.

Consequence assessment

It is likely that New Zealand honey bees would be as susceptible to tracheal mites as honey bees in North America. In the winter of 1995-1996, tracheal mites caused nearly 32% of colonies to die in the north eastern United States[3,7]. This is a major bee disease that would have serious consequences to the New Zealand beekeeping and pollination industries were it to enter this country.

Risk Estimation

There is no risk of importing tracheal mites in the commodities examined. There is a small risk of live bees being imported in used beekeeping equipment.

RISK MANAGEMENT

Inspection safeguards to prevent the importation of live bees are justified.

Sanitary measures recommended

All commodities can be imported without further sanitary measures if they come from an area free of tracheal mites, and this area freedom is supported by appropriate monitoring and quarantine.

Honey, royal jelly,bee-collected pollen, propolis and bees' wax

No restrictions recommended.

Used beekeeping equipment

Should be inspected to ensure there are no live honey bees.

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VAROOASIS

HAZARD ASSESSMENT

Description

Varooasis is caused by the mite *Varroa destructor*[2]. Adult, female mites reproduce on worker and drone pupae of *Apis mellifera*. The nymphal stages of the mite pierce the cuticle of pupae and feed on the haemolymph[3]. Adult *Varroa* attach to adult bees, pierce the body wall between the abdominal segments and feed on the haemolymph[3].

Euvarroa sinhai, which is smaller than *Varroa destructor*, is a parasite of drone brood of the dwarf honey bee *Apis florea*[6]. *Varroa underwoodi* and *V. jacobsoni* are similar in appearance and may be found in low levels in drone cells of *Apis cerana*[6].

Distribution

Varroa destructor is found in all significant beekeeping countries with the exception of Australia[3]. The lower half of the North Island, and the South Island of New Zealand, are reported to be free of *Varroa*.

Hazard determination

Varroa has been blamed for the destruction of hundreds of thousands of colonies[4 7 13 15]. As *Varroa* can kill colonies[6], it will be considered to be a hazard. *E. sinhai* has not been reported to be able to reproduce on *Apis mellifera*[1] and, thus, will not be considered further in this risk assessment. *Varroa underwoodi* has only been reported from drone cells of *Apis cerana*[6] and, thus, will also not be considered further.

Varroa has developed resistance to a number of *Varroa* control products overseas including fluvalinate, flumethrin, acrinathrin[12]. The introduction of these resistant strains could have a negative effect on *Varroa* control in New Zealand as fluvalinate resistant strains have negatively affected *Varroa* control in northern Italy[12]. Trials conducted when *Varroa* was introduced into New Zealand demonstrated that the strain introduced was not resistant to fluvalinate or flumethrin[8 14]. Whether it is resistant to other *Varroa* control products is unknown. Both fluvalinate and flumethrin are registered for *Varroa* control in New Zealand.

RISK ASSESSMENT

Release assessment

Honey and royal jelly

The ability of *Varroa* to survive in honey or royal jelly has not been reported. Of these products, royal jelly probably has the ability to transport living *Varroa* as the mites partly submerge themselves in jelly in worker and drone cells[6]. However, as royal jelly is likely to be frozen or processed, there is little likelihood of live mites being transported in honey or royal jelly.

Bee-collected pollen

Adult *Varroa* have been reported to survive on pollen for 132 hours at 26^{o}C[5].

Propolis

Survival of adult *Varroa* has not been tested, although there is no reason to assume that survival would be longer than on wax or pollen.

Bees' wax

Varroa adults have been reported to be able to survive on comb for 102 hours at 26^{o}C[5].

Used beekeeping equipment

Varroa adults have been reported to survive on wood for 84 hours, metal for 60 hours, comb for 102 hours, cloth for 102 hours, dead worker bees for 120 hours and dead drones for 114 hours[5] at 26^{o}C. It is possible, therefore, that live mites could be carried on used equipment for up to 5 days.

Exposure assessment

Honey and royal jelly

Honey is attractive to honey bees and they actively seek it. Retail containers of honey that are discarded without being washed will be attractive to bees, which may collect the remaining honey. Honey that is used to feed birds is also attractive to bees. Honey is also occasionally fed to bees to avoid waste or to prevent starvation. The honey will be taken back to beehives and some fed to developing larvae. Royal jelly is similarly attractive to bees and poses a similar risk if partially-filled containers are discarded. The attractiveness of these products will depend on other available food sources.

Pollen

Pollen packed into pellets is less attractive to bees than pollen available on flowers, although they will be attracted to such pellets if there is little other pollen to collect. Bees will be more attracted to the pollen dust that frequently accompanies pollen pellets. Pollen pellets are also fed directly to honey bee colonies to supplement what they are collecting naturally [11].

Propolis

Propolis is unlikely to be attractive to bees or to be fed to colonies.

Bees' wax

Bees' wax may attract honey bees, especially if it has residues of honey. Bees' wax may be made into foundation, which would be placed into beehives.

Used beekeeping equipment

Hive parts are likely to be used in conjunction with beehives, e.g. comb, pollen traps, pollen dispensers, clothing, gloves, smokers, hive tools, containers used for transporting bees, artificial insemination equipment. Hives will also be attractive to swarms.

Honey extracting equipment is unlikely to come in contact with bees unless it is coated with residues of honey or wax, which would make it attractive to bees.

Consequence assessment

The introduction of *Varroa* into North America has been claimed to be the biggest catastrophe to befall apiculture there since honey bees were introduced[4 7 13 15]. Usually, all colonies that do not receive chemical or biotechnical treatment die within 2-4 years[6].

If *Varroa* were to be introduced to the South Island of New Zealand, experience in other countries suggests that it would destroy feral colonies, or at least limit their life expectancy[10]. While this might have a positive effect on American foulbrood incidence, any benefits would be outweighed by the need for the South Island beekeeping industry to use chemical control measures to survive.

The need to use chemicals would pose additional production costs both in terms of treatment and the labour involved in administering it. Some treatments, such as Apistan strips, have been demonstrated to result in undesirable residues in wax[9].

The introduction of fluvalinate or flumethrin resistant mites to the North Island would have a negative affect on *Varroa* control as these are the only *Varroa* control products that are currently registered and are likely to be the most popular chemicals in use, even when others are registered.

Risk estimation

It is unlikely that *Varroa* could be introduced in the commodities considered unless they included live bees or were airfreighted. Used beekeeping equipment poses the greatest risk, but only if exposed to bees soon after importation. Should live *Varroa* be imported and exposed to bees the consequences are very likely to be similar to those in every other country where the mite has been introduced.

RISK MANAGEMENT

Sanitary measures recommended

All commodities can be imported into *Varroa*-free zones of New Zealand without further sanitary measures if they come from an area that is free of *Varroa* and this area freedom is supported by appropriate monitoring and quarantine measures.

All commodities can be imported into *Varroa*-infected zones of New Zealand without further sanitary measures if they come from an area that is free of *Varroa* that is resistant to chemical control products and this area freedom is supported by appropriate monitoring and quarantine measures.

If area freedom cannot be certified, the following sanitary measures are recommended:

Honey and royal jelly

No restrictions recommended.

Bees' wax

Should be:

a) processed into blocks or foundation so that all honey and pollen is removed,

or

b) stored (away from live bees or brood) for at least 2 weeks prior to importation into New Zealand.

Two weeks was chosen because it has been demonstrated that *Varroa* can survive up to 5 days and their survival is dependent upon temperature[5]. However, as only 2 temperatures have been tested, it is possible that *Varroa* might survive for longer at other temperatures.

Propolis

Should be:

a) processed so that it is free of pollen, honey and wax,

or

b) stored for at least 2 weeks (away from live bees or brood) prior to importation into New Zealand.

Bee-collected pollen

Should be stored (away from live bees or brood) for at least 2 weeks prior to importation into New Zealand.

Used beekeeping equipment

Should be stored (away from live bees or brood) for at least 2 weeks prior to importation into New Zealand. Used comb should not contain any dead brood.

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TROPILAELAPS CLAREAE AND *TROPILAELAPS KOENIGERUM*

HAZARD ASSESSMENT

Description

Tropilaelaps clareae is a mite, native to Asia, and parasitic originally on *Apis dorsata*, but now also on *Apis mellifera*. The adults feed on the haemolymph of honey bee larvae but are unable to feed on adult bees[9]. *Tropilaelaps koenigerum* is smaller than *Tropilaelaps clareae* and has been collected from *Apis dorsata*[4], *Apis mellifera* and *Apis cerana*[1].

Distribution

T. clareae has been found in South East Asia, Afghanistan, China and Kenya[3] and Parkastan. *T. koenigerum* has been found in Sri Lanka[4], Nepal[5] and India[1] and Borneo

Hazard determination

Damage to *A. mellifera* colonies can be severe[2]. *T. clareae* has been considered by one observer to be a more serious pest than *Varroa* in Southeast Asian countries, where they both exist[11]. The presence of *T. clareae* in New Zealand could have a major effect on the export trade in queens and package bees, although the inability of *T. clareae* to survive on adult bees should reduce the possibility of trade in live bees transporting *T. clareae*.

Even though *T. koenigerum* has been reported on *Apis mellifera*[1,] its effect has not been reported. For the purpose of this risk assessment, it will be considered to be the same as that of *T. clareae*, and both will be classed as hazards.

RISK ASSESSMENT

Release assessment

The ability of *T. clareae* and *T. koenigerum* to be carried on the commodities being considered has not been reported. They are, however, reported to be able to survive without bee brood for only 2[9 10 6] or 3 days[8]. Live *T. clareae* could, therefore, only be introduced on combs with brood or in commodities airfreighted to New Zealand.

Exposure assessment

Honey and royal jelly

Honey is attractive to honey bees and they actively seek it. Retail containers of honey that are discarded without being washed will be attractive to bees, which may collect the remaining honey.

Honey that is used to feed birds is also attractive to bees. Honey is also occasionally fed to bees to avoid waste or to prevent starvation. The honey will be taken back to beehives and some fed to developing larvae. Royal jelly is similarly attractive to bees and poses a similar risk if partially-filled containers are discarded. The attractiveness of these products will depend on other available food sources.

Pollen

Pollen packed into pellets is less attractive to bees than pollen available on flowers, although they will be attracted to such pellets if there is little other pollen to collect. Bees will be more attracted to the pollen dust that frequently accompanies pollen pellets. Pollen pellets may also be fed directly to honey bee colonies to supplement what they are collecting naturally[7].

Propolis

Propolis is unlikely to be attractive to bees or to be fed to colonies.

Bees' wax

Bees' wax may attract honey bees, especially if it has residues of honey. Bees' wax may be made into foundation, which would be placed into beehives.

Used beekeeping equipment

Hive parts are likely to be used in conjunction with beehives, e.g. comb, pollen traps, pollen dispensers, clothing, gloves, smokers, hive tools, containers used for transporting bees, artificial insemination equipment. Hives will also be attractive to swarms.

Honey extracting equipment is unlikely to come in contact with bees unless it is coated with residues of honey or wax, which would make it attractive to bees.

Consequence assessment

T. clareae has been reported to be more dangerous than *Varroa*[12] for *A. mellifera*. It has been reported responsible for the death of 90% of *A. mellifera* colonies in Afghanistan[9]. It is likely to be less of a problem in temperate areas, where there is a seasonal break in brood rearing[3]. However, brood is present in most colonies in the North Island of New Zealand throughout the winter and in many colonies in the South Island. The presence of *T. clareae* in New Zealand would result in beekeepers having to resort to chemical control measures, with the inherent problems of increased costs, resistance and residues.

The consequence of having *T. koenigerum* in New Zealand cannot be predicted, as its pest status has not been reported.

The presence of either *T. clareae* or *T. koenigerum* here would almost completely stop live bee trade from New Zealand.

Risk estimation

As *T. clareae* can survive without brood for only about 2 to 3 days, only commodities transported by air have the potential to harbour live mites. Of the commodities considered, only used beekeeping equipment might have a high likelihood of carrying live *T. clareae*. Should such equipment be contaminated with *T. clareae,* be airfreighted and be restocked with bees immediately or be allowed to be robbed out, there would be a high probability of *T. clareae* spreading to New Zealand colonies. However, the probability of this occurring within a 3 day period must be very low. Although *T. clareae* has yet to become established in a major beekeeping country outside Asia, it is reasonable to assume that should it establish here it would have a negative effect on New Zealand's beekeeping industry.

Although the pest status of *T. koenigerum* has not been reported, it will be considered to be of similar risk.

RISK MANAGEMENT

As *T. clareae* can only survive for 3 days without honey bee brood, the simplest and most effective sanitary measure would be a short quarantine period and inspection of used beekeeping equipment to ensure it does not contain live honey bee colonies.

Sanitary measures recommended

All commodities can be imported without further sanitary measures if they come from an area that is free of *T. clareae* and *T. koenigerum* and this area freedom is supported by appropriate monitoring and quarantine measures.

If area freedom cannot be certified, the following sanitary measures are recommended:

Honey, royal jelly, bee-collected pollen, propolis and bees' wax

No restrictions recommended.

Used beekeeping equipment

Should have been stored free of brood for at least 7 days prior to importation into New Zealand, and should be inspected on arrival to ensure there are no live honey bees.

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BEE LOUSE

HAZARD ASSESSMENT

Description

The bee louse (*Braula coeca*) is a wingless fly. The adult fly is carried around on the thorax or abdomen of worker, drone and queen honey bee adults and feeds from the host's mouthparts[7]. Adult females lay eggs in honeycomb just before the cells are capped. Upon hatching, the larvae construct tunnels of wax that act as a shelter for the pupal stage. The life cycle takes about 3 weeks[3]. It has been suggested that they may overwinter as eggs or pupae[9], but no data have been produced to support this suggestion. Bee lice are thought to spread from one colony to another via robber bees, drifting bees and in swarms distributed by beekeepers[3].

Distribution

The bee louse has been found on all continents[3] and in Tasmania. Smith and Caron[13] have incorrectly interpreted the worldwide distribution maps of Nixon[11] and reported it as being present in New Zealand. It has not been reported in New Zealand.

Hazard determination

The larval tunnelling detracts from the value of comb honey being produced[3]. Heavy louse infestations on queen bees have also been suggested to be a cause of supercedure[3,5]. The actual loss to beekeepers of either of these two events does not appear to have been quantified.

RISK ASSESSMENT

Release assessment

Honey and royal jelly

There are no reports of the ability of eggs or larvae to survive in extracted honey and royal jelly. As eggs can be found on the lower side of cappings of honey cells [7], *Braula* eggs and larvae are likely to be transported in comb honey. Adults die within 6 hours of hatching if they do not attach themselves to a bee[6], so they are unlikely to be transported in extracted honey, royal jelly or comb honey.

Bee-collected pollen

There are no reports on whether *Braula* is able to survive on bee-collected pollen. The information available on the life cycle of *Braula* suggests this would be unlikely.

Propolis

Propolis is unlikely to support *Braula* larvae unless it contains wax and, possibly, honey residues.

Bees' wax

Although it does not appear to have been investigated, wax cappings with a residue of honey might be expected to support *Braula* larvae. However, processed wax is unlikely to do so.

Used beekeeping equipment

Used hive parts may support larvae if they still contain honey and adult live bees. The very short time that adult flies can survive in the absence of adult bees and the larvae's dietary requirements suggest that other beekeeping equipment is unlikely to carry live *Braula* adults or larvae.

Exposure assessment

Braula adults are wingless and, therefore, require adult honey bees or humans to transfer them between hives. It is possible that an adult *Braula*, emerging from a section of comb honey at the same time (within 6 hours) as bees are robbing it out, could climb on a bee and be transferred back to a hive. This would, however, appear to be a relatively unlikely occurrence. Although there is little information about males, it has been suggested that the female *Braula* need to mate soon after eclosion[12]. If this were correct, males would also have to be present for a gravid female to be transported back to a hive, making it even less likely.

It would appear that the most likely means of transmission would be used comb being imported with capped honey and restocked with bees within 21 days. Even though this could occur if the comb was airfreighted, it would appear to be very unlikely.

Consequence assessment

As *Braula* is found in most countries, their introduction here would be unlikely to place restrictions on New Zealand's live bee trade. However, it has the potential to cause problems for comb honey production. The tunnelling of the *Braula* can cause vein like markings on the face of cappings which detract from the appearance of the finished product[4]. It has been suggested that severe infections may decrease the efficiency of queens[1 2], cause paralysis and impaired egg laying[8], cause the queen to supersede[3], and cause the death of developing bees[10]. There do not, however, appear to be any published data to support these suggestions.

Risk estimation

On the basis of the information available, the risk of introducing *Braula* into New Zealand is considered to be very low, with the possible exception of a situation whereby used hives that still had honey in them were restocked with bees soon after being imported. There is a very low probability that *Braula* would be introduced into New Zealand colonies via comb honey, raw wax or raw propolis. The effects of *Braula* on the New Zealand beekeeping industry are likely to be minor if it were introduced. However, they are large enough to justify sanitary measures.

RISK MANAGEMENT

As there is a risk of introducing *Braula* into New Zealand on some of the commodities considered, and there is potential for adverse effects on our comb honey industry and possibly on beekeeping in general, sanitary measures are justified.

The physical conditions required to ensure commodities are free from *Braula* have not been reported. However, as *Braula*'s life cycle takes 3 weeks[3], and adults will die within 6 hours of hatching if they do not attach themselves to an adult bees, storage of product for 6 weeks should ensure there are no surviving *Braula*.

Sanitary measures recommended

All commodities can be imported without further sanitary measures if they come from an area that is free of *Braula* and this area freedom is supported by appropriate monitoring and quarantine measures.

If area freedom cannot be certified, the following sanitary measures are recommended:

Honey (not comb honey) and royal jelly

No restrictions recommended.

Comb honey

Should be stored away from live bees or brood for 6 weeks prior to importation into New Zealand.

Bees' wax

Should be processed into blocks or foundation.

Propolis

Should be processed so that it is free of wax and honey.

Bee-collected pollen

No restrictions recommended.

Used beekeeping equipment

- Clothing, smokers, artificial insemination equipment, honey extractors

  No restrictions recommended.

- Hive parts should be stored away from live bees or brood for 6 weeks prior to importation into New Zealand.

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VESPA ORIENTALIS AND *VESPA MANDARINIA*

HAZARD ASSESSMENT

Description

The oriental hornet *Vespa orientalis* and *Vespa mandarinia* are social wasps that display an annual nesting cycle. The new colony is founded between spring and early summer by a single overwintered queen that copulated in the proceeding autumn[4].

Distribution

V. orientalis is distributed from the Mediterranean to Japan, while *V. mandarinia* is found in Japan, China and India[2].

Hazard determination

The oriental hornet is an important predator of honey bees in the Mediterranean area. It has been known to destroy whole apiaries. The rate of *V. orientalis* predation has been estimated at 33 bees per hornet per day[6]. *V. mandarinia* also has catastrophic effects on honey bee colonies[3]. It has been classed at the most serious enemy of Japanese apiculture[5]. Ten workers of *V. mandarinia* can kill 40 bees per minute with their mandibles and a colony of 30,000 bees can be killed in 3 hours by a group of 20-30 wasps[5]. Both *V. orientalis* and *V. mandarinia* will be classed as hazards.

RISK ASSESSMENT

Release assessment

The only stage of wasps that could be easily transported is the overwintering queen. The only commodities in which these are likely to be introduced would be used beekeeping equipment.

Exposure assessment

As overwintering queen wasps are gravid and can fly, there is a relatively high probability that they would establish a nest if they were introduced. As *V. mandarinia* is found in Japan, it is probable that it would be able to survive in New Zealand. It is, however, uncertain that either species could successfully establish from the establishment of a single nest. The yellow jacket *Vespula vulgaris* was introduced, and one or more nests produced, on several occasions since 1922 until it successfully established here in the 1980s[1].

Consequence assessment

The consequences of having either of these species established in New Zealand are difficult to determine. Honey bee colonies would almost certainly be destroyed. However, much would depend on how successful these hornets were in the New Zealand environment. The success of these species in this country cannot be predicted. The difficulty of making such predictions is illustrated by the way German and Common wasp have a higher impact on honey bee colonies here than elsewhere in the world[2]. Hornets might also have a more serious impact.

Risk estimation

As overwintering, gravid queen hornets choose cracks and crevices as overwintering sites, they could be easily transported in used beekeeping equipment. However, considering the volume of cargo that has been imported into New Zealand from Asia without these hornets having already been introduced, it is unlikely that they would be introduced in the small volume of used beekeeping equipment that is likely to be imported.

RISK MANAGEMENT

All commodities can be imported without further sanitary measures if they come from an area that is free of *Vespa orientalis* and *Vespa mandarinia,* and this area freedom is supported by appropriate monitoring and quarantine measures.

If area freedom cannot be certified, the following sanitary measures are recommended:

Honey, royal jelly, bee-collected pollen, propolis, bees' wax

No restrictions recommended.

Used beekeeping equipment

Should be inspected to ensure there are no overwintering queen wasps or complete nests.

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AFRICANISED BEES

HAZARD ASSESSMENT

Description

Africanised bees (*Apis mellifera scutella*) are a subspecies of the honey bee (*Apis mellifera*). They were introduced into South America (Brazil) from Africa in 1956 (and the “swarms escaped” in 1957) in an attempt to breed a strain of bees that would be more suitable to tropical conditions[6].

Distribution

Since their introduction into Brazil in 1957 they have spread into much of South America, all of Central America, Mexico and into the southern states of the USA[5 6].

Hazard determination

Africanised bees have a number of behavioural traits that make them difficult to manage. Their introduction would consequently have a negative impact on beekeeping in New Zealand. The most important trait is that they show an exceptionally high level of defensive behaviour[6]. Swarms can attach themselves to almost anything, including drums of honey. Their presence in New Zealand would stop the export trade in queens and package bees. Africanised bees will, consequently, be considered to be a hazard.

RISK ASSESSMENT

Release assessment

For Africanised genes to be established in New Zealand, a functional colony or drones would need to be introduced. The only commodities that could carry a functioning colony or sufficiently healthy drones would be used beekeeping equipment.

Exposure assessment

A fully functional colony would have a high probability of survival if it were introduced in the spring or summer.

Consequence assessment

The consequence of introducing a single colony of Africanised bees is not clear. The initial introduction into Brazil was through 26 colonies swarming and the propagation and distribution of queens to beekeepers in Southern Brazil[6]. Whether the genetic material from a single introduction would be swamped by European bees is not known. The apparent dominance of Africanised over

European characteristics[3] suggests that there is a possibility that a single introduction could eventually become dominant in New Zealand.

Should Africanised bees be introduced and the genes not swamped by the local gene pool, they would probably spread over most of New Zealand, if predictions[1] made in the United States were correct. However, it has also been suggested that Africanised bees will not successfully colonise further north or south than the 33rd parallel[2] or overwinter in areas with mean monthly temperatures less than 15.5^{o}C[4]. If this were correct, then Africanised bees would be unlikely to establish in New Zealand in feral colonies except, perhaps, in Northland, as Auckland has six months with mean monthly temperatures less than 15^{o}C. It should be noted however, that these are predictions and, therefore, should be treated with caution.

Should Africanised bees become established in New Zealand it would be likely to stop or, at least, seriously affect, export trade in queens and package bees.

The behaviour of Africanised bees would create a number of problems for beekeepers in New Zealand. Many Latin American countries now require bees to be kept 200–300m from roads, agricultural fields and dwellings[6]. A similar requirement here would mean that much of New Zealand would become unavailable to beekeepers. Major difficulties would occur if a high percentage of the 75,000 colonies used for kiwifruit pollination were to become Africanised. This could prohibit the use of bees for pollination in such situations. The keeping of bees in built-up areas would also be prohibited.

In addition, there is a high probability that any Africanised colony that established in New Zealand would be infected with *Varroa* and/or tracheal mites.

Risk estimation

The uncertainty surrounding the likelihood; of Africanised bees being able to establish in New Zealand's climate and the Africanised genes not being swamped by the genes from the European bees, makes prediction difficult. However, the serious impact on beekeeping if Africanised bees should become established provides sufficient justification for employing sanitary measures.

RISK MANAGEMENT

All commodities can be imported without a further sanitary measure if they come from an area that is free of Africanised bees and this area freedom is supported by appropriate monitoring and quarantine measures.

If area freedom cannot be certified, the following sanitary measures are recommended:

Honey, royal jelly, bee-collected pollen, propolis and bees' wax

No restrictions recommended.

Used beekeeping equipment

Should be inspected to ensure there are no live honey bees.

References

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OTHER *APIS* SPECIES

HAZARD ASSESSMENT

Description

There are four species of bees in the *Apis* genus. *Apis mellifera* is already in New Zealand and is the species most commonly managed by humans. The other three species are *Apis cerana, Apis florea* (the dwarf honey bee) and *Apis dorsata* (the giant honey bee), which have not been introduced. More recently it has been suggested that other species of *Apis* exist. These include *Apis andreniformis* (the small dwarf honey bee), *Apis laboriosa* (a large specialised mountain bee) and *Apis koschevnikovi*[5].

Distribution

Apis cerana occurs in Asia and as far south as New Guinea. *Apis florea* occurs in Asia and as Far West as Iran. It has also been introduced to Africa. *Apis dorsata* is restricted to South and South East Asia[6]. *Apis andreniformis* occurs in South East Asia and as far north as Southern China. *Apis laboriosa* occurs at high altitudes in Nepal. *Apis koschevnikovi* occurs in Northern Borneo[5].

Hazard determination

There is no evidence to suggest that the presence of the other *Apis* species would have a detrimental effect on beekeeping in New Zealand. However, all can be infected with *Tropilaelaps*[3]. European foulbrood (*Melissococcus pluton*), has also been reported from *Apis cerana*[1] as have tracheal mites *Acarapis woodi*[4] and *Varroa*[2]. *A. cerana* could, therefore, be a reservoir for these pests and diseases and, consequently, will be considered as a hazard.

RISK ASSESSMENT

Release assessment

The only way that *Apis cerana*, *Apis florea* and *Apis dorsata* could be accidentally introduced in the commodities being considered would be for a fully functional colony to be introduced. The only commodities that could carry such a colony would be used beekeeping equipment.

Exposure assessment

If a fully functional colony were introduced in the spring or summer it would have a high probability of survival.

Consequence assessment

The consequence of introducing *Tropilaelaps*, European foulbrood, tracheal mites and *Varroa* have been discussed in the relevant chapters.

Risk estimation

The estimation of the risks relies on the likelihood of the bees introduced being infected with exotic pathogens or pests. This will depend on the origin of the bees and whether they have brood. The probability that used beekeeping equipment would be imported with fully functioning colonies would have to be classed as very low.

RISK MANAGEMENT

Sanitary measures recommended

All commodities can be imported without further sanitary measures if they come from an area that is free of other *Apis* species and this area freedom is supported by appropriate monitoring and quarantine measures.

If area freedom cannot be certified, the following sanitary measures are recommended:

Honey, royal jelly, bee-collected pollen, propolis and bees' wax

No restrictions recommended.

Used beekeeping equipment

Should be inspected to ensure there are no live bees.

References

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STONEBROOD

HAZARD ASSESSMENT

Description

Stonebrood is caused by *Aspergillus flavus* or *Aspergillus fumigatus*. These fungi infect and kill other insects and sometimes cause respiratory diseases in animals, particularly humans and birds[1]. Infection is usually via the gut[3] by honey bee larvae ingesting conidiophores. The internal tissues are quickly overgrown with mycelium, which break through the body wall and grow into the brood comb cell wall. Infected larvae and pupae are transformed into hard stone-like mummies after death. Adult honey bees are attacked when fungal spores are ingested[3]. After the spores germinate within the alimentary canal the resulting mycelia attack the softer tissues.

Distribution

Stonebrood has been reported from North America, Europe, Venezuela and Australia[6] but not from New Zealand. *Aspergillus flavus* has, however, been isolated from dead *Vespula vulgaris* larvae[4], and *Aspergillus fumigatus* has been isolated from animals[2 7] in New Zealand. Although stonebrood has not been reported in New Zealand the presence of both pathogens suggests that the disease could occasionally occur in bee hives in this country, but infections are probably minor and escape notice.

Hazard determination

Although stonebrood has not been reported in New Zealand, there are enough possible pathways of infection between the animals where the causative organisms have been reported to suggest that cross-infection is possible. The social wasp, *Vespula vulgaris*, visits flowers that are visited by honey bees and both collect honeydew from beech trees. *V. vulgaris* also preys on honey bees[5]. Honey bees forage from many plant species that are eaten by both cattle and sheep. As the organisms reported to cause stonebrood have been reported in New Zealand, there are no reported zones of low prevalence, no strains present are more pathogenic than those reported overseas, and no official control programme in New Zealand, stonebrood will not be classed as a hazard and will not be considered further in this risk analysis.

References

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SMALL HIVE BEETLE

HAZARD ASSESSMENT

Description

The small hive beetle (*Aethina tumida*) can destroy honey bee colonies. The adult beetle (4.7 mm long) invades colonies where female beetles lay eggs (1.4mm long) that hatch within 6 days. The beetle larvae eat honey bee eggs, larvae, pupae, honey and pollen[4 2]. They also tunnel in sealed honey. The larval stage lasts between 10 and 20 days[6]. The beetle larvae leave the hive when mature and burrow into the soil in the front of the hive to pupate[3]. The pupal stage takes between 2 weeks and 2 months[6]. Adult beetles can survive for up to 6 months[6]. They can survive for 5 days without food or water[5].

Distribution

The small hive beetle has been reported from Africa and the USA[6]. The beetle was first reported in the USA South Carolina in 1996. Infestations have since been found in Georgia, North and South Carolina[3], and a number of other states.

Hazard determination

It is reasonable to assume that *A. tumida* would establish in the North Island of New Zealand if it were introduced. The small hive beetle has resulted in significant losses in the southeastern USA, where one large operation alone has estimated a loss of nearly 10,000 colonies[1]. For these reasons, the small hive beetle will be classified as a hazard.

RISK ASSESSMENT

Release assessment

Honey

Although it has not been investigated, it is unlikely that *A. tumida* would survive in packed honey. Processing will almost certainly remove foreign objects the size of this beetle. However, the beetles could conceivably survive at the top of drums of honey that have not been adequately filtered. As the larvae have been reported to tunnel into sealed honey[6], they might be carried in comb honey.

Royal jelly

As with packed honey, it unlikely that any stage of the beetle would survive for long in royal jelly, which is usually processed and frozen for transport.

Bee-collected pollen

Adult beetles can survive for at least 5 days without food or water[5] so they might be carried in pollen and, as they may feed on pollen[2], they could possibly survive transit and storage in this commodity.

Propolis

As propolis scrapings often have a wax component, adult beetles and larvae could be transported in these.

Bees' wax

Larvae have been reported to feed on cappings wax[3]. Consequently, it is possible that they could be carried in unprocessed wax. However, it is highly unlikely that they would be carried in processed wax.

Used beekeeping equipment.

The larvae are reported to have similar dietary requirements to waxmoth and, therefore, might be able to feed on stored frames and be transported with used comb. As the adults can survive for at least 5 days without food or water they could also be transported with any used beekeeping equipment. As eggs take up to 6 days to hatch and larvae a further 24 days to develop (if the cells contain some pollen), it is possible that used hives airfreighted to New Zealand could be placed in a situation where mature larvae could leave a hive to reach the soil and pupate.

Exposure assessment

A. tumida can fly and are attracted to the combination of hive products plus bees. There is, therefore, a high probability that any larvae that successfully pupate, or adults that are brought into New Zealand, would find their way to a hive.

Consequence assessment

There is not enough information available on the distribution of *A. tumida* in temperate climates to estimate its likely distribution should it be introduced into New Zealand. *A. tumida* does not appear to be a major problem in southern Africa[2], possibly because the African bees (*Apis mellifera scutellata*) are more defensive against beetle infestations. New Zealand bees are likely to show a similar vulnerability to *A. tumida* as USA bees, as they are more closely related to USA bees than to African honey bees. Consequently, there are likely to be significant colony losses and beekeepers would need to use pesticides to control the beetles. Because of the limited distribution of the beetles in the world, their presence in New Zealand would probably result in restrictions being imposed on trade in queen and package bees.

Risk estimation

Comb honey, possibly bulk honey, raw wax, propolis, pollen or used equipment from hives with *A. tumida* infestations could possibly carry living adults, larvae or eggs. Should adult beetles or larvae be brought into New Zealand, there would be a relatively high probability that they could establish. Should environmental conditions be suitable for the beetles to survive, their presence would almost certainly have a large negative impact on beekeeping.

RISK MANAGEMENT

As there is a risk of the honey bee commodities carrying *A. tumida*, and once here that they could invade honey bee colonies resulting in negative consequences, sanitary measures are justified.

The physical conditions required to ensure commodities are free from *A. tumida* have not been reported. However, there are a number of sanitary measures that are likely to be suitable and should be employed. It will be assumed that the eggs, larvae and adults will be removed by processing.

Sanitary measures recommended

All commodities can be imported without further sanitary measures if they come from an area that is free of *A. tumida* and this area freedom is supported by appropriate monitoring and quarantine measures.

If area freedom cannot be certified, the following sanitary measures are recommended:

Honey (not comb honey) and royal jelly

Can be imported in retail containers but not in bulk drums.

Bees' wax

Should be processed into blocks or foundation so that all honey and pollen is removed.

Comb honey

Cannot be imported from areas where area freedom from *A. tumida* cannot be certified.

Propolis

Should be processed so that it is free of pollen, honey and wax.

Pollen

Can be imported in capsules.

Used beekeeping equipment

- Clothing, smokers, artificial insemination equipment, honey extractors should be washed so they are free of honey and wax.

- Hive parts cannot be imported.

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