SCIENTIFIC OPINION

Scientific Opinion on the risk of entry of *Aethina tumida* and *Tropilaelaps* spp. in the EU[1]

EFSA Panel on Animal Health and Welfare (AHAW)[2,3]

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ABSTRACT

Small hive beetle (SHB) and *Tropilaelaps* are bee diseases considered exotic in the EU. SHB is a flying coleopteran that can be attracted to the odours of bees and bee products. In addition, SHB can survive and reproduce on a variety of ripe fruits. *Tropilaelaps* is an ectoparasite that does not survive long without honey bee brood and cannot fly by itself. The methodology used to assess the risk of entry of these pests in this scientific opinion was adapted from a pest risk assessment for entry used in the field of plant health. A qualitative risk assessment was performed taking into account current legislation but excluding the implementation of risk reduction options. This approach allowed the assessment of the worst case scenario for each risk factor. The risk pathways with a high risk of pest entry are 'import of bee products (use in apiculture)' for SHB and 'accidental import of bees' (unintended presence of bees in a non-bee consignment) for both pests. The other risk pathways are associated with a moderate or low risk of SHB or *Tropilaelaps* entry into the risk assessment area. Risk reduction options were assessed separately from the risk assessment. Examples of risk reduction options with a high effectiveness and a high technical feasibility are the use of health certificates to guarantee pest freedom of consignments and keeping consignments without honey bee brood. Options with a high effectiveness and technical feasibility were identified in all risk pathways except 'accidental import of bees' and 'dispersal of the pest via natural means and/or flight'. The AHAW Panel identified the need for validated rapid detection methods and for handling and sampling of imported bees in insect-proof environments. Education and training could help to monitor the pest distribution and to prevent pest entry by improving awareness, skills and expertise.

KEY WORDS

Aethina tumida, *Tropilaelaps* spp., honey bees, *Apis mellifera*, import risk assessment, risk reduction options

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SUMMARY

Following a request from the European Commission, the Panel on Animal Health and Welfare (AHAW) was asked to deliver a scientific opinion on the risk of entry of *Aethina tumida* (small hive beetle, SHB) and *Tropilaelaps* spp. in the European Union (EU) and the identification and evaluation of risk reduction options.

The SHB is a bee-brood scavenger of *Apis mellifera* (honey bee), *Bombus* spp. (bumble bee) and *Melliponini* (stingless bees). Mature larvae leave the hive and burrow in soil to pupate. This coleopteran is a flying, free-living predator that can survive and reproduce on a variety of ripe fruits, but not on vegetables, plants or flowers. Adult SHB can detect airborne volatiles produced by *A. mellifera* and *Bombus* spp. and thereby can be attracted to the odours of bees and bee products that have come into contact with bees. The pest is native to Africa but has spread to North America and Australia during the past 20 years. The larval stage of the pest is destructive to a bee population, whereas the adults have little impact. The larvae burrow through combs, eat honey and pollen, kill bee brood and defecate in honey, which subsequently ferments.

Tropilaelaps is an ectoparasite of honey bee brood (*Apis* spp.) and can have a short phoretic phase on honey bees. The pest cannot fly and requires honey bee brood to survive. Infestation is caused by different species of *Tropilaelaps* mites (including the mites *Tropilaelaps clareae*, *T. koenigerum*, *T. thaii* and *T. mercedesae*). The presumed primary hosts of *T. clareae* and *T. koenigerum* are the open-air-nesting giant wild honey bees *Apis dorsata* and the small cavity-nesting Asian honey bee *Apis cerana*. Following its host shift to *A. mellifera*, *Tropilaelaps* has spread from mainland Asia, Indonesia and the Philippines to Afghanistan, Iran, New Guinea and South Korea. The infestation and feeding activities of the *Tropilaelaps* mites cause honey bee brood mortality and a reduction in the lifespan of adult honey bees that survive the brood stage.

A qualitative risk assessment was performed taking into account current legislation but excluding the implementation of risk reduction options. Risk reduction options were assessed separately from the risk assessment. This approach allowed the assessment of the worst case scenario for each risk factor within a well-defined (legal) framework. The methodology used in this scientific opinion was adapted from a pest risk assessment for entry used in the field of plant health. Risk pathways were identified and scoring of the risk factors (assuming the worst case) was done by expert elicitation supported by the literature where possible, and an overall risk score for each pathway was obtained using a combination matrix that is used in the animal health risk assessment field. The identification and evaluation of risk reduction options was performed separately from the risk assessment for entry. After identifying possible risk reduction options on entry, each option was evaluated by scoring its effectiveness and technical feasibility and estimating the uncertainty of these scores.

Four risk questions were addressed and the conclusions are described below:

The risk of introduction, limited to entry, of SHB and Tropilaelaps *into the EU through importation from third countries of live queen bees, queen bumble bees (*Bombus *spp.), bumble bee colonies and bee products destined to be used in apiculture*

- *A. mellifera* queens. There is a moderate risk of SHB entry via intentional import of honey bee queens. This is substantiated by the rapid detection and adequate reaction which prevented the establishment of SHB when it once entered into the risk assessment area. For *Tropilaelaps*, the risk of entry via intentional import of honey bee queens is low since this pest is a parasite of honey bee brood and has only a short phoretic phase on honey bees.
- *Bombus* spp. queens. Bumble bees are a less likely source of SHB entry than honey bees since there are no field data on the biological association of SHB with *Bombus* spp. at present. Entry of

Tropilaelaps spp. via imports of *Bombus* spp. queen bees was not considered a risk pathway since this pest has never been reported with bumble bees.

- *A. mellifera* swarms/colonies and *Bombus* spp. colonies. The risk of pest entry via import of swarms and/or colonies is high, however, the risk of entry of SHB and *Tropilaelaps* into the risk assessment area is low and moderate, respectively, because import of swarms and colonies is not permitted according to the actual legislation.
- Bee products. The risk of entry via bee products to be used in apiculture is high for SHB since the pest is attracted to these products and no risk reduction options were taken into account during the risk assessment. For *Tropilaelaps,* the risk of entry via this pathway is moderate. Honey bee brood can be infested by *Tropilaelaps* but it is unlikely that bee brood will be introduced into an apiary and that the pest will leave the consignment because of its limited mobility.
- Accidental bee import (unintended presence of bees in a non-bee consignment) is associated with a high risk of entry for both pests since an infested consignment might not be detected.

The risk of introduction of the SHB and Tropilaelaps *into the EU from neighbouring countries, especially through the natural movements of live bees and of the SHB*

At present, the risk of SHB and *Tropilaelaps* entry by natural means and/or flight is moderate and low, respectively, given that both pests are not reported in countries neighbouring the risk assessment area. If either pest were to be present or established in neighbouring countries, there would be a high risk that SHB and *Tropilaelaps* would reach suitable hosts in the risk assessment area.

The risk of introduction of SHB and Tropilaelaps *into the EU through importation from third countries of products other than bee products (e.g., fruits, vegetables, other possible vectors and fomites, etc.)*

- For SHB, non-bee products that could be at risk for entry into the risk assessment area are imported ripe fruits, used beekeeping equipment, soil as contaminant (e.g., attached to the roots of plants for planting) and soil as plant substrate (e.g., potted plants) since import of soil itself is not permitted. The risk of SHB entry through import of these commodities is moderate, mainly because consignments of these products have a low level of infestation and/or have a low to moderate trade volume. Most types of imported fruit are not considered to be at risk since they are shipped in an unripe stage.
- For *Tropilaelaps*, used bee equipment is the only non-bee product at risk for entry into the risk assessment area. The risk is low owing to a low probability of pest survival during transport in the absence of honey bee brood and/or adults.

The risk-mitigating factors that have proven to be or that could potentially be effective in ensuring safe international trade as regards the transmission of SHB and Tropilaelaps *in bees and their products*

Risk reduction options with a high effectiveness, high technical feasibility and low uncertainty are those most likely to prevent SHB and *Tropilaelaps* entry into the risk assessment area and were identified in all risk pathways except ‘accidental import of bees’ and ‘dispersal of the pest via natural means and/or flight’.

Risk reduction options likely to reduce the risk of SHB entry into the risk assessment area are:

- For the importation of *A. mellifera* and *Bombus* spp. queens, introduction of an active surveillance system by an authority in a third country. Such a system would issue a certificate of pest freedom in the specific zone, ensure pest freedom of a consignment before shipment and prevent escape of the pest from the consignment during transport.

- For importation of swarms and colonies, no likely risk reduction is available during transport or at the border whereas the risk of SHB entry via this pathway is high. Therefore, the EU legislation does not primarilly permit import of swarms and colonies into the risk assessment area.
- For the importation of bee products to be used in apiculture, beekeeping equipment and soil (as a contaminant and in potted plants), application of treatments to eradicate the pest in third countries, during transport and at the border. Also likely to reduce the risk of SHB entry is the introduction of an active surveillance system by an authority in a third country that provides a certificate of pest freedom in the specific zone and which ensures pest freedom of a consignment before shipment (not applicable for soil).
- For import of non-bee products, the only risk reduction option likely to reduce the risk of SHB entry is the introduction of an active surveillance system by an authority in a third country that provides a certificate of pest freedom in the specific zone.

For *Tropilaelaps,* there are two risk reduction options likely to reduce the risk of pest entry into the risk assessment area and which can be applied in all risk pathways, except the pathways 'accidental honey bee import' and 'dispersal of *Tropilaelaps* by flying bees':

- Entry of *Tropilaelaps* is likely to be prevented by applying a biological treatment throughout the risk pathway. In the case of queens, this can be achieved by preventing the consignment without honey bee brood for a minimum of 21 days. For importation of used beekeeping equipment or bee products to be used in apiculture, this can be achieved by preventing contact with honey bee brood and/or adults for a minimum of 21 days.
- Introduction of an active surveillance system by an authority in a third country that provides a certificate of pest freedom in the specific zone is also likely to be reduce the risk of pest entry.

Although the risk reduction options were individually evaluated, it is clear that the risk of pest entry via most risk pathways will be further reduced when different risk reduction options are applied throughout the pathway. The likely options are mainly included in the current EU legislation or mentioned in World Organisation for Animal Health (OIE) guidelines. However, the risk pathway 'accidental import of bees' requires special attention since it is associated with high risk for both SHB and *Tropilaelaps* entry and no likely risk reduction option can be applied.

Based on the results of the pest risk assessment and the evaluation of risk reduction options, the AHAW Panel identified a need for validated rapid detection methods for SHB and *Tropilaelaps* and a need for handling and sampling of imported bees in an insect-proof environment at the designated place of final destination. Education and training of people involved in beekeeping, or trade in or transport of bees, by improving awareness, skills and expertise, could help to monitor the distribution of SHB and *Tropilaelaps* in third countries and to prevent entry of both pests into the risk assessment area. It is recommended that research be carried out to ascertain the risk of SHB entry via products such as ripe fruits and soil associated with plants as well as the harmful effects of *Tropilaelaps* infestation. At present, there are only limited data available on the harmful effects of *Tropilaelaps* infestation and the current view is at least partially based on extrapolations from *Varroa* infestations.

TABLE OF CONTENTS

BACKGROUND AS PROVIDED BY THE EUROPEAN COMMISSION

The small hive beetle (SHB), *Aethina tumida,* is a free-living predator and scavenger affecting and infesting bee populations (species of the genera *Apis* and *Bombus* and also stingless bees). This coleopteran can live without bees, as it is also able to survive on fruits and vegetables.

Tropilaelaps infestation of honey bees (species of the genus *Apis*) is caused by different species of *Tropilaelaps* (including the mites *Tropilaelaps clareae, T. koenigerum, T. thaii* and *T. mercedesae*).

Both SHB and *Tropilaelaps* infestations are OIE listed diseases for which notification of outbreaks is compulsory for members of the OIE.

Both infestations are compulsorily notifiable also in the EU in accordance with Annex I to Council Directive 92/65/EEC[4] and so far the EU is free of such infestations. It is believed that the introduction of these agents into the EU would cause major consequences on the bee population and on the beekeeping activities implying serious socio-economic impact on the beekeeping sector. In North America, the introduction of the SHB has already caused damages to the beekeeping sector. As the worldwide distribution of the SHB and *Tropilaelaps* is not clear (with the exception of those countries that have notified their occurrence to the OIE), the risk that the disease may spread through uncontrolled movements of bees in certain areas of the world remains potentially high. Moreover, it should be considered that these agents would be introduced in a bee population already affected extensively by other pathogens or diseases already present in the EU such as the Varroa destructor mite, American foulbrood and others. The EU bee population is not only affected by bee diseases but also by other factors suggested by the conclusion of the study provided to EFSA on "Bee Mortality and Bee Surveillance in Europe"[5] such as pollution, climate change, use of pesticides in agriculture and others.

It is clear that the potential risk of introduction of the SHB and *Tropilaelaps* constitutes a legitimate concern in the EU. This concern has also been reflected in the European Parliament resolution of 15 November 2011 on honeybee health and the challenges of the beekeeping sector (2011/2108(INI))[6], in which the EP has asked for a complete import ban on all live bees.

However, it should be noted that a complete ban on imports of live bees could encourage illegal imports of bees, which are difficult to control, particularly in the case of queen bees that can be easily hidden. This would expose the EU to an even higher risk of introduction of exotic bee pests and diseases.

In order to avoid the introduction into the EU of the SHB and *Tropilaelaps* with imports of live bees, the Commission has put in place since 2003 with Decision 2003/881/EC[7] animal health import requirements on live bees, bumble bees and bee products destined for use in apiculture. Decision 2003/881/EC has been repealed by Regulation (EU) No 206/2010, which has incorporated the import requirements and certificate model for import of live queen bees and queen bumble bees and colonies of bumble bees coming from controlled environment.

These requirements only allow the introduction into the EU of queen bees with a limited number of attendant bees from third countries listed in Part 1 of Annex II to Regulation (EU) No 206/2010 (i.e. countries whose veterinary services are approved to certify to the EU) and also provides for strict controls upon import into the EU. Furthermore, bumble bee colonies undergo more rigorous import controls and measures at destination than other live animals or commodities. These measures include

[4] OJ L 268, 14.9.1992, p. 54.
[5] http://www.efsa.europa.eu/en/efsajournal/pub/154r.htm
[6] http://www.europarl.europa.eu/sides/getDoc.do?type=TA&reference=P7-TA-2011-0493&language=EN
[7] OJ L 328, 17.12.2003, p. 26.

e.g. destruction of the attendants and wrapping material or the destruction of the containers after the end of the lifespan of the bumble bee colony. Bee products for use in apiculture can be imported on condition that they are treated with procedures laid down in Regulation (EU) No 142/2011[8] and accompanied by the relevant certification.

No animal health requirements on imports of bee products intended for human consumption have been established, based on the assumption that these products will not come in contact with bees and therefore that they represent a negligible risk in relation to the introduction of the SHB and *Tropilaelaps* into the EU.

Directive 92/65/EEC lays down animal health requirements for intra EU movements of bees and the model health certificate for such movements. The requirements also cover the SHB and *Tropilaelaps*, even though the EU is currently free of those pests. The requirements are meant to create an automatic block on movements of bees in case an outbreak would be notified in a Member State.

So far the import policy in place has proven to be effective and has enabled Member States to detect and eliminate problems before the introduction of affected bees into the EU on two occasions when suspicions on the presence of the SHB in consignments of queen bees presented for import have been raised.

It should be considered that the SHB is a coleopteran that can live without bees, as it is able to survive on fruits and vegetables. Therefore the SHB could be introduced into the EU with consignments of such products. On the other hand, *Tropilaelaps* is not able to survive without bees.

Moreover, the SHB is by nature able to fly long distances in a very short period of time. In view of this capability, it would be advisable to evaluate the risk of introduction of the SHB into the EU from neighbouring countries due to movements not related with international trade (e.g. natural movements of bees and the SHB).

In order to support the Commission and the Member States in improving the prevention, control and eradication measures as regards the SHB and *Tropilaelaps*, scientific advice from EFSA would be required in this area. The Commission therefore considers it opportune to request EFSA to assess all the available scientific information and to evaluate the risk of the SHB and *Tropilaelaps* being introduced into and becoming animal health problems in the EU.

Terms of reference as provided by the European Commission

In view of the above, and in accordance with Article 29 of Regulation (EC) No 178/2002, the Commission asks EFSA to provide a scientific opinion on:

- the risk of introduction, limited to entry, of SHB and *Tropilaelaps* into the EU through importation from third countries of live queen bees, queen bumble bees, bumble bee colonies and bee products destined to be used in apiculture;
- the risk mitigating factors that have proven to be or that could potentially be effective in ensuring safe international trade as regards the transmission of the SHB and *Tropilaelaps* in bees and their products;
- the risk of introduction of the SHB and *Tropilaelaps* into the EU from neighbouring countries, especially through the natural movements of live bees and of the SHB;
- the risk of introduction of the SHB and *Tropilaelaps* into the EU through importation from third countries of products other than bee products (e.g. fruits, vegetables, other possible vectors and fomites, etc.).

[8] OJ L 54, 26.2.2011, p. 1.

ASSESSMENT

1. Introduction

About 20 years ago, *Aethina tumida* (small hive beetle, SHB) and *Tropilaelaps* were found to be spreading to previously pest-free countries while EU Member States remained free from these pests. *Aethina tumida* and *Tropilaelaps* spp. were made notifiable within the EU, and measures on the import of bees were adopted based on a risk assessment performed by a group of experts from different Member States.[9] It is assumed that both pests are still exotic to the EU.

In this opinion, the term 'pest' is defined as any unwanted and destructive insect or other animal that attacks food or crops or livestock. *Tropilaelaps* spp. cause direct damage to healthy colonies, whereas *Aethina tumida* damages mainly colonies already under stress. The term 'honey bees' refers to all bees of the genus *Apis* and 'bumble bees' refers to *Bombus* spp. The term 'bees' refers to *Apis* spp. and *Bombus* spp. The meanings of additional bee-specific terms are given in the glossary.

This opinion deals with two pests and takes into account the fundamental biological differences between *Tropilaelaps* mites and SHB. *Tropilaelaps* is an ectoparasite that does not survive long without honey bee brood and that cannot fly by itself. SHB is a coleopteran. It can fly and can detect airborne volatiles produced by *A. mellifera* and *Bombus* spp. Thereby, adult SHB can be attracted to the odours of bees and bee products that have come into contact with bees. In addition, SHB can survive and reproduce on a variety of ripe fruits.

On receipt of the mandate, its terms of reference were discussed with the Commission services and the following clarifications were made:

In the case of introduction with imports from third countries, only the risk of entry, and not the risk of establishment, of these pests on bees, queen bees, bumble bees, bee products (for use in apiculture) and non-bee products is to be assessed.

Similarly, in the case of introduction from EU neighbouring countries, only the risk of entry by natural movement and not the risk of establishment of these pests through live bees and SHB is to be assessed.

The risk reduction options to be considered are those referred in the EU legislation, but also other feasible (applicable at the entry) measures that could help to reduce the risk of introduction.

A qualitative risk assessment will be performed taking into consideration current EU legislation; the risk reduction options will be assessed separately from the risk assessment for entry.

The European Commission requested EFSA to address the following risk questions:

1. Risk of entry of SHB and *Tropilaelaps* spp. into the EU through importation from third countries of (1a) live queen bees, queen bumble bees and bumble bee colonies and (1b) bee products destined to be used in apiculture. This question is answered in Sections 2.4.2 and 2.4.3 for SHB and Sections 2.5.2 and 2.5.3 for *Tropilaelaps*.

2. Risk reduction options that have proven to be, or that could potentially be, effective to ensure safe international trade as regards the transmission of SHB and *Tropilaelaps* in bees and their products. This question is answered in Section 3.

[9] OJ L 268, 14.9.1992, p. 54.

3. Risk of entry of SHB and *Tropilaelaps* into the EU from neighbouring countries through the natural movements of live bees and of SHB. This question is answered in Section 2.4.4 for SHB and Section 2.5.4 for *Tropilaelaps*.

4. Risk of entry of SHB and *Tropilaelaps* into the EU through importation from third countries of products other than bee products (e.g., fruits, vegetables, other possible vectors and fomites). This question is answered in Section 2.4.3 for SHB and Section 2.5.3 for *Tropilaelaps*.

1.1. Methodology

1.1.1. Methodology for the pest risk assessment

The approach used in this scientific opinion was adapted from the plant health 'Guidance on a harmonised framework for pest risk assessment and the identification and evaluation of pest risk management options by EFSA' (EFSA, 2010a). The terminology of the plant pest risk assessment approach is used throughout the document and is explained in the glossary. Risk pathways were identified and scoring of risk factors was done by expert opinion. Consensus scores were obtained. To give a clear answer to the Terms of Reference of the mandate, it was necessary to combine the risk scores from each step of the pathway to come to an overall risk score for each pathway. This last step was done using a combination matrix that is used in the animal health risk assessment field (Beckett, 2007; EFSA, 2010b; Wieland et al., 2011). Figure 1 presents an overview of the major pest risk assessment steps performed in this opinion. A detailed description is available in Appendix A.

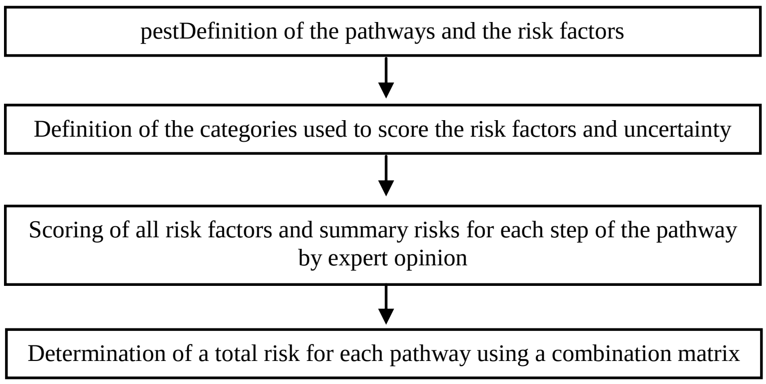

Figure 1: Steps of the pest risk assessment

1.1.2. Methodology for the identification and evaluation of risk reduction options

Identification and evaluation of risk reduction options is based on the 'Guidance on methodology for evaluation of the effectiveness of options for reducing the risk of introduction and spread of organisms harmful to plant health in the EU territory' (EFSA, 2012). After identifying possible risk reduction options on entry, each option was evaluated by scoring its effectiveness, technical feasibility and the corresponding uncertainty. Verbal modifications were introduced in the definitions of the scores as described by the EFSA Panel on Plant Health, to enable their use with regard to bee pests (Appendix B).

1.2. Data

1.2.1. Literature search

A review of the scientific literature was performed to extract information relevant to the risk assessment. Literature searches were carried out in the electronic databases CAB Abstracts (1910 to present), Web of Science (1975 to present) and PubMed (1946 to present) using the search strings '*Tropilaelaps*', '*Aethina tumida*' and 'small hive beetle'. Documents were further considered when (1) the reference was a primary research paper, a thesis or a conference proceeding (to avoid secondary sources) and (2) the language of the main text of the article was English, French or German (to reflect the language capacities of the reviewers). The relevance of retrieved references was assessed by screening their title and abstracts. When references were considered to provide information regarding the biology and epidemiology of the pest that was relevant in relation to the risk assessment, the full text was obtained and relevant information was extracted.

1.2.2. Import data

In addition to the literature review, the following data sources were used to gather data on import of bees, bee products and non-bee products: Trade Control and Export System (TRACES[10]) (bee imports; see Figure 10, Appendix F), Eurostat[11] (bee products and non-bee products; see Figures 11–13, Appendix F).

2. Pest risk assessment

2.1. Pest categorisation of *Aethina tumida*

2.1.1. Identity of the pest

The scientific name of the pest is *Aethina tumida*. It is also known as 'small hive beetle' (SHB).

2.1.2. Risk assessment area

The pest risk assessment area is the legal EU territory. Overseas Countries and Territories are not included due to differences in application of EU law.

2.1.3. Occurrence

2.1.3.1. In the risk assessment area

At present, SHB is not reported (OIE, WAHID interface 2012[12]) and is considered exotic in the risk assessment area. SHB is able to survive in all climatic conditions present in the risk assessment area.

In September 2004, two immature SHB larvae were found in cages of mated *Apis mellifera ligustica* queens and attendants imported from Texas (USA) to Portugal. All beehives of the apiary and another apiary 5 km from the first apiary were burned and the soil layer was removed and buried deep in the ground. The places where beehives had been located were covered with plastic and the soil was flooded with permethrin (Murilhas, 2004). Imports of *A. mellifera* from SHB-endemic countries into the risk assessment area have been recently reported (TRACES, 2012[10]), although erroneous insertion of data into the system seems to be likely. There are no reports on other confirmed cases of SHB entry into the risk assessment area.

[10] https://webgate.ec.europa.eu/sanco/traces/
[11] http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home
[12] http://www.oie.int/wahis_2/public/wahid.php/Diseaseinformation/diseasehome

2.1.3.2. In countries neighbouring the risk assessment area

SHB has never been reported in these countries, although there is uncertainty on the confidence of freedom owing to the limited available information (OIE, WAHID interface 2012[12]).

2.1.3.3. In countries outside and not neighbouring the risk assessment area

SHB is native to sub-Saharan Africa. In June 1998, SHB was first detected in Florida (USA), and by 2003 had spread to 30 states. Other countries outside the risk assessment area where SHB has been detected are Egypt (first report in 2000), Australia (first report in 2001), Canada (first report in 2002), Mexico (first report in 2007) (Hood, 2004; Neumann and Ellis, 2008) and Cuba (first report in 2012, WAHID interface[12]). A survey of 1 239 honey bee colonies in 11 districts throughout Egypt has not detected SHB since the first report in 2000 (Hassan and Neumann, 2008). These results suggest that the pest did not establish in the country, although the study period is not described.

No conclusive evidence has been reported on how SHB spread to the USA and Australia. For USA, it is speculated that SHB entered the port of Charleston (South Carolina) and other ports along the south-eastern US coast on cargo ships loaded with a common commodity that facilitated SHB entry from Africa (Hood, 2004). Based on the rapid rate of the pest's dissemination and the sporadic nature of its distribution pattern, it is hypothesised that transportation of SHB across the USA has occurred primarily through the movement of beehives by migratory beekeepers, the distribution of package bees and, possibly, the distribution of commodities that might serve as alternative hosts (Wenning, 2001).

2.1.4. Hosts

SHB is a parasite of *A. mellifera* colonies. These honey bees are present in the risk assessment area (see Figure 3). The main impact SHB has on African honey bee colonies is a reduction in pollen stores, whereas SHB infestation of European honey bee colonies causes a significant reduction in brood area and damages the bee colony (Ellis et al., 2003a). Such differences seem to be related to better defensive behaviours in African honey bee (*A. mellifera scutellata*) colonies than in other *A. mellifera* colonies. South African beekeepers commonly report defensive behaviour in African honey bees against adult and larval SHB (Elzen et al., 2001). A comparative behavioural study of European and Cape honey bees showed that the latter attacked significantly more SHB than the former (Elzen et al., 2001) and that Cape honey bees imprison and guard adult SHB more efficiently than European honey bees (Neumann et al., 2001; Ellis, 2002a). Strong colonies of African bees are able to control all frames and discard SHB larvae effectively (Johannsmeier, 2001).

Bumble bees are considered a less likely host than honey bees. SHB can successfully reproduce in laboratory *Bombus impatiens* colonies (Ambrose et al., 2000; Stanghellini et al., 2000; Hoffmann et al., 2008) and has also been found to infest bumble bee (*Bombus impatiens*) colonies placed nearby infested colonies (Spiewok and Neumann, 2006a). However, no field data on pest prevalence are available.

There are a few reports of SHB in stingless bee colonies of *Dactylurina staudingerii* in Africa (Mutsaers, 2006) or *Austroplebeia australis* (Halcroft et al., 2011) and *Trigona carbonaria* in Australia (Greco et al., 2009). These stingless bees are not present in the risk assessment area but there are no harmonised import requirements.

Bee brood is the most attractive feeding substrate for SHB (Buchholz et al., 2008). Laboratory experiments have shown that SHB can also survive and reproduce on ripe or rotten fruits, although reproductive rates are much lower than in the beehive. Beetle adults survived between 60 and 188 days when supplied with honeycomb and/or pollen comb or fruit (Lundie, 1940; Ellis et al., 2002c), but only 19 days when supplied with water and beeswax (Schmolke, 1974). When beetles were deprived of food or water, they survived between 2 and 10 days (Schmolke, 1974; Pettis and

Shimanuki, 2000; Ellis et al., 2002c). Larvae survived only up to four days even if supplied with honey (Lundie, 1940). Diets without water always result in a shorter longevity (Schmolke, 1974). More data are available in Appendix C. The numbers are only indicative and cannot be compared between different studies as the experimental settings are not identical. It is also likely that SHB can survive on other (non-tested) fruits. SHB survival and/or reproduction on fruit in field conditions have not been reported. SHB is not able to extract adequate nutrition from plants and flowers to survive (Buchholz et al., 2008). Reproduction on vegetables is not documented, either in laboratory or in field conditions.

2.1.5. Biology of SHB

The life cycle begins with the adult SHB laying eggs, usually in irregular masses in crevices or into sealed brood cells (Figure 2). Most eggs hatch after two to three days (Lundie, 1940; Schmolke, 1974) and the emerging larvae begin to feed on brood comb, bee eggs, pollen and honey within the beehive. At maturation (for the majority between 10 and 16 days after hatching; Lundie, 1940), the larvae, seeking light, exit the beehive, where they fall to the ground, burrow into the surrounding soil and form a pupal chamber. The insect is very vulnerable at this stage and it is believed that there must be a high mortality during this period (Lundie, 1940). The presence of soil is required to complete this step in the life cycle. Adult SHB emerge after an average of three to four weeks, although pupation can take between 8 and 60 days (Lundie, 1940; de Guzman and Frake, 2007; Meikle and Patt, 2011). Adult females reach sexual maturity from two to seven days after emergence from the pupal chamber (Lundie, 1940; Schmolke, 1974).

Adult SHB can live for more than six months under ideal conditions (Lundie, 1940), although different factors influence their abilities to reproduce during this period. Field observations in Africa indicate that successful reproduction of SHB can be enhanced by hot and humid conditions (Torto et al., 2010a). Young pupae are affected more by soil moisture content (negative effect of dry and wet soil) than by soil type (Schmolke, 1974; Ellis et al., 2004; de Guzman and Rinderer, 2009). In addition, diet and ambient temperature affect the lifespan of adult SHB. For example, average adult lifespan on a honey and pollen diet is 92.8 days at 24 °C but only 11.6 days at 35 °C (Meikle and Patt, 2011).

Mature SHB detects kairomones (in the form of airborne volatiles) produced by *Apis mellifera* and *Bombus* spp. (Graham et al., 2011). The odours of bees and of products that have come in contact with bees (e.g., beeswax) can attract adult beetles to colonies, beehives, honey storage and extraction facilities, where they find food and reproduce. Other SHB are attracted to infested beehives as a result of a symbiosis between SHB and the yeast *Kodamaea ohmeri*: the yeast induces fermentation of pollen in the beehive, producing volatiles (e.g., isopentyl acetate) that mimic honey bee kairomones, which are potent attractants for the SHB (Torto et al., 2007, 2010b; Benda et al., 2008). The same mechanism allows SHB to find ripe fruit because isopentyl acetate has been detected in the aroma of some ripening fruits (Mayr et al., 2003).

More detailed information on the mobility, infestation level and harmful effects of SHB is provided in Appendix D.

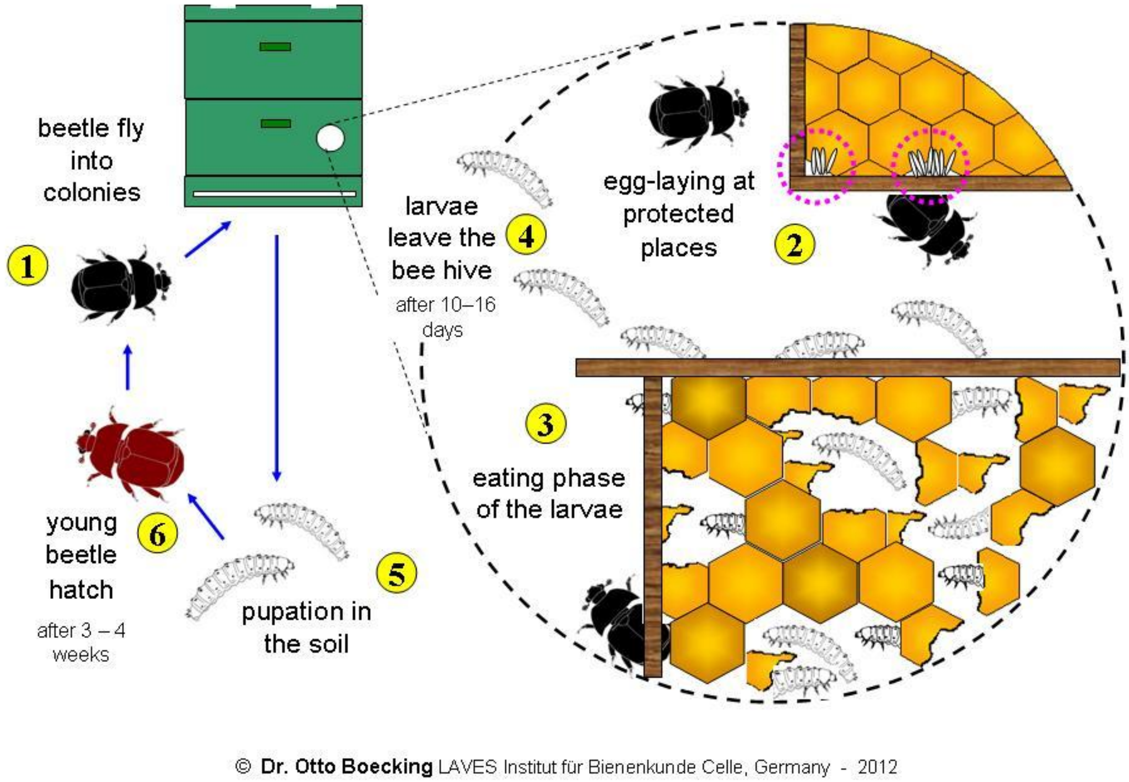

Figure 2: Life cycle of SHB (figure provided by Dr Otto Boecking)

2.1.6. Identification and collection of the organism

Diagnosis of SHB infestation is based on the identification of various life stages of the SHB and clinical signs seen in the beehive or in stored honey. Adult SHB have a length of about 5 mm and can be observed hiding inside cells or in beehive debris. They avoid light and scurry to darker locations when the beehive is opened. Less labour-intensive diagnosis is feasible using beehive control devices (e.g., beehive inserts). Adults can be confused with other beetles from the same family, which can also be associated with colonies (e.g., *Cychramus luteus*) (Neumann and Ritter, 2004). Identification can be done based on morphological characteristics or using molecular biological methods such as polymerase chain reaction (PCR) (Ward et al., 2007). However, sampling is difficult because SHB eggs and larvae are hidden and adults run away from light and hide in crevices and dark corners of beehives and consignments. In addition, the availability of reference material (all life stages of SHB) is limited and there is a huge variation in experience in some laboratories since the pest is exotic in the risk assessment area (Hendrikx et al., 2009). Recently, an EU Reference Laboratory has been designated and provides confirmative diagnosis of SHB. A more detailed description of the identification and collection of the agent is also available in the OIE Terrestrial Manual.[13]

[13] http://www.oie.int/fileadmin/Home/eng/Health_standards/tahm/2.02.05_SMALL_HIVE_BEETLE.pdf

2.2. Pest categorisation of *Tropilaelaps*

2.2.1. Identity of the pest

The scientific name of the pest is *Tropilaelaps.*

Four species of *Tropilaelaps* mites have been identified: two species (*Tropilaelaps clareae* and *Tropilaelaps mercedesae*) are pests of *Apis mellifera*. The other two species (*Tropilaelaps koenigerum* and *Tropilaelaps thaii*) appear to be harmless to *Apis mellifera* (Anderson and Morgan, 2007).

2.2.2. Risk assessment area

The pest risk assessment area is the legal EU territory. Overseas Countries and Territories are not included due to differences in application of EU law.

2.2.3. Occurrence

2.2.3.1. In the risk assessment area

At present, *Tropilaelaps* is not reported (OIE, WAHID interface 2012[14]) and is considered exotic in the risk assessment area. *Tropilaelaps* is able to survive in all climatic conditions present in the risk assessment area. *A. mellifera* imports from *Tropilaelaps*-endemic countries into the risk assessment area have been reported (TRACES, 2008, 2009 and 2011) although erroneous insertion of data into the system seems to be likely.

2.2.3.2. In countries neighbouring the risk assessment area

Tropilaelaps spp. have never been reported in these countries, although there is uncertainty on the confidence of freedom owing to the limited available information (OIE, WAHID interface 2012[15]).

2.2.3.3. In countries outside and not neighbouring the risk assessment area

Tropilaelaps is found throughout the range of the giant honey bees *A. dorsata* and *A. laboriosa*, including mainland Asia, Indonesia and the Philippines. However, since infesting *A. mellifera*, *Tropilaelaps* has spread beyond the geographical range of its primary host to Afghanistan, Iran, New Guinea and South Korea (Matheson, 1996; Anderson and Morgan, 2007). A report from Kenya noted the presence of *T. clareae* (Kumar et al., 1993), but this record has not been confirmed (Anderson and Morgan, 2007). It is inferred that the spread of *Tropilaelaps* following its host shift to *Apis mellifera* remains limited. The reason is not clear at present. Low ambient temperatures are unlikely to affect pest survival in honey bee colonies since bees are able to maintain brood nest temperatures within the range of 33–36 °C, even under extreme environmental temperatures (Lindauer, 1954; Southwick and Heldmaier, 1987; Southwick, 1988). On the other hand, in the case of *Varroa* infestation, it has been observed that parameters affecting brood production (e.g., flowering, rainfall) could be important since the pest is dependent on brood to reproduce (Ritter and De Jong, 1984). In the absence of direct evidence, this information could be extrapolated to *Tropilaelaps*.

2.2.4. Hosts

Tropilaelaps species are ectoparasites (mites) of honey bees of the genus *Apis*, which also occur in the risk assessment area (Figure 3). The presumed primary hosts of *Tropilaelaps clareae* and *T. koenigerum* are the open-air-nesting giant wild bees *Apis dorsata* but they have also been found on the small cavity-nesting Asian honey bee *Apis cerana*. The species *T. mercedesae* was mistaken for *T. clareae* until recently. *Tropilaelaps mercedesae* and *T. koenigerum* are parasites of *Apis dorsata* on the mainland of Asia and Indonesia. *T. mercedesae* and *T. clarae* are damaging pests of the introduced

[14] http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home

cavity-nesting European honey bee *Apis mellifera* in Asia, while *T. koenigerum* and *T. thaii* (occurring in the Himalaya region) are harmless to *Apis mellifera* (Burgett et al., 1983; Aggarwal, 1988; Delfinadobaker et al., 1989; Anderson and Morgan, 2007).

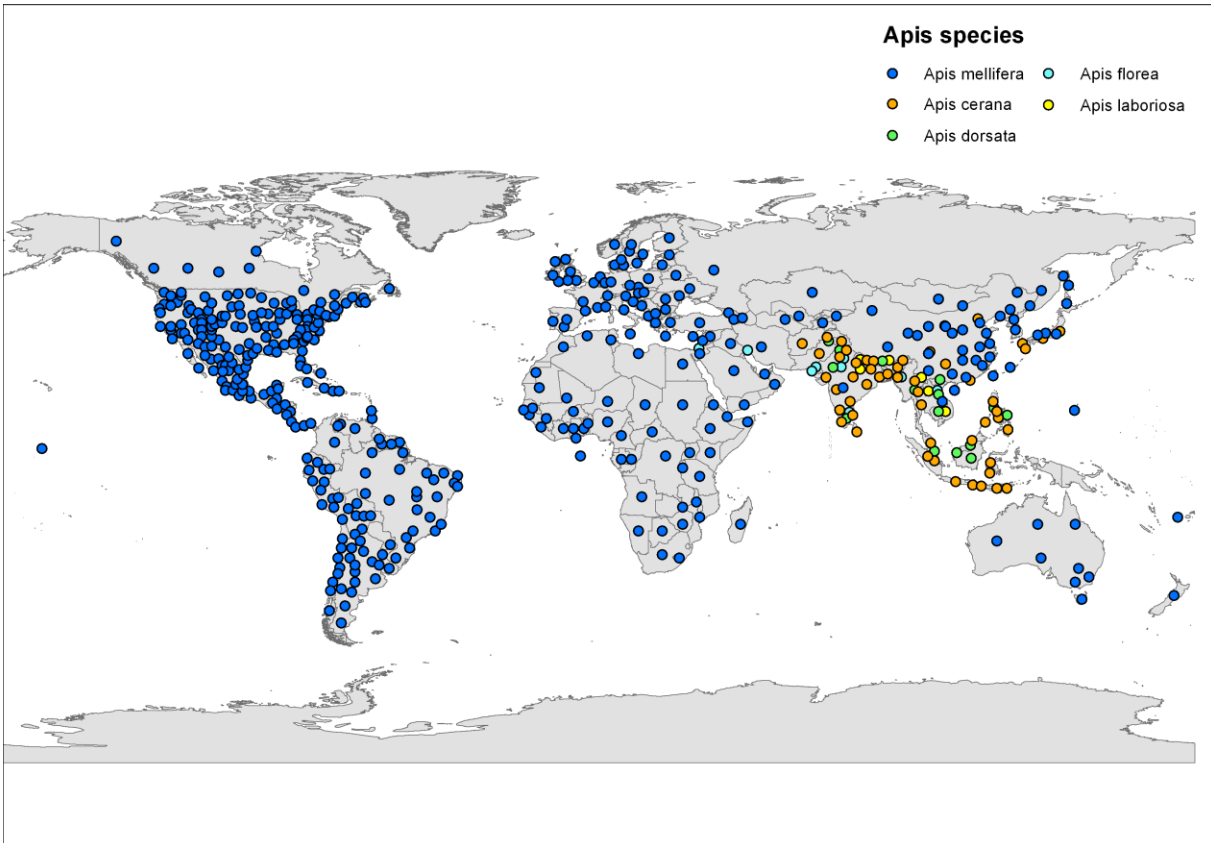

Figure 3: Map representing distribution of *Apis* spp. (based on www.discoverlife.org; last accessed 23 November 2012)

2.2.5. Biology of *Tropilaelaps*

This section mainly describes the biology of *Tropilaelaps* on *Apis mellifera* and *Apis cerana*. The number of studies on the natural host is limited due to the high tendency of the giant honey bees to defend their nest (personal communication, 21 November 2012, Wolfgang Ritter, CVUA-Freiburg, Germany).

The *Tropilaelaps* female infests bee brood shortly before the brood cell is capped (Figure 4) (Burgett et al., 1983). It is difficult to remove the mites attached to pre-pupae of bees as their mouthparts fix firmly on the cuticle to suck haemolymph and the mites' front legs are also clamped onto the host larvae (Ritter and Schneider-Ritter, 1988). The body of the mite swells as a result of increased intake of haemolymph and development of eggs (Woyke, 1984).

It is reported that oviposition of three or four eggs by female *T. clareae* takes place 72 hours after their introduction into brood cells (Sharma et al., 1994). The durations of the egg and larval stages are 0.33 and 0.66 days, respectively, and of nymphal (protonymph and deutonymph) stages 2.66 and 3.25 days, respectively. Once hatched, all stages of both female and male mites feed on haemolymph of the developing bee. In ideal conditions (e.g., in a beehive), the total developmental period from egg to adult is on average 6.92 days. Mature *Tropilaelaps* mites, including the original female, emerge from the brood cell along with the hatching honey bee to search for new hosts. *Tropilaelaps* mites actively search for and enter a new honey bee brood cell within 1.3 days (Oldroyd et al., 2006).

Tropilaelaps has a short phoretic stage on the adult honey bee. In contrast to the flat body shape of the *Varroa* mite, the more egg-shaped *Tropilaelaps* cannot reach the less sclerotised integument between the abdominal rings of the bee. Thus, it is able to survive for only a short time if confined solely to adult honey bees—estimates of this period vary from five hours up to two to three days, or even eight days, depending on the study conditions (Woyke, 1984; Koeniger and Muzaffar, 1988; Rinderer et al., 1994; Sharma et al., 1998). This is similar to the lifespan recorded for mites held with bee eggs (Woyke, 1984) or without brood (Woyke, 1994a). *Tropilaelaps* is not adapted for survival in beehives where there are long broodless periods. In the presence of live honey bee pupae, the lifespan of the mite can reach about one month (Woyke, 1994a), or 50 days under laboratory conditions (Rath et al., 1991). The time periods stated above are only examples since they are derived from regions with different climatic conditions from the risk assessment area or from experiments in specific conditions.

More detailed information on the mobility, infestation level and harmful effects of *Tropilaelaps* is provided in Appendix E.

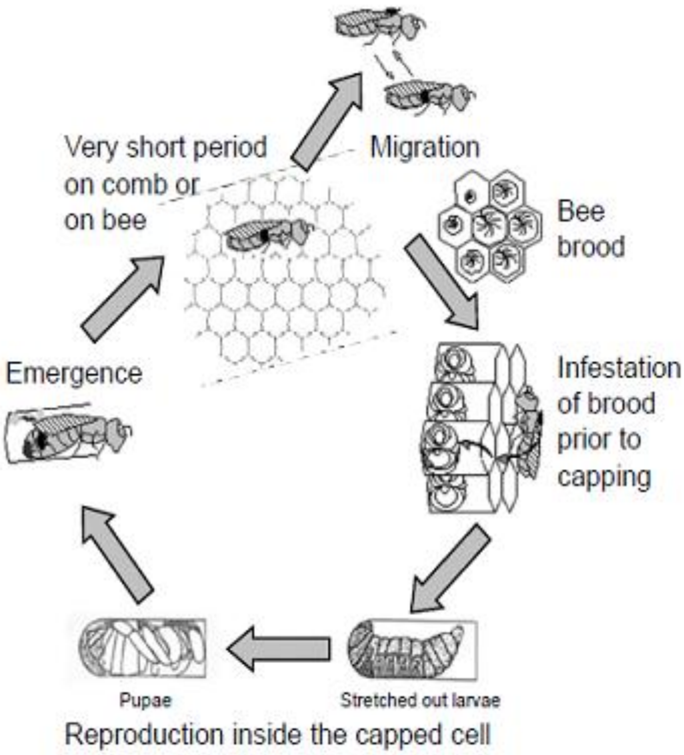

Figure 4: Life cycle of *Tropilaelaps* (figure modified from Donzé et al. (1998) and provided by Dr Marc Schäfer, FLI, National Reference Laboratory for bee diseases)

2.2.6. Identification and collection of the organism

An infestation by *Tropilaelaps* can be recognised either visually on bees or by examining beehive debris. The length of the mite ranges from <0.7 mm (*T. koenigerum*) through <1 mm (*T. clareae*) to <9 mm (*T. mercedesae*). Irregular brood patterns, dead or malformed immature bees, bees with malformed wings that crawl at the hive entrance, and in particular the presence of fast-running, large, red-brown, elongated mites on the combs, are all diagnostic symptoms for the presence of

Tropilaelaps mites. An early diagnosis can be made after opening brood combs and finding immature and adult mites therein. A reliable species identification can only be done in a laboratory, based on morphological characteristics or molecular biological methods such as PCR (Anderson and Morgan, 2007). However, colony sampling is difficult because *Tropilaelaps* hides in sealed brood combs or on the bee. In addition, the availability of reference material (all life stages of *Tropilaelaps*) is limited. There is also a huge variation in training and in experience in the diagnosis of these mites in laboratories since the pest is exotic in the risk assessment area (Hendrikx et al., 2009). Recently, an EU Reference Laboratory for bee health has been designated[15] and provides confirmative diagnosis. A more detailed description on the identification and collection of the agent is available in the OIE Terrestrial Manual.[16]

2.3. Bee import control procedures that were considered during the pest risk assessment

A qualitative non-restricted risk assessment was performed taking into account full compliance with the current legislation (e.g., import of colonies is according to the actual legislation not permitted) but excluding the implementation of risk reduction options (e.g., use of mesh around queen cage during shipment) even though they are included in the current legislation. Risk reduction options were assessed separately from the risk assessment (see Section 3). This approach allowed the assessment of the worst case scenario for each risk factor (e.g., SHB might escape from the consignment during shipment) within a well-defined (legal) framework. For reasons of transparency, this section describes the bee import control procedures that were considered during the pest risk assessment.

Three different options were considered for import of bees, depending on the number of bees and the presence or absence of brood combs:

- import of queens: queen bee with a small number of attendants;
- import of swarms: group of adult bees without brood combs;
- import of colonies: group of adult bees with brood combs

Import of *A. mellifera* and *Bombus* spp. with a health certificate is permitted in the whole risk assessment area based on Commission Regulation (EC) No 206/2010. Import of other bee species can be prohibited by any Member State based on an animal health basis (Council Directive 92/65/EEC). For instance, if the competent authority from a Member State considers *Apis cerana* as a host for *Tropilaelaps*, the Member State could prohibit or establish import requirements at national level for import of *A. cerana* into its territories. In the risk assessment of this scientific opinion, import of any *Apis* spp. is considered for *Tropilaelaps.*

Import of swarms and colonies was considered as a rare event as it is not permitted according to the actual legislation, except from New Zealand. This country has a specific trade agreement with the EU on sanitary measures applicable to the trade in live animals and animal products, based on pest freedom and equivalent sanitary measures (Commission Decision 2006/855/EC[17]).

Transport of bees was defined as a two-phase process. It starts with introduction of the bees (individual bee handling for queen imports or group handling for swarm and colony imports) into a new cage and ends with arrival of the consignment at the border inspection post of the risk assessment area. Here, a veterinary check of the consignment takes place and a decision is made whether or not to approve entry into the risk assessment area. After approval, a second transport phase takes place to bring the consignment to its final destination.

[15] http://www.europarl.europa.eu/oeil/popups/printsummary.pdf?id=1176315&l=en&t=E
[16] http://www.oie.int/fileadmin/Home/eng/Health_standards/tahm/2.02.06_TROPILAELAPS.pdf
[17] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:338:0045:0070:EN:PDF

The veterinary check consists of a documentary, identity and physical check in accordance with Directive 91/496/EEC.[18] The 'documentary and identity check' of a bee consignment is always performed at the border inspection post. The 'physical check' requires staff who are able to transfer bees, new attendants (in the case of queen imports) and an equipped and closed room. At present, these are not available in most border control posts within the risk assessment area; hence the EU import conditions include a specific risk mitigation step, which is unique to bees, i.e., that they remain under the control of the competent authorities at the place of destination until freedom from risk is ascertained. It was assumed during the risk assessment that after the checks at the border inspection post, the bees are further handled in implementation of and in compliance with Commission Regulation (EC) No 206/2010.[19] This means, in the case of *A. mellifera* queen imports, that the queen bee is removed from the cage and its attendants at the final destination (e.g., the importer's premises/apiaries), visually inspected and transferred to a new cage with new attendants. The original cage and attendants are sent to a laboratory for diagnostic testing for SHB and *Tropilaelaps*. When the laboratory results confirm pest freedom from statutory notifiable SHB and *Tropilaelaps*, the queen bee and the new attendants can be introduced into local colonies, shipped to further destinations or generally be placed on the EU market. The time period between the introduction of queens in a consignment and the release of queens in an apiary in the risk assessment are is limited since queens survive only a few days in presence of attendants. Therefore, variations in transport time might influence the risk of SHB and *Tropilaelaps* entry since less time would be available for pest detection. The minimum time required for adequate detection of the pest is determined by the available detection methods.

Bumble bee colonies are produced in a confined closed system where no contact with the environment is possible. The only way in which a bumble bee consignment can become infested is via entry of the pest during transport, but this is prevented by proper packaging. Bumble bee queens are shipped individually in a hibernating state at 5 °C. After arrival, bumble bees are released in a confined closed system to produce new colonies or they are used for pollination in open tunnels and greenhouses as they can only fly a short distance.

2.4. Probability of entry of SHB

2.4.1. Overview of risk pathways for SHB

The risk of SHB entry was assessed as described in Section 1.1.1 and considered the risk pathways presented in Figure 5. Risk reduction options are assessed separately from the risk assessment (see Section 3).

[18] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:1991:268:0056:0068:EN:PDF
[19] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:073:0001:0121:EN:PDF

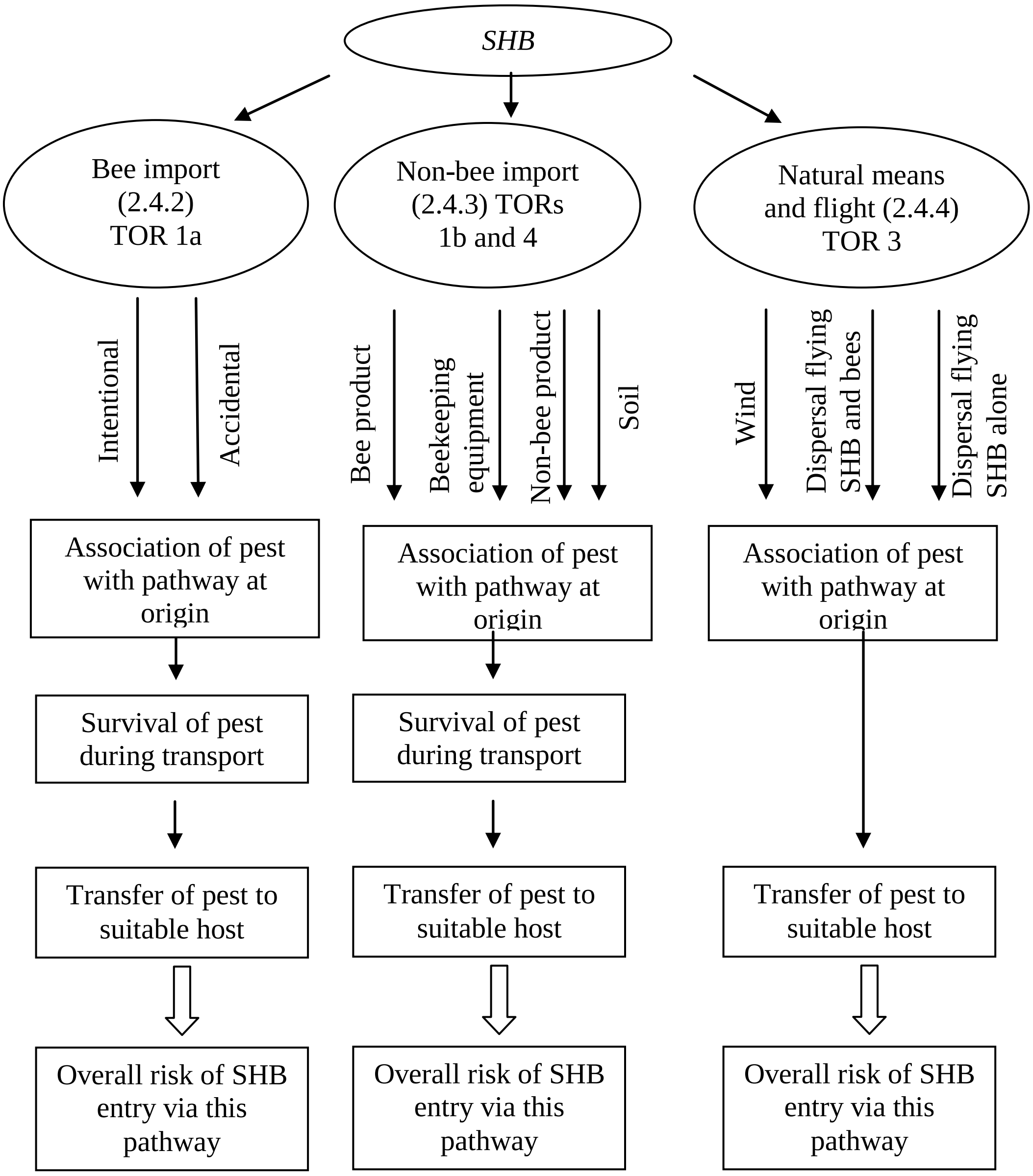

Figure 5: Risk pathways on SHB entry

A detailed analysis of the different pathways can be found in Appendix G. The worst case scenario was always considered during the assessment (e.g., import of an infested consignment). Table 1 presents an overview of the risk and uncertainty scores for each pathway. In the sections below, a description of the main conclusions regarding each pathway is provided.

Table 1: Overview of the risk score/uncertainty score for SHB entry per pathway. Risk score (H: high—red; M: moderate—orange; L: low—green; NA: not applicable) and uncertainty score (H: high—low colour intensity; M: moderate—moderate colour intensity; L: low—high colour intensity).

	Bee import TOR 1a: live bees					**Non-bee import** TOR 1b: bee products; TOR 4: non-bee products				**Natural means and flight** TOR 3: natural movement		
	Intentional				Accidental							
	Queens		Swarms and colonies		Swarms and colonies							
	A. mellifera	*Bombus* spp.	*A. mellifera*	*Bombus* spp.	*Apis* spp.	Bee products	Beekeeping equipment	Non-bee products	Soil	Wind	Dispersal of flying SHB and bees	Dispersal of flying SHB alone
Association of the pest with the pathway at origin (risk/uncertainty)	H/L	M/M	L[20]/L	L[21]/L	H/L	H/L	M/L	M/H	M/H	M/H	M/H	M/H
Survival of the pest during transport (risk/uncertainty)	M/M	M/M	H/L	M/L	H/L	H/L	H/L	H/L	H/L	NA	NA	NA
Transfer of the pest to a suitable host (risk/uncertainty)	M/H	M/M	H/L	H/L	H/L	H/L	H/L	H/L	H/L	H/L	H/L	H/L
Overall risk of SHB entry via this pathway (risk/uncertainty)	M/H	M/M	L/L	L/L	H/L	H/L	M/L	M/H	M/H	M/H	M/H	M/H

[20] The risk of SHB association with swarms and colonies is high. However, the risk assessment considered the actual situation, in which import of swarms and colonies is in general not permitted (see Section 2.3).

2.4.2. Pathway 'Bee import'

2.4.2.1. Intentional bee import

This section assesses the risk of entry of SHB via any type of intentional import of bees. The conditions influencing the risk of SHB entry are different between import of queens and import of swarms/colonies and depend on the bee species that is imported. A detailed analysis of the different pathways can be found in Section 1.1 of Appendix G. The main differences between the four pathways are summarised below.

*Intentional import of queens—*A. mellifera *(risk of SHB entry: M; uncertainty: H)*

The association of SHB with the pathway at origin is high since SHB is attracted to *A. mellifera* (see Section 2.1.5) and might be present in the consignment. Import of *A. mellifera* takes place (see Figure 3, Appendix F), and there are indications from pedigrees that illegal import into the risk assessment area has also occurred. Survival of SHB during transport is moderate as it is most likely that the pest is present as eggs and/or larvae (e.g., case in Portugal). It is less likely that the consignment will contain SHB adults since the queen and attendants are individually introduced (see Section 2.3). During shipment of the consignment, it is practically impossible to open cages for detection of SHB. The conditions applied during transport to keep the bees alive are ideal for SHB survival. SHB larvae and adults could escape the consignment through the air ventilation holes of the cage and adults could fly away when the cage is opened. However, escaping larvae need soil to complete the life cycle (see Section 2.1.5). The risk of SHB transfer to a suitable host is moderate. Current rules are adequate to detect the pest in consignments of queens at arrival when they are correctly applied. Fast detection and instant reaction prevented the establishment of SHB when it once entered into the risk assessment area. At present, procedures associated with import of bees into the risk assessment area are clear, but there is a need for a validated rapid SHB detection method. The risk of SHB entry would increase when honey bees are sent to the final destination and released in the environment before the lab results are available since SHB adults are attracted by honey bee colonies. Variation in awareness on pest detection might influence the capacity to detect SHB. Suitable hosts are available throughout the risk assessment area and SHB adults are attracted to honey bee colonies and bee products.

*Intentional import of queens—*Bombus *spp. (risk of SHB entry: M; uncertainty: M)*

The association of SHB with the pathway at origin is moderate. There is import of bumble bees into the risk assessment area (see Figure 10, Appendix F). However, bumble bees are considered as a less likely host for SHB and there are no field survey data on the distribution of SHB on *Bombus* spp. at present. Data on SHB reproduction on bumble bees are available from experimental conditions but not from field data (see Section 2.1.4). The risk of SHB survival on *Bombus* spp. during transport is similar to survival on *A. mellifera* and was considered to be moderate. In addition, the risk of SHB transfer to a suitable host is moderate. On arrival, the bees are transferred to a confined production unit for bumble bees or as pollinators to greenhouses and tunnels. Although only limited data are available, the possibility that escaping SHB adults will reach a suitable host cannot be excluded, as they are attracted to honey bee colonies and bee products.

*Intentional import of swarms and colonies—*A. mellifera *(risk of SHB entry: L, uncertainty: L) and colonies—*Bombus *spp. (risk of SHB entry: L; uncertainty: L)*

The association of SHB with the pathway at origin is high for swarms and colonies. However, the risk is low in practice taking into account the fact that import of swarms and colonies is not permitted according to the actual legislation (see Section 2.3). The risk of SHB survival during transport is high for *A. mellifera* and moderate for *Bombus* spp. The possibility of adult SHB being present in the consignment increases with the number of bees present and the number of brood combs. For both bee species, the risk of SHB transfer to a suitable host is high. Bees (which could be infested with SHB) go out foraging and thus the adult beetles can also escape. Bumble bees are often used in glasshouses or tunnels where the climate is suitable and loose soil is present for pupation of the pest larvae.

2.4.2.2. Accidental bee import by contaminated consignments

This section assesses the risk of entry of SHB via accidental imports of *Apis* spp. swarms and/or colonies. Bee eggs and larvae are immobile and therefore not included in the risk pathway. The chance of a single bee surviving accidental bee import was considered negligible. *Bombus* spp. do not swarm and are therefore excluded from this pathway. A detailed analysis of the pathway can be found in Section 1.2 of Appendix G. The main conclusions are summarised below.

*Accidental import of swarms and colonies—*Apis *spp. (risk of SHB entry: H; uncertainty: L)*

The association of SHB with the pathway at origin is high. Swarms and colonies of *A. mellifera* have been reported in different types of (non-bee) consignments. Adult SHB is attracted to honey bees and has been reported in swarms (see Appendix D). Survival of the pest during transport is high since there are no specific conditions applied to eradicate SHB and detection of the pest is very unlikely. On arrival, there is a high risk that SHB will come in contact with a local host in the risk assessment area via swarms and/or adult SHB that leave the consignment.

2.4.3. Pathway: 'Non-bee import'

This section assesses the risk of SHB entry via import of bee products, beekeeping equipment, non-bee products and soil. A detailed analysis of the different pathways can be found in Section 2 of Appendix G. The main differences between the four pathways are summarised below.

Bee products (risk of SHB entry: H; uncertainty: L)

Bee-collected pollen, unprocessed comb honey, fresh royal jelly, propolis with beeswax, comb beeswax and brood combs were considered to be at risk for SHB entry and were included in the risk assessment. The import of these products for use in an apiary was taken into account since this represents the scenario with the highest risk. Import of bee products into the risk assessment area is reported (see Figures 11–13, Appendix F), and adult SHB is attracted to bee products (see Section 2.1.5). SHB larvae and adults are likely to survive transport for three to five days without food and water (see Appendix C). The available bee products could act as a suitable food source and extend the survival period. In addition, the risk assessment did not take into account risk reduction options that could be applied to eradicate SHB (see Section 2.3). In the absence of clear visual signs of infestation, detection of the pest is difficult and can be ruled only out by destroying the consignment (e.g., brood combs). Mature SHB could escape from the consignment and come into contact with a suitable host in the risk assessment area, but it is unknown if the availability of food might reduce the likelihood of flying away (see Appendix D).

Beekeeping equipment (risk of SHB entry: M; uncertainty: L)

Only used beekeeping equipment was considered to be at risk for entry of SHB into the risk assessment area. The risks are similar to the pathway 'bee products'. The main differences are the lower risk of the association of the pest with the origin of the pathway owing to lower trade volumes of used beekeeping equipment and the fact that food for SHB is present only as a contaminant in used beekeeping consignments.

Non-bee products (risk of SHB entry: M; uncertainty: H)

Only fruit transported in a ripe state was considered to be at risk because it has been reported that SHB survives and reproduces on ripe fruit (see Section 2.1.4 and Appendix C). More research is required to allow listing of all susceptible fruits and/or definition of the ripening stage at which they become susceptible (see Sections 2.1.4 and 2.1.5). However, only a limited volume of the total tonnage of imported fruit was considered to be at risk since most fruit is imported in an unripe state. Larvae and adults are attracted to ripe fruit and could be present in the consignment. However, infestation of ripe fruit is likely to happen only when no bees and/or bee products are available. SHB survival on fruit is shown under experimental conditions, but there is no clear proof that this can occur under real field conditions. The risk of SHB survival during transport and the risk of SHB transfer to a suitable host are similar to those described for the pathway 'bee products'.

Soil (risk of SHB entry: M; uncertainty: H)

Import of soil itself is excluded from the risk assessment as it cannot be imported into the EU except from Algeria, Egypt, Israel, Libya, Morocco and Tunesia (Council Directive 2000/29/EC[21]), but soil as contaminant (e.g., attached to plants for planting) and soil as plant substrate (e.g., potted plants) were considered. The available data indicate that pupae can be present in soil and newly emerged adults might be present in the consignment (see Appendix D). Infestation of soil is likely to happen only when bee colonies or honey houses are nearby (because of the limited mobility of crawling larvae) and when the conditions for pupation are fulfilled. The risks of SHB survival during transport and SHB transfer to a suitable host are similar to those described for the pathway 'bee products'.

2.4.4. Pathway: 'Natural means and flight'

This section assesses the probability of SHB entry into the risk assessment area by wind (natural means), by dispersal of flying SHB and bees, and by dispersal of flying SHB alone. A detailed analysis of the different pathways can be found in Section 3 of Appendix G. The main conclusions are summarised below.

All three pathways (risk of SHB entry: M; uncertainty: H)

In the case of all three pathways, the risk of SHB association with the origin of the pathway is high, especially regarding the adult life stage of the pest. Wandering larvae leaving the beehive can also be passively dispersed by wind. At present, SHB is not reported in neighbouring countries (see Section 2.1.3.2). There are no data available on dispersal distance of SHB via wind, neither on how far SHB and bees are flying together (see Appendix D). No clear data are available on the dispersal distance of SHB alone. There is a low probability that swarms entering the risk assessment area via wind or natural flight will be detected. The probability that these swarms will be checked for SHB is negligible. Suitable hosts are available in the risk assessment area and adult SHB is attracted to honey bee colonies and bee products.

If SHB were present or established in neighbouring countries, the pest would reach suitable hosts in the risk assessment area. Canada, for instance, tried actively but failed to prevent SHB entry into its territory after establishment of the pest in the USA.

2.4.5. Conclusions on probability of SHB entry

An overview of the conclusions on the risk of SHB entry into the risk assessment is provided in Table 2. Low awareness regarding SHB influences the capacity to detect the pest.

[21] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2000:169:0001:0112:EN:PDF

Table 2: Conclusions on the probability of SHB entry into the risk assessment area. Risk score (H: high—red, M: moderate—orange, L: low—green) and uncertainty score (H: high, mainly due to lack of data—low colour intensity, M: moderate—moderate colour intensity, L: low—high colour intensity).

Risk pathways of SHB entry				Risk/ uncertainty	Main rationale
Bee import TOR 1a: live bees	Intentional bee import	Queens	*A. mellifera*	M/H	Fast detection and instant reaction prevented the establishment of SHB when it once entered the risk assessment area.
			Bombus spp.	M/M	Bumble bees are a less likely source of SHB entry than honey bees because there are no field survey data on the biological association of SHB with *Bombus* spp. at present.
		Colonies and swarms	*A. mellifera*	L/L	The risk of SHB entry via import of swarms and colonies is high, however, the risk of entry of this pest into the risk assessment area is low because import of swarms and colonies is not permitted according to the actual legislation.
			Bombus spp.	L/L	
	Accidental bee import			H/L	Swarms and colonies of *A. mellifera* have been reported in different types of (non-bee) consignments. They can be infested with SHB since the pest is attracted to honey bees and an infested consignment might not be detected.
Non-bee import TOR1 b: bee products; TOR 4: non-bee products	Bee products to be used in apiculture			H/L	Bee products are attractive to SHB and no measures are taken to prevent the survival of SHB (risk reduction options were not taken into account during the risk assessment).
	Beekeeping equipment			M/L	The risk is lower than for bee products, as food for SHB is present only as a contaminant of the consignment and imports of used beekeeping equipment are less frequent.
	Non-bee products and soil			M/H	The products at risk are fruits transported in a ripe stage and soil attached to plants or as plant substrate. These products have a low level of infestation and/or have a low to moderate trade volume.
Natural means TOR 3: natural movement	Wind			M/H	Adult SHB and wondering larvae leaving the beehive can be passively dispersed by wind and adult SHB is attracted to bees. However, SHB is not reported in countries neighbouring the risk assessment area. There is a high risk that SHB will reach suitable hosts in the risk assessment area if the pest would be present or established in neighbouring countries.
	Dispersal of flying SHB and bees			M/H	The flight patterns of SHB along with swarms or alone is reported but is not well known. However, SHB is not reported in countries neighbouring the risk assessment area. There is a high risk that SHB will reach suitable hosts in the risk assessment area if the pest were present or established in neighbouring countries.
	Dispersal of flying SHB alone			M/H	

2.5. Probability of entry of *Tropilaelaps*

2.5.1. Overview of risk pathways for *Tropilaelaps*

The risk on *Tropilaelaps* entry was assessed as described in Section 1.1.1 and considered the risk pathways presented in Figure 6. Risk reduction options are assessed separately from the risk assessment (see Section 3).

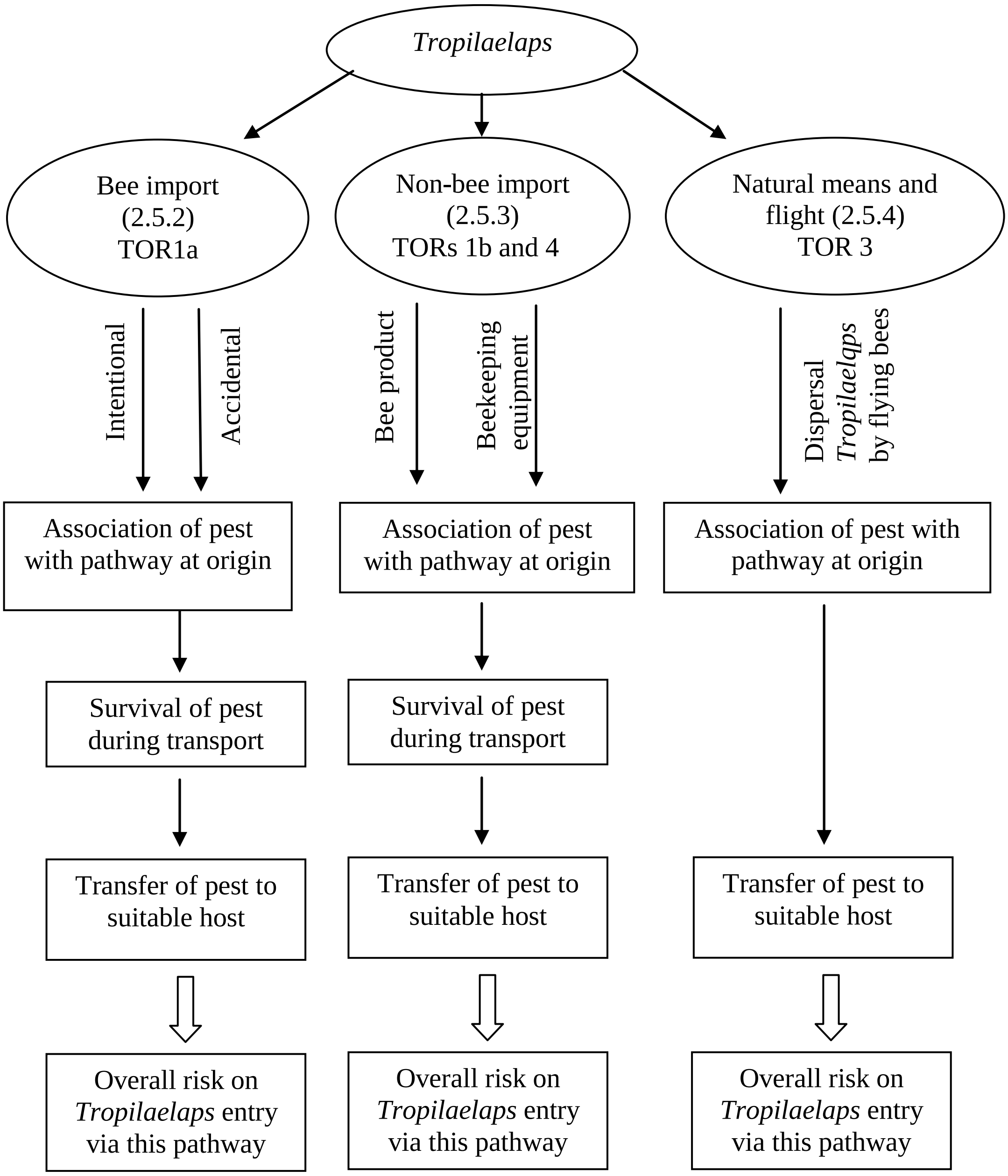

Figure 6: Risk pathways on *Tropilaelaps* entry

A detailed analysis of the different pathways can be found in Appendix H. The worst case scenario was considered during the assessment (e.g., import of an infested consignment). Only the risk of *Tropilaelaps* entry in the risk assessment area via import of *A. mellifera* is described in this section because import of other *Apis* spp. is not included in the current legislation (see Section 2.3). Other cavity-nesting species of *Apis* are able to survive and can establish populations in the risk assessment area. The risk of *Tropilaelaps* entry is similar for import of either *Apis* spp. Table 3 presents an overview of the risk and uncertainty scores for each pathway. In the sections below, the main conclusions for each pathway are described.

2.5.2. Pathway: 'Bee import'

2.5.2.1. Intentional bee import

This section assesses the risk of entry of *Tropilaelaps* via intentional import of honey bees, both legal and illegal. The conditions influencing the risk of *Tropilaelaps* entry are different for import of queens, swarms and colonies. *Tropilaelaps* mites have never been reported in bumble bee queens and colonies (see Section 2.2.4). Therefore, only *A. mellifera* is included in the risk assessment. A detailed analysis of the different pathways can be found in Section 1.1 of Appendix H. The main differences between the three pathways are summarised below.

*Intentional import of queens and swarms—*A. mellifera *(risk of Tropilaelaps entry: L; uncertainty: H)*

The association of *Tropilaelaps* is low for both pathways since import of swarms is not permitted according to the actual legislation (see Section 2.3). The risk of *Tropilaelaps* association with swarms would be high if import of swarms would be permitted. In queen bee consignments, only adult mites can be present. The pest has a short phoretic phase on honey bees emerging from honey bee brood combs but is not a parasite of adult honey bees. Other life stages can be excluded since they lack the protective environment of honey bee brood. Adult mites survive in the same environmental conditions as the imported honey bees. However, survival is limited to 8 days since there is no honey bee brood available (see Section 2.2.5). During shipment of the consignment, it is practically impossible to open cages for detection of *Tropilaelaps*. The probability that *Tropilaelaps* mites will escape from a bee-tight consignment is low due to their limited mobility (see Appendix E). The risk of transfer of *Tropilaelaps* to a suitable host is moderate. Current rules are adequate to detect the pest in consignments of queens at arrival if they are correctly applied. At present, procedures associated with import of honey bees into the risk assessment area are clear and adequate, but there is a need for a validated rapid *Tropilaelaps* detection method. Variation in awareness on pest detection might influence the capacity to detect *Tropilaelaps*.

Intentional import of colonies—*A. mellifera* (risk of *Tropilaelaps* entry: M; uncertainty: H)

The presence of honey bee brood in consignments of *A. mellifera* colonies is the major difference with the two pathways described above. The life cycle of *Tropilaelaps* is highly dependent on honey bee brood (see Section 2.2.5). All life stages can be present in the consignment but import of colonies is not permitted according to the actual legislation (see Section 2.3). The risk of *Tropilaelaps* association with colonies would be high when import of colonies would be permitted. The risk of *Tropilaelaps* survival during transport is high. Detection of the pest is difficult (see Section 2.2.6) and adult mites may survive up to 50 days in the presence of honey bee brood (see Section 2.2.5). After arrival, honey bees will forage or express robbing behaviour and could transfer *Tropilaelaps* mites to other honey bees. However, this is only based on observational data in other species of bees and mites (see Appendix E).

Table 3: Overview of the risk score/uncertainty score for *Tropilaelaps* entry per pathway. Risk score (H: high—red; M: moderate—orange,; L: low—green; NA: not applicable) and uncertainty score (H: high—low colour intensity; M: moderate—moderate colour intensity; L: low—high colour intensity).

	Bee import TOR 1a: live bees				**Non-bee import** TOR 1b: bee products; TOR4: non-bee products		**Natural means and flight** TOR 3: natural movement
	Intentional			Accidental			
	A. mellifera			*Apis* spp.			
	Queens	Swarms	Colonies	Swarms and colonies	Bee products	Beekeeping equipment	Dispersal of *Tropilaelaps* by flying bees
Association of the pest with the pathway at origin (risk/uncertainty)	L/L	L[22]/L	M[23]/L	H/L	H/L	M/M	L/M
Survival of the pest during transport	L/L	L/L	H/L	H/L	M/L	L/L	NA
Transfer of the pest to a suitable host	M/H	M/H	H/H	H/H	H/H	M/L	H/H
Overall risk of *Tropilaelaps* entry via this pathway (risk/uncertainty)	L/H	L/H	M/H	H/H	M/H	L/L	L/H

[22] The risk of *Tropilaelaps* association with swarms and colonies is high. However, the risk assessment considered the actual situation in which import of swarms and colonies is in general not permitted (see Section 2.3).

2.5.2.2. Accidental bee import by contaminated consignments

This pathway includes accidental import of *Apis* spp. swarms and colonies. Honey bee eggs and larvae are immobile and therefore not included in the risk pathway. The chance of a single honey bee surviving accidental bee import was considered negligible. *Bombus* spp. are also excluded from this pathway as they do not swarm and are not reported to be infested with *Tropilaelaps* (see Section 2.2.4). A detailed analysis of the different pathways can be found in Section 1.2 of Appendix H. The main conclusions on this pathway are summarised below.

*Accidental import of swarms and colonies—*Apis *spp. (risk of Tropilaelaps entry: H; uncertainty: H)*

The association of *Tropilaelaps* with the pathway at origin is high since honey bee brood could be present. No specific measures are taken to eradicate *Tropilaelaps* and detection of the pest is very unlikely. On the other hand, there is a low likelihood that the pest will escape from the consignment owing to its limited mobility. After arrival, honey bees will go out to forage and could transfer *Tropilaelaps* mites to other honey bees. However, this is based on only observational data in other species of bees and mites (see Appendix E).

2.5.3. Pathway: 'Non-bee import'

This section assesses the risk of entry of *Tropilaelaps* via import of bee products and beekeeping equipment. *Tropilaelaps* requires honey bee brood to survive for longer than eight days (see Section 2.2.5). Non-bee products and soil are not included in the risk assessment since they are not contaminated with honey bee brood. A detailed analysis of the different pathways can be found in Section 2 of Appendix H. The main differences between the two pathways are summarised below.

Bee products (risk of Tropilaelaps *entry: M; uncertainty: H)*

Unprocessed comb honey, fresh royal jelly, propolis with beeswax, comb beeswax and honey bee brood combs were considered to be at risk for *Tropilaelaps* entry and were included in the risk assessment because they can contain honey bee brood. The import of these products for use in an apiary was taken into account since this represents the scenario with the highest risk. Import of bee products into the risk assessment area is reported (see Figure 11, Appendix F) and all life stages of *Tropilaelaps* could be present (e.g., honey bee brood). *Tropilaelaps* mites survive only about eight days in the absence of honey bee brood, but this period can be extended to 50 days in the presence of honey bee brood. The risk assessment did not take into account risk reduction options that could be applied to eradicate *Tropilaelaps* (see Section 2.3). In the absence of clear visual signs of infestation, detection of the pest is difficult and can be ruled out only by destroying the consignment (e.g., honey brood combs). Honey bees emerging from brood combs are attracted to new colonies and could distribute adult mites to a beehive, although no clear data are available.

Beekeeping equipment (risk of Tropilaelaps entry: L, uncertainty: L)

Only used beekeeping equipment was considered to be at risk for entry of *Tropilaelaps* into the risk assessment area. Adult mites in the phoretic stage can enter the consignment attached to honey bees. Adult mites in the non-phoretic stage could also enter the consignment, although only limited data are available to support this (see Section 2.2.5). The number of adult mites in the consignment increases with increase in availability of honey bee brood. The risk assessment did not take into account risk reduction options that could be applied to eradicate *Tropilaelaps* (see Section 2.3). Even in cases where intensive inspection takes place, there is still a possibility that adult mites will not be detected since they are very small and hard to see with the naked eye (see Section 2.2.6). There is a low risk that *Tropilaelaps* will come into contact with a suitable host in the risk assessment area because there are no honey bees in the consignment and the pest has a limited mobility (see Section 2.2.5).

2.5.4. Pathways 'natural means and flight

This section assesses the probability of *Tropilaelaps* entry via dispersal of *Tropilaelaps* by flying honey bees. A detailed analysis can be found in Section 3 of Appendix H and the main conclusions are summarised below. Dispersal of *Tropilaelaps* by wind was not considered as a risk pathway since survival of *Tropilaelaps* is negligible because of the absence of honey bee brood (see Section 2.2.5). The pest itself cannot fly or otherwise move far (see Appendix E), excluding this as a risk pathway.

Dispersal of Tropilaelaps *by flying bees (risk of* Tropilaelaps *entry: L; uncertainty: H)*

Only adult mites during their phoretic stage will be associated with the pathway at origin, but data are lacking on pest presence on flying honey bees (see Appendix E). At present, *Tropilaelaps* has not been reported in neighbouring countries (see Section 2.2.3.2). During foraging or robbing, honey bees could come in contact with local honey bees and transfer the pest. However, this is based only on observational data in other species of bees and mites (see Appendix E). If *Tropilaelaps* were present or established in neighbouring countries, the pest would reach suitable hosts in the risk assessment area. There is a low probability that swarms entering the risk assessment area by wind or natural flight will be detected. The probability that these swarms will be checked for *Tropilaelaps* is negligible.

2.5.5. Conclusions on probability of *Tropilaelaps* entry

An overview of the conclusions on the risk of *Tropilaelaps* entry into the risk assessment is provided in Table 4. The risk of *Tropilaelaps* entry is similar for import of either *Apis* spp. Variation in awareness regarding *Tropilaelaps* might influence the capacity to detect the pest.

Table 4: Conclusions on the probability of *Tropilaelaps* entry into the risk assessment area. Risk score (H: high—red; M: moderate—orange; L: low—green) and uncertainty score (H: high, mainly due to lack of data—low colour intensity, M: moderate—moderate colour intensity, L: low—high colour intensity).

Risk pathways of *Tropilaelaps* entry			**Risk/ uncertainty**	**Main rationale**
Bee import TOR 1a: live bees	Intentional bee import *A. mellifera*	Queens	L/H	*Tropilaelaps* has a short phoretic phase on honey bees emerging from honey bee brood combs but is not a parasite of adult bees.
		Swarms	L/H	*Tropilaelaps* has a short phoretic phase on honey bees emerging from honey bee brood combs but is not a parasite of adult honey bees. Import of swarms is not permitted according to the actual legislation.
		Colonies	M/H	*Tropilaelaps* is a parasite of honey bee brood and is difficult to detect but import of colonies is not permitted according to the actual legislation.
	Accidental bee import		H/H	Colonies of *Apis* spp. have been reported in different types of (non-bee) consignments. They can be infested with *Tropilaelaps* since the pest is a parasite of honey bee brood and an infested consignment might not be detected.
Non-bee import TOR 1b: bee products; TOR 4: non-bee products	Bee products to be used in apiculture		M/H	Bee products containing honey bee brood may be infested with *Tropilaelaps*. There is a low probability that the pest will leave the consignment owing to its low mobility.
	Beekeeping equipment		L/L	*Tropilaelaps* survives for only about eight days without honey bee brood and/or adults.
Natural means TOR3: natural movement	Dispersal of *Tropilaelaps* by flying bees		L/H	*Tropilaelaps* is not able to fly and the possibility of using bees as carriers is limited. The pest is not reported in countries neighbouring the risk assessment area. There is a high risk that *Tropilaelaps* would reach suitable hosts in the risk assessment area if the pest were present or established in neighbouring countries.

3. Risk reduction options

The identification and evaluation of risk reduction options was done using the methodology described in Section 1.1.2. In agreement with the pest risk assessment section, ripe fruits are the non-bee products taken into account and soil is restricted to soil attached to plants (e.g., in consignments of potted plants or plants for planting) (see Section 2.4.3).

3.1. Identification of risk reduction options for SHB and *Tropilaelaps*

The risk reduction options that were identified as relevant to reduce the risk of entry of SHB can be applied in third countries, during transport or at the border. They are also relevant to reduce the risk of entry of *Tropilaelaps*, except for the option 'isolate the bee or product to avoid exchange of the pest with the environment'. For both pests, no risk reduction options could be identified to reduce the risk of pest entry via the pathways 'natural means and flight'. An overview is presented in Figure 7.

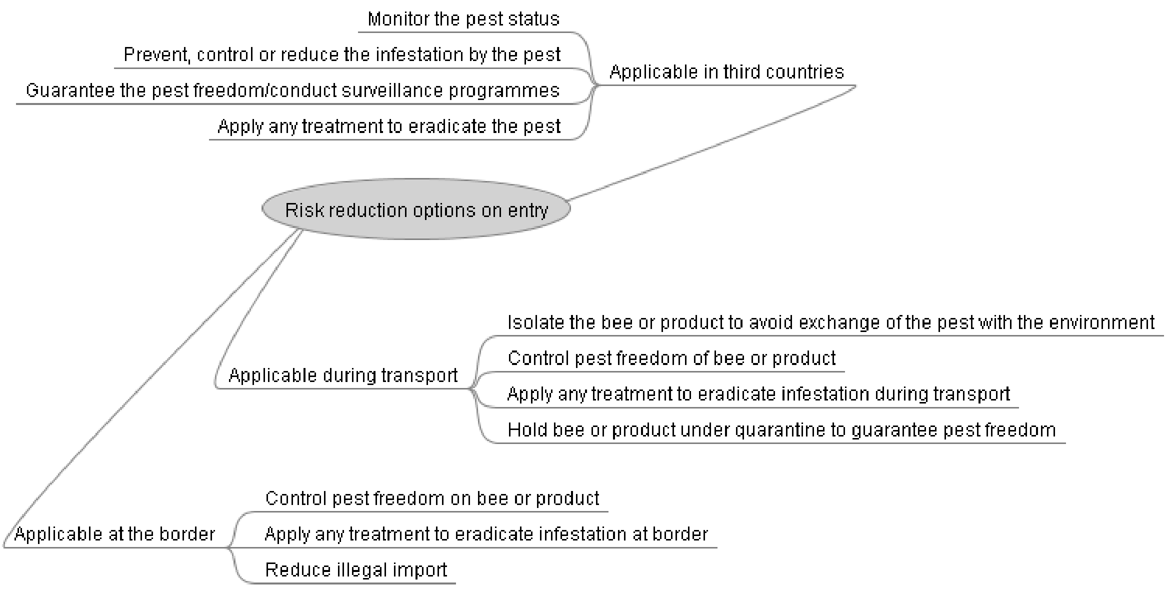

Figure 7: Risk reduction options relevant to reduce the risk of entry of SHB and/or *Tropilaelaps*

All identified risk reduction options were evaluated by scoring their effectiveness, technical feasibility and the corresponding uncertainty. The definitions used for scoring purposes in the original guidance document of EFSA's Plant Health Unit were adapted to enable their use in regard to bee pests (see Section 3 of Appendix B). The evaluation of the risk reduction options is described in detail in Appendix I.

3.2. Evaluation of risk reduction options for SHB and *Tropilaelaps*

Each risk reduction option was evaluated in terms of its capacity to reduce a high risk of pest entry into the risk assessment area. This evaluation was performed for each risk pathway (see Section 2.4.1 for SHB and Section 2.5.1 for *Tropilaelaps*) but was independent of the risk score determined in the risk assessment sections (Sections 2.4.2, 2.4.3 and 2.4.4 for SHB and Sections 2.5.2, 2.5.3 and 2.5.4 for *Tropilaelaps*).

An overview of the evaluated risk reduction options is presented in Table 5 for SHB and in Table 6 for *Tropilaelaps*. The options with a high score for effectiveness (H) and technical feasibility (H) and a low score for uncertainty (L) are highlighted in green as they were considered to be the most likely to be applied and affect the risk of pest entry. They are also called the 'likely' risk reduction options in this scientific opinion. The evaluation of the risk reduction options is described in detail in Appendix I.

Table 5: Evaluation of the risk reduction options for SHB. Three-letter codes represent scores for effectiveness, technical feasibility and uncertainty. N = negligible, L = low, M = moderate, H = high and NA = not applicable. The options with a high score for effectiveness and technical feasibility and a low score for uncertainty are highlighted in green since they are the most likely to be applied and to affect the risk of pest entry.

Risk reduction options	**Evaluation of each pathway**								
	Intentional				Accidental	Bee products to be used in apiculture	Beekeeping equipment	Non-bee products	Soil
	Queens		Swarms and colonies		Swarms and colonies				
	A. mellifera	*Bombus* spp.	*A. mellifera*	*Bombus* spp.	*Apis* spp.				
Applicable in third countries									
Monitor the pest status	LHL	LHL	LHL	LHL	NA	LHL	LHL	LHL	LHL
Prevent, control or reduce infestation by the pest	NA	NA	LMH	HHL	NA	MMH	HLL	NA	NA
Guarantee pest freedom/conduct surveillance programmes	HHL	HHL	HHL	HHL	NA	HHL	HHL	HHL	HHL
Apply any treatment to eradicate the pest	NA	NA	NA	NA	NA	HHL	HHL	MNH	HHL
Applicable during transport									
Isolate the bee or product to avoid exchange of the pest with the environment	HHL	HHL	LLH	LLH	NA	HNL	HNL	HNL	HNL
Control pest freedom of bee or product	HHL	HHL	HMH	HMH	NA	HHL	HHL	NA	NA
Apply any treatment to eradicate infestation during transport	NA	NA	NA	NA	NA	HHL	HHL	NA	HHL
Hold bee or product under quarantine to guarantee pest freedom	HNL	HNL	HNL	HNL	NA	NA	HLL	NA	NA
Applicable at the border									
Control pest freedom on bee or product	MML	MML	NA	NA	NA	MML	MML	MML	MML
Apply any treatment to eradicate infestation at the border	NA	NA	NA	NA	MML	HHL	HHL	NA	HHL
Reduce illegal import	No scoring possible								

Table 6: Evaluation of the risk reduction options for *Tropilaelaps*. Three-letter codes represent scoring for effectiveness, technical feasibility and uncertainty. N = negligible, L = low, M = moderate, H = high and NA = not applicable. The options with a high score for effectiveness and technical feasibility and a low score for uncertainty are highlighted in green since they are the most likely to be applied and to affect the risk of pest entry.

Risk reduction option	**Evaluation of each pathway**					
	Intentional			Accidental	Bee products to be used in apiculture	Beekeeping equipment
	A. mellifera			*Apis* spp.		
	Queens	Swarms	Colonies	Swarms and colonies		
Applicable in third countries						
Monitor the pest status	LHL	LHL	LHL	NA	LHL	LHL
Prevent, control or reduce infestation by the pest	NA	MMH	LMH	NA	NA	HHL
Guarantee the pest freedom/conduct surveillance programmes	HHL	HHL	HHL	NA	HHL	HHL
Apply any treatment to eradicate the pest	HHL	HHL	HHL	NA	HHL	HHL
Applicable during transport						
Control pest freedom of bee or product	HHL	HMH	HMH	NA	HHL	HHL
Apply any treatment to eradicate infestation during transport	HHL	HHL	HHL	NA	HHL	HHL
Hold bee or product under quarantine to guarantee pest freedom	HNL	HNL	HNL	NA	NA	HHL
Applicable at the border						
Control pest freedom on bee or product	MML	NA	NA	NA	NA	MML
Apply any treatment to eradicate infestation at the border	HHL	HHL	HHL	NA	HHL	HHL
Reduce illegal import	No scoring possible					

3.2.1. Risk reduction options applicable in third countries

3.2.1.1. Monitoring the pest status

This risk reduction option means the implementation of a passive monitoring system. An international notification system is available for both pests and is useful in highlighting pest presence in a country. However, this risk reduction option is less useful in providing confidence in pest freedom. More details are provided in Section 1.1 of Appendix I.

3.2.1.2. Prevent, control or reduce infestation by the pest

This risk reduction option means that best practices and/or active monitoring programmes without certification (e.g., private initiative) are performed to ensure that the pest is absent. More details are provided in Section 1.2 of Appendix I.

SHB
This option is already applied in the production of *Bombus* spp. colonies as they are produced in a contained closed system. In the case of *A. mellifera*, application of this option would rely heavily on the training and skill level of the persons performing visual inspection of the colonies. However, even with trained staff, there is a that infestation may be missed. Measures are available to reduce the infestation level of bee products to be used in apiculture and beekeeping equipment, but not to eradicate the pest completely. This is a likely risk reduction option for the risk pathway intentional import of *Bombus* spp. swarms and colonies.

Tropilaelaps
The infestation of beekeeping equipment can be prevented when it is kept away from honey bee brood and/or adults. In the case of *A. mellifera* colonies, application of this option would strongly depend on the persons involved receiving adequate training in visual inspection. However, even with trained staff, there is a possibility that infestation may be missed. This is a likely risk reduction option for the risk pathway import of beekeeping equipment.

3.2.1.3. Guarantee the pest freedom/conduct surveillance programmes

This risk reduction option means that an active surveillance programme is in place and a certificate is provided by an authority in case of a negative result for pest presence. An official pest-free status is awarded to a country or zone based on internationally agreed criteria. More details are provided in Section 1.3 of Appendix I.

SHB and *Tropilaelaps*
When this risk reduction option is applied, it minimises the risk of pest entry. However, the effectiveness of this risk reduction option is influenced by variation in awareness of bee pests and the available diagnostic capacity. This is a likely risk reduction option for all risk pathways except the pathway ‘accidental import of bees’.

3.2.1.4. Apply any treatment to eradicate the pest

This risk reduction option means the application of a chemical, biological, physical or some other treatment to eradicate the pest. The effectiveness and technical feasibility of this option were considered identical when applied in the third country, during transport or at the border. More details on the application of treatment to eradicate the pest in third countries are provided in Section 1.4 of Appendix I.

For bee products, biological treatments are already implemented systematically and other treatments are available to kill all living organisms, including SHB and *Tropilaelaps*. However, brood combs are an exception as no treatment is available for brood combs without destroying the product. Therefore, brood combs were not taken into account when scoring this risk reduction option for the pathway import of bee products.

SHB
There are treatments available which kill all living organisms and are applicable to bee products (except for brood combs), beekeeping equipment and soil. Treatments such as freezing cannot be applied to intentional imports of bees or non-bee products (ripe fruits) since they would damage the consignment. This is a likely risk reduction option for the risk pathways 'import of bee products, beekeeping equipment and soil'.

Tropilaelaps
For imports of queens, swarms and colonies, a biological treatment that could be applied is to keep the consignment without honey bee brood for minimum 21 days. For imports of used beekeeping equipment or bee products, this could be achieved by preventing contact between the consignment and honey bee brood and/or adults for a minimum of 21 days. Other treatments which kill all living organisms are available and are applicable except to the pathways of intentional bee import. This is a likely risk reduction option for either risk pathway except the pathway 'accidental import of bees'.

3.2.2. Risk reduction options applicable during transport

3.2.2.1. Isolate the bee or product of the consignment to avoid exchange of the pest with the environment

This risk reduction option means the application of any measure to prevent escape of the pest from the consignment or from transport material after arrival at the final destination. More details are provided in Section 2.1 of Appendix I.

SHB
Bee consignments are covered with fine mesh through which a live SHB cannot pass. This option is systematically applied. This is a likely risk reduction option for the risk pathway 'intentional import of *A. mellifera* and *Bombus* spp. queens'.

Tropilaelaps
No relevant measure could be identified.

3.2.2.2. Control pest freedom of bee or product

This risk reduction option means that a consignment is controlled for pest presence and that a positive consignment will not be transported or will be destroyed. More details are provided in Section 2.2 of Appendix I.

This option is in place (e.g., veterinary certificate, restrict of colony import to importation from pest-free countries). When the risk reduction option is applied, it minimises the probability of pest entry into the risk assessment area. However, the effectiveness is influenced by variation in awareness of bee pests and the available diagnostic capacity.

SHB
This is a likely risk reduction option for the risk pathways 'intentional import of *A. mellifera* and *Bombus* spp. queens' and 'intentional import of bee products and beekeeping equipment.'

Tropilaelaps
This is a likely risk reduction option for the risk pathways intentional import of *A. mellifera* queens, bee products and beekeeping equipment.

3.2.2.3. Apply any treatment to eradicate infestation during transport

This option is identical to that described in Section 3.2.1.4. More details are provided in Section 2.3 of Appendix I.

3.2.2.4. Hold bee or product under quarantine to guarantee pest freedom

This risk reduction option means that the consignment is placed under quarantine. More details are described in Section 2.4 of Appendix I.

SHB and *Tropilaelaps*
This option has high effectiveness but low technical feasibility for application on a large scale. This is a likely risk reduction option for import of beekeeping equipment associated with *Tropilaelaps* and can be applied by keeping the equipment away from honey bee brood and/or adults for a minimum of 21 days.

3.2.3. Risk reduction options applicable at the border of the risk assessment area

3.2.3.1. Control pest freedom of bee or product

This risk reduction option means that a consignment is controlled for pest presence and that a positive consignment will not be transported onwards or will be destroyed. More details are given in Section 3.1 of Appendix I.

SHB and *Tropilaelaps*
There are methods available, but application of this option would greatly depend on the persons performing visual inspection of the colonies having the necessary training and level of skill. The effectiveness is influenced by variation in awareness of bee pests and the available diagnostic capacity. The availability of validated rapid detection method and would increase the effectiveness of this risk reduction option. There is a risk of pest escape when closer examinations of consignments and collection of samples is performed in a non-insect-proof environment.

3.2.3.2. Apply any treatment to eradicate infestation at the border

This option is identical to that described in Section 3.2.1.4. More details are given in Section 3.2 of Appendix I.

3.2.3.3. Reduce illegal import

This risk reduction option means the implementation of any action to reduce illegal import. More details are provided in Section 3.3 of Appendix I.

SHB and *Tropilaelaps*
Scoring of effectiveness, technical feasibility and uncertainty was not possible.

3.3. Analysis of risk reduction options for each risk pathway associated with SHB

3.3.1. Intentional import of *A. mellifera* and *Bombus* spp. queens

There are three likely risk reduction options that can be applied to reduce the risk of SHB entry into the risk assessment area via these pathways. In the third country, an active surveillance system can be introduced by an authority that provides a certificate of pest freedom in the specific zone. Pest freedom of a consignment can be controlled before shipment and escape of the pest from the consignment can be prevented during transport.

3.3.2. Intentional import of *A. mellifera* and *Bombus* spp. swarms and colonies

Although import of swarms and colonies is not permitted according to the actual legislation and is therefore considered a rare event since (see Section 2.3), there is one likely risk reduction option that can be applied to reduce the risk of SHB entry via this pathway. It is the introduction of an active surveillance system by an authority in a third country that provides a certificate of pest freedom in the specific zone. For *Bombus* spp., production of bumble bees in a closed contained system provides a second likely risk reduction option since it prevents SHB infestation.

3.3.3. Accidental bee import

No likely risk reduction options could be applied to reduce the risk of SHB entry into the risk assessment area via this pathway.

3.3.4. Import of bee products to be used in apiculture and beekeeping equipment

There are five likely risk reduction options, including one at the border, that can be applied to reduce the risk of SHB entry into the risk assessment area via this pathway. Treatments can be applied to eradicate the pest in third countries, during transport and at the border. In the third country, an active surveillance system can be introduced by an authority that provides a certificate of pest freedom in the specific zone. Pest freedom of a consignment can be controlled before shipment.

3.3.5. Import of soil

There are four likely risk reduction options, including one at the border, that can be applied to reduce the risk of SHB entry into the risk assessment area via this pathway. These are the same options as for the pathways ‘import of bee products’ and ‘import of beekeeping equipment’, except for the control of the product during transport.

3.3.6. Import of non-bee products

The only likely risk reduction option for this pathway is the introduction of an active surveillance system by an authority in a third country that provides a certificate of pest freedom in the specific zone. There is no appropriate treatment to eradicate the pest, especially if the pest is inside a non-bee product.

3.3.7. Wind—Dispersal of flying SHB and bees—Dispersal of flying SHB alone

No risk reduction option could be identified to reduce the risk of SHB entry into the risk assessment area via this pathway.

3.4. Analysis of risk reduction options for each risk pathway associated with *Tropilaelaps* entry

3.4.1. Intentional import of *A. mellifera* queens and import of bee products to be used in apiculture :

There are five likely risk reduction options, including one at the border, that can be applied to reduce the risk of *Tropilaelaps* entry into the risk assessment area via both pathways. Eradication of the pest can be done by keeping the bees without honey bee brood for a minimum of 21 days or by preventing contact between bee product consignments and honey bee brood and/or adults for a minimum of 21 days. This could be applied in the third country, during transport and on arrival in the risk assessment area. An active surveillance system can be implemented by an authority in a third country that provides a certificate of pest -freedom in the specific zone. Finally, pest freedom of a consignment can be controlled before shipment.

3.4.2. Intentional import of *A. mellifera* swarms and colonies:

Although import of swarms and colonies is not permitted according to the actual legislation and is therefore considered a rare event (see Section 2.3), there are four likely risk reduction options that can be applied to reduce the risk of *Tropilaelaps* entry via this pathway. Eradication of the pest can be done by keeping the bees without honey bee brood for a minimum of 21 days. This could be applied in the third country, during transport and on arrival in the risk assessment area. An active surveillance system can be implemented by an authority in a third country that provides a certificate of pest freedom in the specific zone.

3.4.3. Accidental bee import

No risk reduction options could be applied to reduce the risk of *Tropilaelaps* entry into the risk assessment area.

3.4.4. Import of beekeeping equipment

There are seven likely risk reduction options, including one at the border, that can be applied to reduce the risk of *Tropilaelaps* entry into the risk assessment area via this pathway. The five likely options of the pathway import of bee products are also applicable to the pathway import of beekeeping equipment. In addition, methods are available to prevent infestation of beekeeping equipment and quarantine can be applied to guarantee *Tropilaelaps* freedom.

3.4.5. Dispersal of *Tropilaelaps* by flying bees

No risk reduction option could be identified to reduce the risk of SHB entry into the risk assessment area.

3.5. Conclusions on risk reduction options for SHB and *Tropilaelaps*

Eleven risk reduction options were identified for SHB and ten for *Tropilaelaps* (see Section 3.1). An evaluation of each risk reduction option for each of different risk pathways was carried out (Section 3.2). The risk reduction options with high effectiveness, high technical feasibility and low uncertainty are the most likely to prevent SHB and *Tropilaelaps* entry into the risk assessment area (Table 7). Likely risk reduction options could be identified for all risk pathways except the pathways 'accidental import of bees' and 'natural means and flight' (see Sections 3.3 and 3.4 and Tables 8 and 9). These likely options are mainly included in the current EU legislation or mentioned in OIE guidelines. For importation of swarms and/or colonies, no likely risk reduction is available during transport or at the border whereas the risk of pest entry via this pathway is high. Therefore, the EU legislation does not primarilly permit import of swarms and colonies into the risk assessment area.

Although the risk reduction options were individually evaluated, it is clear that the risk of pest entry via a specific pathway will be further reduced if more than one risk reduction option can be applied throughout the pathway. Tables 8 and 9 show that a combination of likely risk reduction options can be applied to most risk pathways for SHB and *Tropilaelaps*.

Table 7: Overview of the likely reduction options with a high effectiveness, high technical feasibility and low uncertainty for SHB and *Tropilaelaps*

Risk reduction options	Pest	Relevant to pathway	Main rationale
Applicable in third countries			
Prevent, control or reduce the infestation by the pest	SHB	Intentional import of *Bombus* spp. swarms and colonies	*Bombus* spp. swarms and colonies are currently produced in a confined environment.
	Tropilaelaps	Beekeeping equipment	The infestation of beekeeping equipment can be prevented by keeping it away from honey bee brood and/or adults.
Guarantee pest freedom/conduct surveillance programmes	SHB and *Tropilaelaps*	All pathways except accidental import of bees	An official pest-free status based on internationally agreed criteria minimises the risk of infested consignments.
Apply any treatment to eradicate the pest	SHB	Import of bee products, beekeeping equipment and soil	There are treatments available which kill all living organisms.
	Tropilaelaps	All pathways except accidental import of bees	Biological treatment is applied systematically. Other treatments which kill all living organisms are available and are applicable except to the pathways of intentional bee import.
Applicable during transport			
Isolate the bee or product to avoid exchange of the pest with the environment	SHB	Intentional import of queen bees	A high effective and easy to handle measure is applied.
Control pest freedom of bee or product	SHB and *Tropilaelaps*	Intentional import of queen bees; import of bee products and beekeeping equipment	An official veterinary certificate confirming the pest-free status of a consignment minimises the risk of infested consignments.
Apply any treatment to eradicate infestation during transport	SHB	Import of bee products, beekeeping equipment and soil	There are treatments available which kill all living organisms.
	Tropilaelaps	All pathways except accidental import of bees	Biological treatment is applied systematically. Other treatments which kill all living organisms are available and are applicable except in the pathways of intentional bee import.
Hold bee or product under quarantine to guarantee pest freedom	*Tropilaelaps*	Import of beekeeping equipment	The infestation of beekeeping equipment can be eradicated by keeping it away from honey bee brood and/or adults for minimum 21 days.
Applicable at the border			
Apply any treatment to eradicate infestation at the border	SHB	Import of bee products, beekeeping equipment and soil	There are treatments available which kill all living organisms.
	Tropilaelaps	All pathways except accidental import of bees	Biological treatment is applied systematically. Other treatments which kill all living organisms are available and are applicable except in the pathways of intentional bee import.

Table 8: Number of likely risk reduction options (high effectiveness score, high technical feasibility score and low uncertainty) for each SHB risk pathway

SHB risk pathway			Number of likely risk reduction options		
			In third country	During transport	At the border
Intentional bee import	Queens	*A. mellifera*	1	2	0
		Bombus spp.	1	2	0
	Colonies and swarms	*A. mellifera*	1	0	0
		Bombus spp.	2	0	0
Accidental bee import			0	0	0
Bee products to be used in apiculture			2	2	1
Beekeeping equipment			2	2	1
Soil			2	1	1
Non-bee products			1	0	0
Wind			0	0	0
Dispersal of flying SHB and bees					
Dispersal of flying SHB alone					

Table 9: Number of likely risk reduction options (high effectiveness score, high technical feasibility score and low uncertainty) for each *Tropilaelaps* risk pathway

***Tropilaelaps* risk pathway**			Number of likely risk reduction options		
			In third country	During transport	At the border
Intentional bee import	*A. mellifera*	Queens	2	2	1
		Swarms	2	1	1
		Colonies	2	1	1
Accidental bee import			0	0	0
Bee products to be used in apiculture			2	2	1
Beekeeping equipment			3	3	1
Dispersal of *Tropilaelaps* by flying bees			0	0	0

4. Conclusions

A qualitative non-restricted risk assessment was performed assuming full compliance with the current legislation but excluding the implementation of risk reduction options, even though they are included in the current legislation. Risk reduction options were assessed separately from the risk assessment.

The conclusions of the pest risk assessment sections (TORs 1, 3 and 4) are presented first, followed by the conclusions on the identification and evaluation of risk reduction options (TOR 2).

TOR 1: the risk of introduction, limited to entry, of small hive beetle (SHB) and Tropilaelaps *into the EU through importation from third countries of live queen bees, queen bumble bees (*Bombus *spp.), bumble bee colonies and bee products destined to be used in apiculture*

A. mellifera queens

- There is a moderate risk of SHB entry via intentional import of honey bee queens. This is substantiated by the rapid detection and adequate reaction which prevented the establishment of SHB when it once entered the risk assessment area.
- There is a low risk of *Tropilaelaps* entry via intentional import of honey bee queens since this pest is a parasite of honey bee brood and has only a short phoretic phase on honey bees.

Bombus spp. queens

- Bumble bees are a less likely source of SHB entry than honey bees. SHB reproduction on bumble bees is reported under experimental conditions but there are no field survey data on the biological association of SHB with *Bombus* spp. at present.
- Entry of *Tropilaelaps* spp. via imports of *Bombus* spp. queen bees was not considered a risk pathway since *Tropilaelaps* has never been reported as a pest of bumble bees.

A. mellifera swarms/colonies and *Bombus* spp. colonies

- The risk of SHB and *Tropilaelaps* association with swarms and colonies would be high if the import of swarms and colonies would be permitted.
- Currently, there is a low association of SHB with these pathways at origin since import of swarms and colonies is not permitted according to the actual legislation.
- Although *Tropilaelaps* is a parasite of honey bee brood and is difficult to detect, the risk of *Tropilaelaps* entry via import of *A. mellifera* colonies is high, however, the risk of entry of this pest into the risk assessment area is moderate because import of *A. mellifera* colonies is not permitted according to the actual legislation.
- Entry of *Tropilaelaps* spp. via imports of *Bombus* spp. colonies was not considered as a risk pathway since this pest has never been reported with bumble bees.

Bee products to be used in apiculture

- The risk of entry via bee products to be used in apiculture is high for SHB since the pest is attracted to these products and no risk reduction options were taken into account during the risk assessment.
- The risk of entry via bee products to be used in apiculture is moderate for *Tropilaelaps.* Honey bee brood can be infested by *Tropilaelaps* but it is unlikely that bee brood will be introduced into an apiary and that the pest will leave the consignment owing to its limited mobility.

Accidental bee import (unintended presence of bees in a non-bee consignment) is associated with a high risk of entry for both pests since an infested consignment might not be detected.

TOR 3: the risk of introduction of the SHB and Tropilaelaps *into the EU from neighbouring countries, especially through the natural movement of live bees and of SHB*

At present, SHB and *Tropilaelaps* are not reported in countries neighbouring the risk assessment area.

- There is a moderate risk of SHB entry via dispersal. This can be either passive (by wind) or active (by flying SHB alone and/or with bees). Dispersal of *Tropilaelaps* by wind was not considered a risk pathway since its survival is negligible owing to the absence of honey bee brood. *Tropilaelaps* mites are flightless and thus cannot move far from honey bee brood or adults.
- The risk of entry of *Tropilaelaps* on flying bees is low since only adult mites during their phoretic stage will be attached to bees. This phoretic stage is relatively short (3 days).

If either pest were to be present or established in neighbouring countries:

- There is a high risk that SHB and *Tropilaelaps* would reach suitable hosts in the risk assessment area if either pest were present or established in neighbouring countries.

TOR 4: the risk of introduction of SHB and Tropilaelaps *into the EU through importation from third countries of products other than bee products (e.g., fruits, vegetables, other possible vectors and fomites, etc.)*

Non-bee products that could be at risk for entry of SHB into the risk assessment area are used beekeeping equipment, ripe fruits (excluding all fruits imported in an unripe state), soil as contaminant (e.g., attached to the roots of plants for planting) and soil as plant substrate (e.g., potted plants) since import of soil itself is not permitted. The risk of SHB entry via import of these commodities is moderate, mainly because consignments of these products have a low level of infestation and/or have a low to moderate trade volume.

There is a low risk of *Tropilaelaps* entry via used bee equipment because there is a low probability of pest survival during transport in the absence of honey bee brood and/or adults. Other non-bee products and soil were not included in the risk assessment since it was presumed that these products have not been in contact with honey bee brood and/or adults.

TOR 2: the risk mitigating factors that have proven to be or that could potentially be effective in ensuring safe international trade as regards the transmission of the SHB and Tropilaelaps *in bees and their products*

Risk reduction options could be identified to reduce the risk of SHB or *Tropilaelaps* entry into the risk assessment area by all risk pathways except the pathway ‘dispersal of the pest via natural means and/or flight’.

The risk reduction options with a high effectiveness, high technical feasibility and low uncertainty are the most likely to prevent SHB and *Tropilaelaps* entry into the risk assessment area. These options are mainly included in the current EU legislation or are mentioned in OIE guidelines.

For the risk pathway ‘accidental import of bees’, no likely risk reduction option can be applied to reduce the risk of SHB or *Tropilaelaps* entry into the risk assessment area.

Although the risk reduction options were individually evaluated, it is clear that the risk of pest entry by a specific pathway will be further reduced when different risk reduction options can be applied throughout the pathway.

Likely risk reduction options to reduce the risk of SHB entry into the risk assessment area are:

- For the importation of *A. mellifera* and *Bombus* spp. queens, introduction of an active surveillance system by an authority in a third country. Such a system would issue a certificate of pest freedom in the specific zone, ensure pest freedom of a consignment before shipment and prevent escape of the pest from the consignment during transport.
- For importation of swarms and colonies, no likely risk reduction is available during transport or at the border whereas the risk of SHB entry via this pathway is high. Therefore, the EU legislation does not primarilly permit import of swarms and colonies into the risk assessment area.
- For the importation of bee products to be used in apiculture, beekeeping equipment and soil (as a contaminant and in potted plants), application of treatments to eradicate the pest in third countries, during transport and at the border. Also likely to be effective is the introduction of an active surveillance system by an authority in a third country that provides a certificate of pest freedom in

the specific zone and which ensures pest freedom of a consignment before shipment (not applicable for soil).

- For import of non-bee products, the only risk reduction option likely to be effective is the introduction of an active surveillance system by an authority in a third country that provides a certificate of pest freedom in the specific zone.

For *Tropilaelaps*, there are two risk reduction options likely to reduce the risk of pest entry into the risk assessment area and which can be applied in all risk pathways, except the pathways 'accidental honey bee import' and 'dispersal of *Tropilaelaps* by flying bees':

- Entry of *Tropilaelaps* is likely to be prevented by applying a biological treatment throughout the risk pathway.

- In the case of queens, this can be achieved by preventing the consignment from coming into contact with honey bee brood for a minimum of 21 days.

- For importation of used beekeeping equipment or bee products to be used in apiculture, this can be achieved by preventing contact with honey bee brood and/or adults for a minimum of 21 days.

- Introduction of an active surveillance system by an authority in a third country that provides a certificate of pest freedom in the specific zone is also likely to be effective.

5. Uncertainties and variations

There is uncertainty regarding the geographical distribution of SHB and *Tropilaelaps* in the countries neighbouring the risk assessment area.

It is likely that import of bees from pest-endemic regions as well as illegal import of bees have occurred, but the frequency and volumes cannot be estimated. Therefore, their effect on the risk of pest entry is difficult to assess.

The time period between the introduction of queens in a consignment and the release of queens in an apiary in the risk assessment area is limited since queens only survive a few days in presence of attendants. Therefore, variations in transport time might influence the risk of SHB and *Tropilaelaps* entry since less time would be available for pest detection. The minimum time required for adequate detection of the pest is determined by the available detection methods.

Variation in awareness, knowledge of bees and expertise in pest detection on the part of beekeepers, laboratories and Veterinary Services might influence the capacity to detect SHB or *Tropilaelaps* in apiaries and consignments.

Variation in awareness, knowledge of bees and expertise in bee diseases on the part of national competent authorities might influence the capacity to identify bee species that function as host of a bee pathogen and/or pest and to prohibit their import into the national territories.

Availability of SHB data

- Although SHB reproduction on bumble bees is reported under experimental conditions, there are no field survey data on the biological association of SHB with *Bombus* spp. at present.
- There are limited data available to suggest that SHB adults escaping from a consignment can reach honey bee colonies and bee products.
- Only limited data are available on the flow of *Bombus* spp. consignments after arrival.
- SHB survival on ripe fruits has been shown under experimental conditions, but there is no proof that this can occur under field conditions.

- There are only limited data available regarding the SHB infestation level in soil associated with plant imports.
- There are no clear data available on dispersal distance of crawling SHB larvae.
- There are no data available on dispersal distance of SHB by wind.
- It is reported that SHB can fly with swarms but there are no data available on how far they fly together.
- There are no clear data available on dispersal distance of SHB via flight of the beetle alone.
- It is not known if the availability of food for SHB in consignments of bee products might reduce the probability of SHB flying away from the consignment.
- Although ripe fruit is considered a risk factor, there are no data available to allow listing of all susceptible fruits and/or to define the ripening stage at which they become susceptible to SHB infestation.

Many studies on *Tropilaelaps* are performed in Asia since this is the continent where the pest is currently present. Consequently, there are *Tropilaelaps* studies published in Asian languages and/or the publications are not always accessible.

Availability of *Tropilaelaps* data

- Adult mites in the phoretic stage can enter a consignment attached to honey bees. Adult mites in the non-phoretic stage could also enter the consignment, although only limited data are available.
- Data are lacking on pest presence on flying honey bees.
- After swarms or colonies arrive in the risk assessment area, honey bees go out foraging and come into contact with other bees. Transfer of the pest to local honey bees might be possible based on observational data from other bee species and other mites.
- Honey bees emerging from honey bee brood combs are attracted to other honey bee colonies but the impact of transmission of mites through this pathway is unclear.
- There are only limited data on harmful effects of a *Tropilaelaps* infestation. In *Varroa*, early signs of infestation usually go unnoticed. It was assumed that this is the case for *Tropilaelaps* as well.

6. Recommendations

There is a need for validated rapid detection methods for SHB and *Tropilaelaps*.

There is a need for handling and sampling of imported bees in an insect-proof environment at the designated place of final destination.

Training in the diagnosis and control of SHB and *Tropilaelaps* for relevant people in third countries could improve the implementation of the monitoring/surveillance programmes and guarantee pest freedom.

Education and training in the detection and control of SHB and *Tropilaelaps* for officials involved in the control of imported consignments is recommended in order to improve the awareness, skills and expertise required to prevent entry of these pests.

Education is recommended to create more awareness of the risks and consequences associated with the entry of SHB and *Tropilaelaps* mites among stakeholders, including those associated with beekeeping, trade, transport, monitoring and control.

Research is recommended to ascertain the risk of SHB entry via products such as ripe fruits and soil associated with plants.

Research is recommended on the harmful effects of *Tropilaelaps* infestation since there are only limited data available and the current view is based on extrapolations from *Varroa* infestations.

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APPENDIX A. DETAILED METHODOLOGY FOR PEST RISK ASSESSMENT

The first step in the pest risk assessment was the definition of the pathways and all risk factors. The pathway model used in this scientific opinion follows the course of the pest from the origin of infestation to possible hosts in the risk assessment area. Three main groups of risk pathways were identified: 'bee import', 'non-bee import' and 'natural means and flights'. A more detailed description of the pathways is provided in Section 2.4 for SHB and in Section 2.5 for *Tropilaelaps.*

Each pathway consists of several risk factors which can influence the number of the pests entering the risk assessment area, e.g., amount of material, level of infestation, detection rate, etc. A generic pathway model (Figure 8) containing nine risk factors (Table 10) was developed to evaluate the risk for each pathway and to compare the pathways.

Table 10: Risk factors of the generic pathway model

Code	Risk factor	Description
A1	Dangerous life stages of the pest	Rate pest life stage(s) present in an environment associated with the pathway at origin that allows development, reproduction or infection of new hosts
A2	Level of infestation	Rate or amount of infestation of the consignment
A3	Number of bees or products imported	Amount of material (bees or products) entering the risk assessment area with the potential to carry the pest
T1	Vulnerability of life stage(s)	Rate of natural survival/development (depending of duration of transport, absence of feed, etc.) of life stages during transport
T2	Conditions during transport	Survival rate under specific conditions (measures) applied to destroy the pest during transport (e.g., cooling)
T3	Detection during transport	Rate of non-detection of the pest during transport
T4	Possibility of escape	Rate of pest, which escapes transport and may enter uncontrolled
H1	Detection at arrival	Rate of non-detection of the pest on arrival
H2	Flow of consignment after arrival	Rate of pest reaching a possible host

In comparison with a fully quantitative model, the qualitative analysis used in this scientific opinion involved estimation of the risk of infestation at origin and all the influencing factors using five categories, e.g.

- Negligible—the conditions of the pathway do not allow the pest to enter the risk assessment area.
- Low—it is unlikely that the pest will enter the risk assessment area through this pathway.
- Moderate—the pest may enter the risk assessment area through this pathway to a low amount.
- High—the pest may enter the risk assessment area through this pathway to a relevant amount.
- Unknown—the conditions of the pathway are mostly unknown.

The risk factors were appraised as clear and independent. To give a clear statement, the risk factor should not comprise different independent aspects or overlap in their content. The definition of the categories is not standardised between the different risk factors; nor is an absolute scale used. The sensitivity range of the category scale is based on expert knowledge or judgement to obtain the best differentiation in the expected risk range. Therefore, the categories are defined for each risk factor (Appendix B). The uncertainty categories are defined in a general way and used for all risk factors (Appendix B).

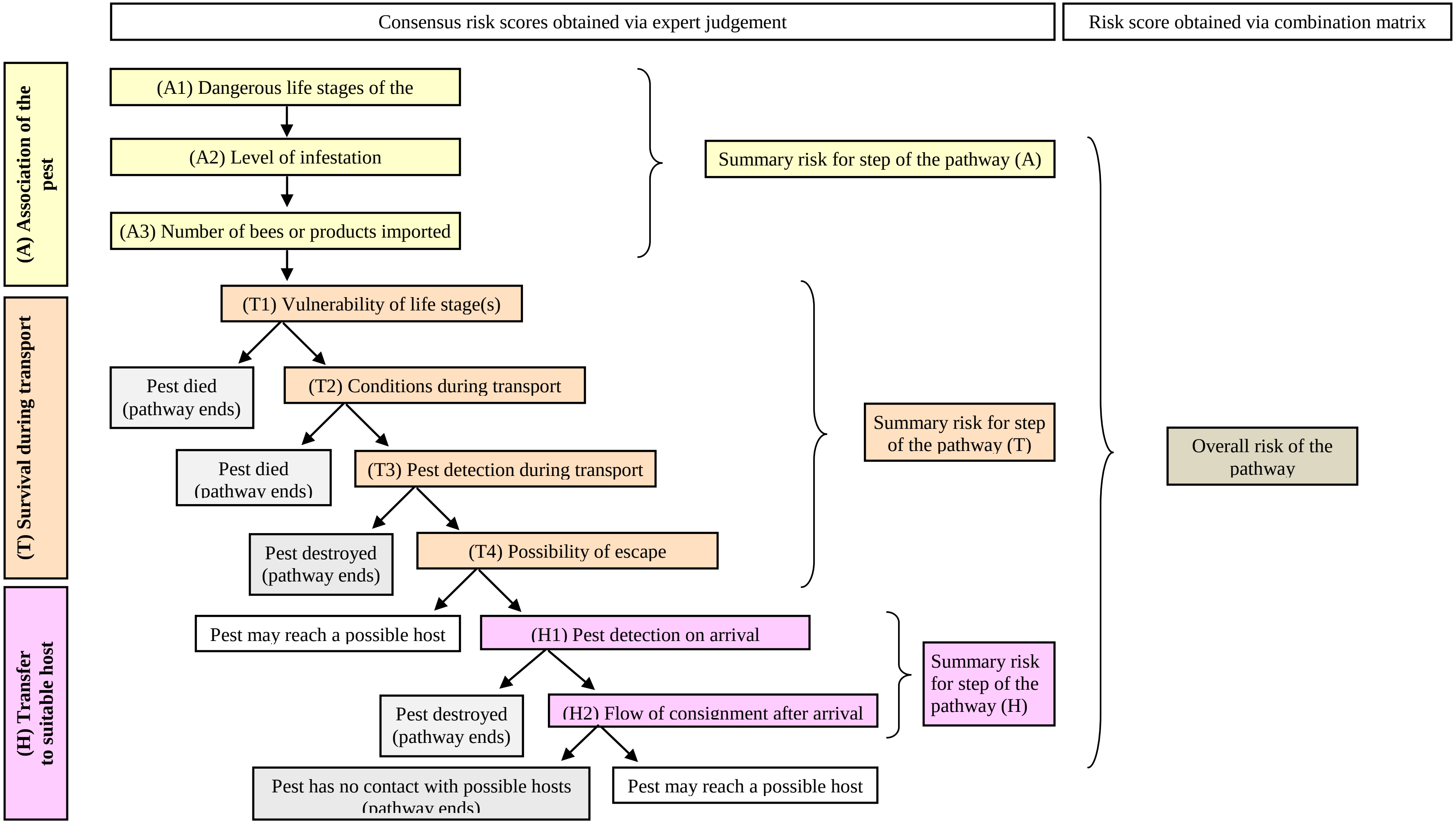

Figure 8: Generic pathway model

Expert elicitation sessions were run for both pests. Every risk factor was scored in a horizontal way over the different pathways (Figure 9). For instance, the risk factor 'dangerous life stages of the pest ' (represented by 'A1' in Figure 9 and Table 10) is scored in the pathways 'bee import', then in the pathways 'non-bee products' and finally in the pathway 'natural means and flight'. This approach enables direct comparisons of risk scores—in the sense of ranking—between the pathways. The detailed results are provided in Appendix C for SHB and in Appendix D for *Tropilaelaps*.

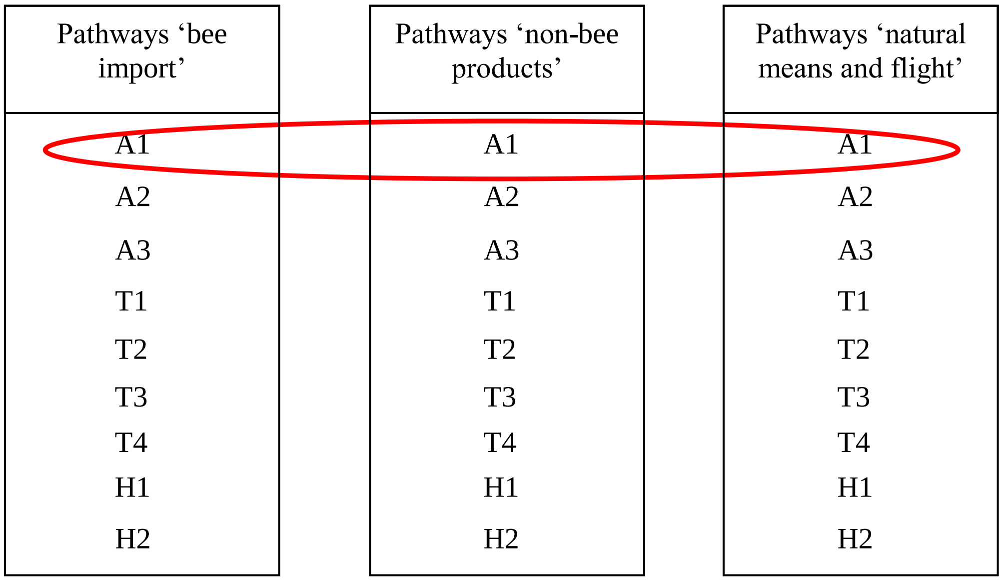

Figure 9: Every risk factor was scored in a horizontal way over the different pathways. The risk factors (A1, …, T1, …, H1, …) are presented using the code presented in Table 10

Additional to the rating of the individual risk factors, a summary risk score was given to the three steps of the pathway model:

1. association of the pest with the pathway at origin (A);

2. survival of the pest during transport (T);

3. transfer of the pest to a suitable host (H);

This summary scoring for each step of the pathway (Figure 8) was done by expert judgement using more general definitions for the scoring categories (Appendix B). A combination of uncertainty levels was never applied in the risk assessment. In all cases, the highest uncertainty level among the individual parameters under consideration was transferred to the higher level.

The last step in the risk assessment was the determination of an overall risk score for each pathway by combining the risk scores for each step of the pathway. This was done using a combination matrix that is used in the animal health risk assessment field (Beckett, 2007; EFSA, 2010b; Wieland et al., 2011). This combination matrix is used to evaluate two consecutive risk estimates based on the assumption that the following event is conditioned on the previous event and/or an increase of risk is not meaningful.

Table 11: Combination matrix used to define the overall risk score per pathway

Previous event	**Following event**				
	Negligible	**Low**	**Moderate**	**High**	**Unknown**
Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
Low	Negligible	Low	Low	Low	Low
Moderate	Low	Low	Moderate	Moderate	Moderate
High	Low	Moderate	Moderate	High	High
Unknown	Low	Moderate	Moderate	High	Unknown

For example, assume the following summary risk scores per step of a pathway:

Moderate (M) —for step ‘association of the pest with the pathway at origin’;
High (H) —for the step ‘survival of the pest during transport’;
Low (L) —for the step ‘transfer of the pest to a suitable host’;

The determination of the overall risk score of the pathway can be described by the formula:

$(M \times H) = M \times L = L$

According to the combination matrix, the combination of the risk score ‘moderate’ for the step ‘Association of the pest with the pathway at origin’ (considered the previous event) with the risk score ‘high’ for the step ‘Survival of the pest during transport’ (considered the following event) results in a combined risk score ‘moderate’. The obtained result ‘moderate’ is now considered as the previous event’s risk score and is combined with the risk score ‘low’ for the step ‘Transfer of the pest to a suitable host’ (here considered as the following event). According to the combination matrix, this results in a ‘low’ overall risk of the pathway.

APPENDIX B. RATINGS AND DESCRIPTORS

This appendix contains all definitions of ratings used in this scientific opinion. They were first agreed upon and then used in the pest risk assessment or in the evaluation of risk reduction options.

1. Ratings used for describing the level of uncertainty

For the risk assessment section as well as for the evaluation of the effectiveness of the risk reduction options, the level of uncertainty has been rated separately.

Table 12: Ratings used for describing the level of uncertainty

Name	Explanation
Low	No or limited information or data are lacking, incomplete, inconsistent or conflicting. No subjective judgement is introduced. No unpublished data are used.
Medium	Some information or data are lacking, incomplete, inconsistent or conflicting. Subjective judgement is introduced with supporting evidence. Unpublished data are sometimes used.
High	The majority of information or data are lacking, incomplete, inconsistent or conflicting. Subjective judgement may be introduced without supporting evidence. Unpublished data are frequently used.

2. Ratings used in the pest risk assessment on entry

2.1. Ratings used for qualitative risk scoring of parameters related to 'Association of the pest with the pathway at origin'

Table 13: Ratings used for qualitative risk scoring of 'dangerous life stages of the pest at origin' (product for export to EU)

Name	Explanation
Negligible	The life stage and environment of the pest associated with the pathway at origin is not able to develop, reproduce or infect new hosts
Low	Only a minimal part of the pest is in a life stage and environment at origin, that allows development, reproduction or infection of new hosts
Moderate	A moderate part of the pest is in a life stage and environment at origin, that allows development, reproduction or infection of new hosts
High	A relevant part of the pest is in a life stage and environment at origin, that allows development, reproduction or infection of new hosts
Unknown	The life stage and environment of the pest associated with the pathway at origin unknown to judge on the ability to develop, reproduce or infect new hosts

Table 14: Ratings used for qualitative risk scoring of 'level of infestation'

Name	Explanation
Negligible	Infestation of material is unlikely.
Low	Infestation only in single (individual) cases.
Moderate	Infestation is likely in some imports.
High	Infestation is likely in imports.
Unknown	Infestation is unknown.

Table 15: Ratings used for qualitative risk scoring of 'number of bees or products imported into the risk assessment area'

Name	Explanation
Negligible	The number is negligible, or there is no legal import.
Low	The number is minimal, import only to a single zone.
Moderate	The number is moderate, small amount to several zones.
High	The number is relevant, regular import to several zones.
Unknown	The number and destinations are unknown.

Table 16: Ratings used for qualitative risk scoring of 'summary of association of the pest with the pathway'

Name	Explanation
Negligible	The pest is not or only occasionally associated with the pathway at origin.
Low	The pest is rarely associated with the pathway at origin.
Moderate	The pest is frequently associated with the pathway at origin.
High	The pest is regularly or usually associated with the pathway at origin.
Unknown	The association of the pest with the pathway at origin is unknown.

2.2. Ratings used for qualitative risk scoring of parameters related to 'survival of the pest during transport'

Table 17: Ratings used for qualitative risk scoring of 'vulnerability of life stages'

Name	Explanation
Negligible	The pest is in a life stage that cannot survive in the conditions prevailing during transport and/or storage.
Low	SHB: it is most likely that the pest is present as eggs and/or larvae. *Tropilaelaps*: a few adults might be present.
Moderate	SHB: a small number of adults and/or wandering larvae and/or pupae might be present. *Tropilaelaps*: a small number of adults might be present.
High	SHB: a relevant number of adults and/or wandering larvae and/or pupae might be present. *Tropilaelaps*: a relevant number of adults might be present.
Unknown	The life stages of the pest during transfer or storage are unknown.

Table 18: Ratings used for qualitative risk scoring of 'conditions during transport'

Name	Explanation
Negligible	Conditions ensure that the pest is killed during transport./Special measures are taken to kill the pest completely during transport.
Low	Conditions reduce infestation to a very low level during transport./Special measures are taken to reduce infestation to a very low level during transport .
Moderate	Conditions reduce infestation during transport./Special measures are taken to reduce infestation during transport.
High	Conditions may not reduce infestation during transport./Only inadequate measures are taken to reduce infestation during transport.
Unknown	Reduction of infestation is unknown.

Table 19: Ratings used for qualitative risk scoring of 'pest detection during transport'

Name	**Explanation**
Negligible	Conditions of transport ensure that the pest will be detected in an infested lot.
Low	Conditions of transport make it likely that the pest will be detected in an infested lot.
Moderate	Conditions of transport allow the pest to go undetected in a small number of infested lots.
High	Conditions of transport allow the pest to go undetected in a relevant number of infested lots.
Unknown	The detection of infested lots during transport is unknown.

Table 20: Ratings used for qualitative risk scoring of 'possibility of escape'

Name	**Explanation**
Negligible	Conditions of transport or special means ensure that the pest cannot escape.
Low	Conditions of transport or special means make it unlikely that the pest will escape.
Moderate	Conditions of transport or special means may allow the pest to escape to a low extent.
High	Conditions of transport may allow the pest to escape to a relevant extent.
Unknown	The likelihood of the pest escaping during transport is unknown.

Table 21: Ratings used for qualitative risk scoring of 'summary of survival during transport'

Name	**Explanation**
Negligible	Pest will be killed during transport.
Low	It is unlikely that the pest will survive transport.
Moderate	The pest survives transport to a low extent.
High	The pest mostly survives transport.
Unknown	The survival of the pest during transport is unknown.

2.3. Ratings used for qualitative risk scoring of parameters related to 'transfer of the pest to a suitable host'

Table 22: Ratings used for qualitative risk scoring of 'pest detection after arrival'

Name	**Explanation**
Negligible	Import control procedures ensure that the pest will be detected in an infested lot.
Low	Import control procedures make it likely that the pest will be detected in an infested lot.
Moderate	Import control procedures allow for a low level of infested lotsthe pest will not be detected.
High	Import control procedures allow for a relevant level of infested lots that the pest will not be detected.
Unknown	The detection of infested lots during import control is unknown.

Table 23: Ratings used for qualitative risk scoring of 'flow of consignment'

Name	Explanation
Negligible	The intended use of products ensures that the pest cannot be transferred to a suitable host.
Low	The intended use of products makes it unlikely that the pest will be transferred to a suitable host.
Moderate	The intended use of products allows that the pest may be transferred to a suitable host to a low extent.
High	The intended use of products allows that the pest may be transferred to a suitable host to a relevant extent.
Unknown	The transfer to suitable hosts is unknown for the use of the product.

Table 24: Ratings used for qualitative risk scoring of 'summary of transfer of the pest to a suitable host'

Name	Explanation
Negligible	The pest is not able to transfer to a suitable host.
Low	It is unlikely that the pest will transfer to a suitable host.
Moderate	The pest may transfer to a suitable host to a low extent.
High	The pest may transfer to a suitable host to a relevant extent.
Unknown	The transfer of the pest to a suitable host is unknown.

2.4. Ratings used for qualitative risk scoring of 'total risk of a pathway'

Table 25: Ratings describing the 'total risk of a pathway'

Name	Explanation
Negligible	The conditions of the pathway do not allow the pest to enter the risk assessment area.
Low	It is unlikely that the pest will enter the risk assessment area through this pathway.
Moderate	The pest may enter the risk assessment area through this pathway to a low extent.
High	The pest may enter the risk assessment area through this pathway to a relevant extent.
Unknown	The conditions of the pathway are mostly unknown.

2.5. Colour representation of risk and uncertainty

The colour-coding system allows visualisation of qualitative judgements for each cell by a specific colour according to the criteria "risk" and "uncertainty".

Table 26: Two dimensional scoring scheme: Risk × Uncertainty. NA: not applicable

	Uncertainty		
Risk	Low	Medium	High
Negligible			
Low			
Moderate			
High			
Unknown	NA	NA	

3. Ratings used for the evaluation of the risk reduction options

The Panel developed the following ratings with their corresponding descriptors for evaluating the effectiveness of the risk management options to reduce the level of risk.

Table 27: Rating of the effectiveness of risk reduction options

Name	Explanation
Negligible	The risk reduction options do not allow a reduction in the probability of entry.
Low	The risk reduction options are unlikely to reduce the probability of entry.
Moderate	The risk reduction options reduce the probability of entry.
High	The risk reduction options eliminate the probability of entry.
Unknown	The effects of the risk reduction options are mostly unknown.

Table 28: Rating of the technical feasibility of risk reduction options

Name	Explanation
Negligible	The risk reduction options have many technical difficulties (e.g., changing or abandoning current practices, implementing new practices and/or measures) making their implementation in practice impossible.
Low	The risk reduction options can be implemented (e.g., changing or abandoning current practices, implementing new practices and/or measures) with technical difficulties.
Moderate	The risk reduction options can be implemented in practice (e.g., changing or abandoning current practices, implementing new practices and/or measures) with limited technical difficulties.
High	The risk reduction options are already in use in the risk assessment area or they can be easily implemented in practice.
Unknown	The feasibility of the risk reduction options is mostly unknown.

APPENDIX C. DATA ON SURVIVAL TIME AND REPRODUCTION OF SHB ON DIFFERENT FOOD SOURCES

Table 29: Overview of data on survival time and reproduction of SHB on different food sources. The numbers are only indicative and cannot be compared between different studies as the experimental settings are not identical

Life stage of SHB	Food source	Reproduction possible	Survival time	Reference
Larvae	Honey	Not applicable	2–4 days	Lundie, 1940
Wandering larvae	No food	Not applicable	48 days	Cuthbertson et al., 2008
Adult	Honey and pollen	Not analysed in the study	40/68 SHB survived over two months, one SHB up to 180–188 days	Lundie, 1940
	Honey and pollen comb	Yes	81.0 ± 15.7 days	Ellis et al., 2002c
	Honey comb	No	167.2 ± 8.7 days	Ellis et al., 2002c
	Pollen comb	Yes	123.4 ± 17.5 days	Ellis et al., 2002c
	Fruit (fresh and rotten): Kei apples, avocado, banana, cantaloupe, pineapple, grape, grapefruit, mango, orange, papaya, strawberry	Yes	Different for each fruit type: 63.6 ± 30.4 and 58.6 ± 30.0 days (fresh and rotten Kei apples, respectively)	Eischen et al., 1999; Ellis et al., 2002c; Keller, 2002; Buchholz et al., 2008; Arbogast et al., 2009a, 2010
	Empty brood comb	No	49.8 ± 10.2 days	Ellis et al., 2002c
	Beeswax	No	19 days	Schmolke, 1974
	Only water	No	9.6 ± 4 days	Ellis et al., 2002c
		No	8 days	Schmolke, 1974
		No	10–14 days	Buchholz et al., 2008
	No food, no water	No	3–5 days	Pettis and Shimanuki, 2000
	Only pollen	No	2 days	Schmolke, 1974
	Tomatoes	No	No SHB detected	Eischen et al., 1999

APPENDIX D. DETAILED BIOLOGICAL ASPECTS OF SHB

SHB larvae leave the beehive for pupation. In the sandy soil of central Florida (USA), around 83 % were found within 30 cm of the beehive entrance and no SHB was found at 180 cm (Pettis and Shimanuki, 2000). In the absence of soil, larvae crawl quite a distance to find soil (Schmolke, 1974). There are no clear data available on exact distances, but beekeepers mention a distance up to 200 m (Somerville, 2003). SHB density is greatest in the first 10 cm of soil, where most of the larvae and pupae are observed close to the surface of the soil (Schmolke, 1974; de Guzman and Rinderer, 2009).

During the first day or two after their emergence from the soil, young SHB are very active flyers. Later they become less active, rarely use their wings and actively seek less well-illuminated places (Lundie, 1940). It is suggested that SHB initially do not fly to colonies in close proximity (<15 m) but might disperse over longer distances (Neumann et al., 2012), although additional experiments are necessary to confirm this finding. SHB flight distances have not been studied in detail. SHB could be detected in traps 200 m from infested beehives but longer distances have not been investigated (Arbogast et al., 2007). However, based on anecdotal evidence, beekeepers believe that SHB can fly a distance of 200 m to >10 km (Somerville, 2003), but there is no published scientific evidence to substantiate this notion.

In addition to individual flights, SHB is probably able to fly together with bees (Eischen et al., 1999; Ellis et al., 2003b). Swarming[23] is reported to take place over distances of 20–400 m (Seeley and Morse, 1977), 300–960 m (Lindauer, 1951) or 200 m to 10 km with a mean of 3.36 ± 0.72 km (Villa, 2004) depending on *Apis mellifera* bee race and nesting availability. *Bombus* spp. do not form reproductive swarms (Michener, 1974). It is clear that SHB readily disperse within apiaries (Elzen et al., 1999, 2000; Spiewok et al., 2008). Even in a region of low infestation (Maryland, USA) (Spiewok et al., 2007), 92 % of cleaned colonies within infested apiaries were reinfested within two weeks (Spiewok et al., 2008). SHB from outside the apiaries might also have contributed to these numbers, but the majority or all of the collected SHB most likely originated from within the apiary since no SHB influx into experimental apiaries within a radius of 10 km from the infested apiaries in Maryland could be detected. Comparison of mitochondrial DNA haplotypes of SHB across the south-eastern USA revealed significant differences at the apiary level (Evans et al., 2003). However, the high reproductive rate of SHB, together with the founder effect on genetic variability of the recently introduced pest, makes it difficult to estimate long-distance dispersal from these data. It is clear that more research is required on the long-distance dispersal of SHB as a pathway of entry into non-infested regions.

SHB is present all year long but its abundance varies among the seasons. The lowest numbers are detected during winter because reproduction does not take place during the coldest months of the year or during (summer) periods with low humidity (Arbogast et al., 2009b; de Guzman et al., 2010; Torto et al., 2010b). Adult SHB can overwinter in colder climates (e.g., Minnesota, USA) by hiding within clusters of bees (Wenning, 2001; Schäfer et al., 2011). Bees form thermoregulatory clusters when ambient temperature fall is below 18 °C. It is predicted that the last SHB enters a bee cluster at 7°C as the temperature descends (Atkinson and Ellis, 2011).

SHB has a high reproductive potential as five generations can be produced in a single year (Lundie, 1940). It is estimated that one female SHB may potentially lay up to 1 000 eggs in her lifetime (Schmolke, 1974). The number of eggs per brood cell is in the range of 20–30 (Ellis and Delaplane, 2008). Heightened levels of stress in honey bee colonies (e.g., after removal of honey supers) can lead to a very rapid rate of egg laying by SHB (Wenning, 2001). Severe SHB infestations can lead to bees abandoning the hive completely (Ellis et al., 2003a; Neumann et al., 2010). The numbers of adult SHB can range from hundreds to thousands per beehive (Somerville, 2003; Neumann et al., 2010). On the

[23] A more detailed discussion on the different types of swarming is beyond the scope of this opinion since they have similar flight distances.

other hand, SHB cryptic low-level reproduction is an alternative to population build-up in colonies which are unable to remove debris or are less efficient in doing so (Spiewok and Neumann, 2006b).

Environmental conditions influence SHB development and lifespan (see above) and, as a consequence, infestation levels vary. Availability of suitable food also determines the SHB infestation levels. For instance, increased infestations of SHB have been found in the proximity of rooms where honey is stored (Spiewok et al., 2007). The average number of offspring produced by SHB pairs fed on fruit in a laboratory situation was lower than the average number of offspring produced by SHB pairs fed on bee products (Ellis et al., 2002ca). At present, it is unclear whether use of fruits as alternative food sources in the absence of beehives (e.g., after migratory beekeeping) is likely to contribute to SHB population build-up (Buchholz et al., 2008).

The destructive phase of the SHB infestation is the larval stage, whereas the adults have comparatively little impact on the honey bee colony (Lundie, 1940); thus, early signs of infestation may go unnoticed. SHB reproduction can occur at low levels in colonies without readily visible damage (Spiewok and Neumann, 2006b). However, growth of the SHB population can be rapid, leading to high bee mortality in the beehive (Spiewok et al., 2007). Weakened or stressed colonies will typically succumb after SHB population expansion. Larvae burrow through comb, eating honey and pollen, killing brood and defecating as they go. The faeces cause the honey to become discoloured and fermentation to start (Lundie, 1940). The honey develops an odour that is similar to that of decaying oranges. The fermentation together with damage to the comb and cappings causes a frothy honey to run out of combs and sometimes out of the beehive. The SHB larvae leave behind a trail of foul-smelling slime that sometimes causes bees to abandon their hive (Wenning, 2001). Severe damage seems to be limited to areas where sandy soils and humid conditions are present (Wenning, 2001).

APPENDIX E. DETAILED BIOLOGICAL ASPECTS OF *TROPILAELAPS* SPP.

Only mature *Tropilaelaps* mites can leave the beehive attached to flying bees during their phoretic life stage (see above). In the case of *Varroa*, it has been shown that infestation influences the flight behaviour of forager bees, resulting in lower numbers of bees returning to the colony (Kralj and Fuchs, 2006). There are some reports suggesting that *Varroa* and phoretic mites of bumble bees are transferred to bees and insects visiting flowers (Kevan et al., 1990; Schwarz and Huck, 1997). It is assumed that *Tropilaelaps* mites use insects for phoretic transport. Transfer of *Tropilaelaps* from one bee to another for instance by bee drifting, robbing or when the bees are on the same flower could lead to dispersal to other beehives (Paar et al., 2002). In adult bees, *Tropilaelaps* often takes up a position between thorax and abdomen to protect itself against the cleaning behaviour of the bees (Ritter and Schneider-Ritter, 1988; Büchler et al., 1992; Rinderer et al., 1994).

Infested honey bees hatched from brood combs outside a bee colony (e.g., bee colony died, bees absconded, or infested brood combs were transported without bees) are not able to survive independently without the host. They will try to enter a new colony close by.

The dispersal distance of *Tropilaelaps* by bees is likely to be correlated with bee flight distances. Adult worker bees have a flight radius of about three to six kilometres (Eckert, 1933); males fly two to five kilometres to drone congregation areas (Ruttner and Ruttner, 1972; Koeniger, 1986) and queen (mating) flights are two to three kilometres (Ruttner and Ruttner, 1966). Robbing is also a factor in spread of pests (Fries and Camazine, 2001). Worker bees rob honey from neighbouring colonies within at least one kilometre (Lindström et al., 2008). The drifting of bees into the wrong colony occurs frequently in apiaries, where colony densities are high. Swarming[24] is reported to take place with distances over distances of 20–400 m (Seeley and Morse, 1977), 300–960 m (Lindauer, 1951), 200 m to 5 km (Koeniger and Koeniger, 1980) or 200 m to 10 km with a mean of 3.36 ± 0.72 km (Villa, 2004) depending on *Apis mellifera* bee race and nest site availability. *Tropilaelaps* has been observed in a newly settled *Apis dorsata* swarm (Koeniger et al., 2002). This might suggest dispersal of *Tropilaelaps* by bee swarms, but this needs to be confirmed. It is reported that *Apis dorsata* stops brood rearing some days before the onset of swarming and that swarming takes place in different stages, with rest between stages of the flight. Rest periods of one to three days are observed (Koeniger and Koeniger, 1980) and a total migration time of up to one month is hypothesised (Kavinseksan et al., 2003). A broodless period of more than eight days should reduce the probability of mite survival during swarming (see Section 2.2.5).

The short life cycle (see above) and the capacity of repeated egg laying by female mites (Woyke, 1994b) may lead to rapid growth of the *Tropilaelaps* population. The percentage of infested brood cells can reach levels of more than 50 %, and up to 14 mites per cell have been described (Woyke, 1984; Sharma et al., 1994). The infestation rate of adult worker bees is in an infested colony is around 1.5 % (range 0–6.7 %), or one mite per infested bee (Woyke, 1984; Rinderer et al., 1994; Camphor et al., 2005). Severe infestation may lead to absconding of colonies (Atwal and Goyal, 1971).

The rate of infestation increases with increase in the availability of brood. The level of brood is determined mainly by the amount of pollen and nectar available, which vary according to the season. Consequently, the mite population fluctuates with the season (Camphor et al., 2005; Luo et al., 2011).

There are only limited data published on the harmful effects of a *Tropilaelaps* infestation. In *Varroa*, early signs of infestation usually go unnoticed (OIE—Terrestrial Animal Health Code 2010). This might be the case for *Tropilaelaps* as well. The infestation and feeding activities of *Tropilaelaps* mites cause brood mortality and a reduction in the lifespan of adult bees that survive the infested brood stage. The bees emerging from infested brood cells may show deformed wings and legs as well as malformed abdomen (Ritter and Schneider-Ritter, 1988; Forsgren et al., 2009). These bees may be seen crawling at the entrance to the beehive. Other signs include irregular and poor brood patterns

[24] A more detailed discussion on the different types of swarming is beyond the scope of this opinion since they have similar flight distances.

with patches of neglected brood, perforated cappings due to worker bees attempting to clean out sick or dead larvae and mummified pupae (Sharma et al., 1994). Severe infestation can lead to rapid death of honey bee colonies (Camphor et al., 2005).

APPENDIX F. DATA ON IMPORT OF BEES AND PRODUCTS INTO THE EU

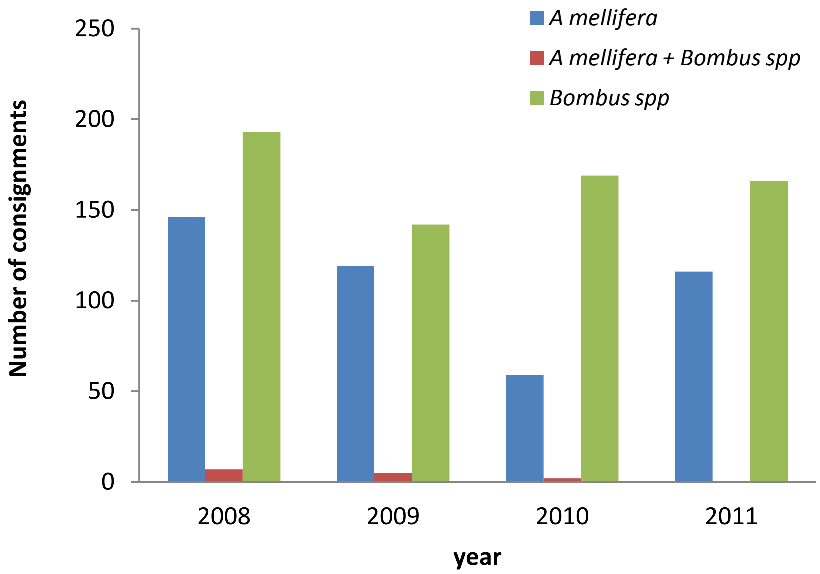

Figure 10: Number of intentional bee imports into the 27 EU Member States in the period 2008–2011 (source: TRACES[25])

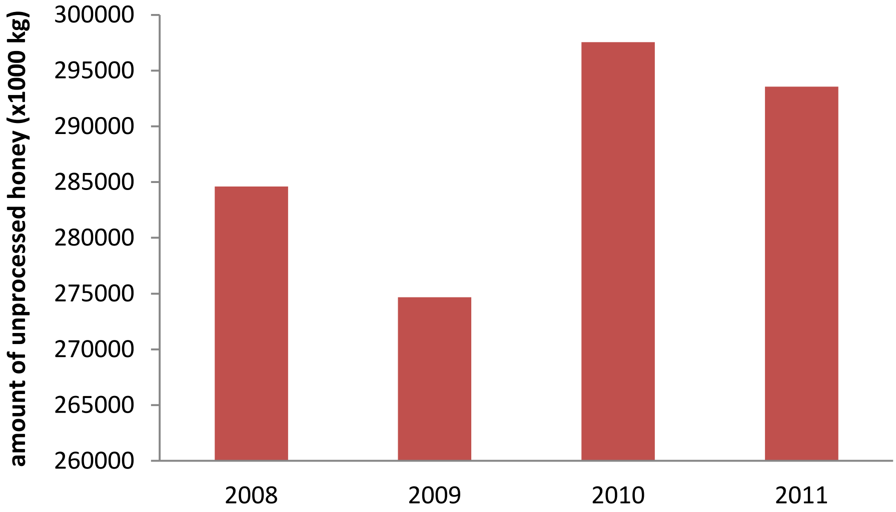

Figure 11: Amount of natural (unprocessed) honey imported into the 27 EU Member States in the period 2008–2011 (source: Eurostat[26])

[25] https://webgate.ec.europa.eu/sanco/traces/
[26] http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home/

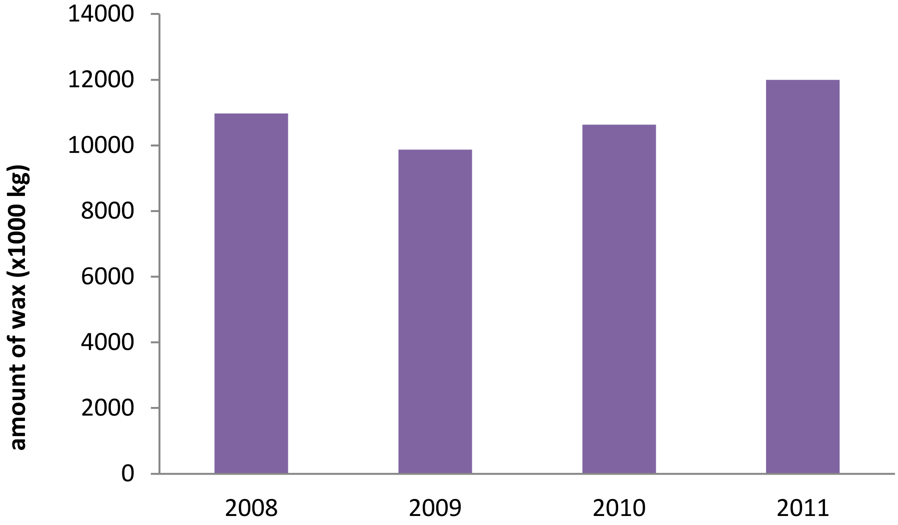

Figure 12: Amount of wax (beeswax as well as wax from other insects) imported into the 27 EU Member States in the period 2008–2011 (source: Eurostat[27])

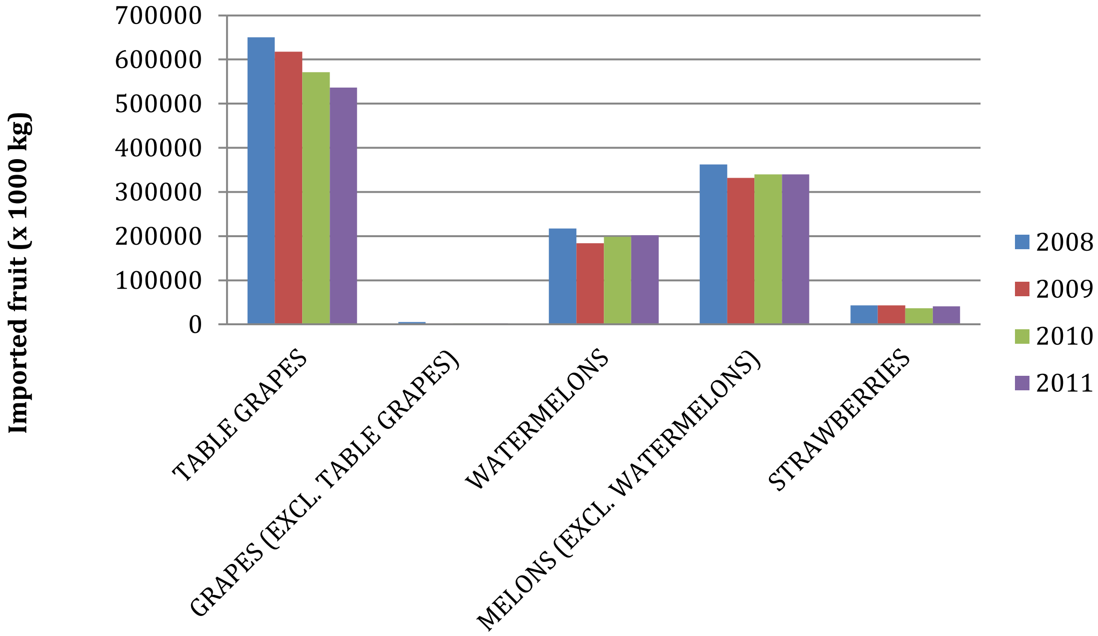

Figure 13: Amount of fresh grapes, melons and strawberries imported into the 27 EU Member States in the period 2008–2011 (source: Eurostat[27])

APPENDIX G. DETAILED TABLES ON PROBABILITY OF ENTRY OF SHB

1. Pathway: 'Bee import'

1.1. Intentional bee import

Table 30: Association of SHB with the pathway at origin

Risk factor	**Queens**		**Swarms and colonies**	
	Apis mellifera	***Bombus* spp.**	***Apis mellifera***	***Bombus* spp.**
Dangerous life stages of the pest at origin	Eggs, larvae and/or adults can be present in the cage at the origin of the pathways. It is not possible for pupae to be present since there is no soil in the consignment (see Section 2.1.5).			
Risk	H	H	H	H
Uncertainty	L	L	L	L
Level of infestation	SHB is attracted to *A. mellifera* and may be present in the consignment (see Section 2.1.5).	Bumble bees come from a confined closed system. *Bombus* is a less likely host for SHB; there are no field survey data on distribution of SHB on *Bombus* spp. at present (see Section 2.1.4).	SHB is attracted to *A. mellifera* and may be present in the consignment (see Section 2.1.5). There is a higher likelihood of importing SHB eggs and larvae in bee colonies (containing bee brood) than in swarms. For SHB adults, there is no difference between colonies and swarms.	Bumble bees come from a confined closed system. *Bombus* is a less likely host for SHB; there are no field survey data on distribution of SHB on *Bombus* spp. at present (see Section 2.1.4).
Risk	H	M	H	M
Uncertainty	L	M	L	M
Number of bees or amount of products imported into the risk assessment area	Import data are available from TRACES (see Figure 10, Appendix F). These data give only an impression of bee imports. In addition, there are indications (Anderson et al., 2010; and from pedigrees[27]) that illegal import took place and should be considered.	Import data are available from TRACES (see Figure 10, Appendix F). These data give an impression of bee imports. Data on SHB reproduction on bumble bees are available from experimental conditions but not from field data (see Section 2.1.4).	Import of swarms and colonies is not permitted according to the actual legislation (see section 2.3).	Import and colonies is not permitted (see Section 2.3).
Risk	H	M	L	L
Uncertainty	L	H	L	L
Summary Risk	H	M	L	L
Uncertainty	L	M	L	L

[27] http://perso.fundp.ac.be/~jvandyck/homage/elver/index.html#paysSE (last assessed on 11 February 2013)

Table 31: Survival of SHB during transport

Risk factor	**Queens**		**Swarms and colonies**	
	Apis mellifera	***Bombus* spp.**	***Apis mellifera***	***Bombus* spp.**
Vulnerability of life stage(s)	It is most likely that the pest is present as eggs and/or larvae (e.g., as is the case in Portugal). It is less likely that adults are inside the consignment since the queen (and attendants) is (are) individually introduced and visually checked.		The possibility of adult SHB being present in the consignment increases with the number of bees present and the number of brood combs.	
Risk	L	L	H	H
Uncertainty	L	L	L	L
Conditions during transport	The conditions applied to keep bees alive are ideal for SHB survival (see Section 2.1.5)			
Risk	H	H	H	H
Uncertainty	L	L	L	L
Ease of pest detection during transport	During packaging, bees and queens are individually handled and visually checked, which should allow detection of the pest. During shipment of the consignment, it is not possible to open cages for detection of SHB.		During packaging, bees and queens are handled in bulk, which makes inspection more difficult. During shipment of the consignment, it is practically impossible to open cages for detection of SHB.	Bumble bees come from a confined production unit (see Section 2.3).
Risk	M	M	H	L
Uncertainty	M	M	L	L
Possibility of escape	Larvae ready to pupate can crawl (see Section 2.1.5 and Appendix D). SHB larvae and adults are smaller than bees (Schäfer et al., 2008) and may escape through air ventilation holes in the cage. Adults could also fly away when cage is opened.		SHB larvae ready to pupate can crawl (see Section 2.1.5 and Appendix D) and may escape through the holes in the cage and the mesh that is used to confine the bees. SHB adults may fly away when the container is opened.	
Risk	M	M	M	M
Uncertainty	L	L	L	L
Summary Risk	M	M	H	M
Uncertainty	M	M	L	L

Table 32: Transfer of SHB to a suitable host

Risk factor	**Queens**		**Swarms and colonies**	
	Apis mellifera	***Bombus* spp.**	***Apis mellifera***	***Bombus* spp.**
Ease of pest detection at arrival	SHB adults could fly away when the cage is opened, which could lead to a false-negative result. Control requires new attendants, a person able to transfer bees, and an equipped and closed room (see Section 2.3). Current rules are adequate to detect the pest in consignments of honey bee queens at arrival, if correctly applied. However, transport time might influence the risk of SHB entry since less time would be available for pest detection. In addition, variation in awareness of bee pests might also influence the capacity to detect SHB.	There is no control foreseen in the regulation since the bees come from a closed, confined system (see Section 2.3).	There is no control procedure in the regulation since import is not permitted according to the actual legislation (see section 2.3).	There is no control foreseen in the regulation because the bees come from a closed, confined system (see Section 2.3).
Risk	M	H	H	H
Uncertainty	H	L	L	L
Flow of consignment after arrival	At present, procedures associated with import of bees into the risk assessment area are clear. However, the risk on SHB entry would increase when bees are sent to the final destination and released in the environment before the lab results are available since SHB adults are attracted by honey bee colonies.	The queens are transferred to a confined production unit for bumble bees and SHB adults are attracted by honey bee colonies. Only limited data are available.	Honey bees go out foraging and come in contact with other bees and SHB adults are attracted by honey bee colonies (see Section 2.1.5 and Appendix D).	The bumble bees are transferred to the field (e.g., glasshouses or tunnels) and can come in contact with other bees and SHB adults are attracted by honey bee colonies (see Section 2.1.5, 2.3 and Appendix D).
Risk	M	M	H	H

Risk factor		Queens		Swarms and colonies	
		Apis mellifera	***Bombus* spp.**	***Apis mellifera***	***Bombus* spp.**
	Uncertainty	H	M	L	L
Summary	Risk	M	M	H	H
	Uncertainty	H	M	L	L

1.2. Accidental bee import

Table 33: Association of SHB with the pathway at origin

Risk factor		Colonies and swarms (*Apis* spp.)
Dangerous life stages of the pest at origin		Adults are mobile and are attracted to bees (Appendix D). They could enter a transport facility where bees are present. Eggs and larvae are not considered to be present at the start of this pathway but might develop during transport and/or storage. Pupation can occur only in the presence of soil (see Section 2.1.5).
	Risk	H
	Uncertainty	L
Level of infestation		SHB is attracted to *A. mellifera* and may be present in the consignment (Section 2.1.5).
	Risk	H
	Uncertainty	L
Number of bees or amount of products imported into the risk assessment area		Swarms of *A. mellifera* in various types of transport are reported in the risk assessment area (personal communication, 21 November 2012, Mike Brown, National Bee Unit, UK) as well as in other countries[28].
	Risk	H
	Uncertainty	L
Summary	Risk	H
	Uncertainty	L

[28] http://www.abc.net.au/rural/news/content/201211/s3639408.htm

Table 34: Survival of SHB during transport

Risk factor	**Colonies and swarms (*Apis* spp.)**
Vulnerability of life stage(s)	Infested colonies with a high number of SHB adults can be present in the consignment (Appendix D).
Risk	H
Uncertainty	L
Conditions during transport	Conditions will vary depending on the transported commodity. Frequently, there are no conditions applied to reduce SHB infestation.
Risk	H
Uncertainty	L
Ease of pest detection during transport	It is possible, although difficult, to detect a swarm or colony during transport. Examination of bees is very unlikely. In addition, detection and identification of SHB life stages by untrained persons is very unlikely (see Section 2.1.6).
Risk	H
Uncertainty	L
Possibility of escape	Mature SHB can escape alone or together with a bee swarm (see Appendix D). In the case that a swarm leaves the commodity during transport, it is possible that SHB eggs, larvae and adults remain present in the commodity.
Risk	H
Uncertainty	L
Summary Risk	H
Uncertainty	L

Table 35: Transfer of SHB to a suitable host

Risk factor	Colonies and swarms (*Apis* spp.)
Ease of pest detection at arrival	Detection of colonies and swarms is reported (personal communication, 21 November 2012, Mike Brown, National Bee Unit, UK). Bees could be visually checked for pest presence but a negative result does not mean that the consignment is pest free.
Risk	H
Uncertainty	L
Flow of consignment after arrival	Bees might come into contact with bees in the vicinity.
Risk	H
Uncertainty	L
Summary Risk	H
Uncertainty	L

2. Pathway: 'Non-bee import'

Table 36: Overview of bee products and comments on their inclusion/exclusion from the risk assessment

Bee product	**Why included/excluded from risk assessment**
Bee-collected pollen	It could be infested with SHB. Therefore, it is included in the risk assessment.
Honey	It is unlikely that SHB would survive in extracted and filtered honey; only unprocessed comb honey is included in the risk assessment.
Royal jelly	Royal jelly is in most cases processed and frozen before transport, making it unlikely that SHB can survive in it; only fresh royal jelly is considered.
Propolis	SHB is not attracted to pure or processed propolis, which, therefore, are safe and not considered in the risk assessment. Only propolis with beeswax is included in the risk assessment.
Beeswax	It is unlikely that SHB can survive in melted beeswax; only beeswax in the form of combs is included in the risk assessment.
Brood	Bee brood might be imported as food source but the amounts are negligible at present. Only brood combs are included in the risk assessment.
Bee bread	Not considered as it is not imported at present.
Semen	SHB cannot survive in semen. Therefore, semen is not included in the risk assessment.
Venom	SHB cannot survive in venom. Therefore, venom is not included in the risk assessment.
Beekeeping equipment	'New' beekeeping equipment is not included in the risk assessment because the probability of infestation is negligible. Only 'used' beekeeping equipment is included in the risk assessment.

Table 37: Association of SHB with the pathway at origin

Risk factor	Bee products	Bee equipment	Non-bee products	Soil
Products that are considered	Bee-collected pollen, unprocessed comb honey, fresh royal jelly, propolis with beeswax, comb beeswax, brood comb (as defined and explained in Table 36).	Used beekeeping equipment (as defined and explained in Table 36).	Fruit is transported unripe (e.g., banana, pineapple, papaya, mango, grapefruit orange, avocado) or ripe (e.g., strawberry, grape, melon). Only fruit transported in a ripe state is considered to be at risk at present because it is reported that SHB survives/reproduces on ripe fruit. SHB can also survive/reproduce on rotten fruit, but this commodity is not imported as such. More research is required to allow listing of all susceptible fruits and/or to define the ripening stage at which they become susceptible (see Sections 2.1.4 and 2.1.5).	Import of soil itself is excluded from the risk assessment as it cannot be imported into the EU except from Algeria, Egypt, Israel, Libya, Morocco and Tunesia (Council Directive 2000/29/EC[29]), but soil as a contaminant (e.g., on plants for planting) and soil as plant substrate (e.g., potted plants) are considered.
Dangerous life stages of the pest at origin	Eggs, larvae and adults can be present at the origin of the pathway. Pupae will not be present since there is no soil in the consignment (see Section 2.1.5).		SHB adults are attracted to ripe fruit (see Section 2.1.5).	SHB pupae can be present in the soil and newly emerged SHB adults might be present in the consignment (see Section 2.1.5).
Risk	H	H	H	H
Uncertainty	L	L	L	L
Level of infestation	It is documented that SHB is attracted to *A. mellifera* colonies, honey houses, honey packaging stations and all material (bee products and bee equipment) that has been in contact with the bees (see Section 2.1.5).		The consignment is infested only when there are no bees and/or bee products available. There are no reported cases of SHB presence in shipped non-bee products (see Section 2.1.4).	The consignment is infested only when bee colonies or honey houses are nearby owing to limited mobility of crawling larvae and when the conditions for pupation are fulfilled. Limited data are available (Appendix D).
Risk	H	H	L	L
Uncertainty	L	L	H	H

[29] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2000:169:0001:0112:EN:PDF

Risk factor	**Bee products**	**Bee equipment**	**Non-bee products**	**Soil**
Number of bees or amount of products imported into the risk assessment area	Import of bee products and bee equipment is reported (see Figures 4 and 5, Appendix F) and trade volumes of bee products are higher than those of used bee equipment.		Only a limited volume of the total tonnage of imported fruit is considered to be at risk (see Figure 13, Appendix F). There is no clear definition of ripe fruits and there are only limited data on the survival and reproduction of SHB on fruits (see Section 2.1.4).	Soil cannot be imported except in special conditions (e.g., ON pot plants production). SHB infestation is likely only in the case that infested bee colonies are near the production site. There are limited data available (Appendix D).
Risk	H	M	M	M
Uncertainty	L	L	M	M
Summary Risk	H	M	M	M
Uncertainty	L	L	H	H

Table 38: Survival of SHB during transport

Risk factor	Bee products	Bee equipment	Non-bee products	Soil
Vulnerability of life stage(s)	All SHB larvae stages and adults are likely to survive transport (normally three to five days without food and water) (see Appendix C). The available bee products or bee products as contaminants on used bee equipment could act as a suitable food source and extend the survival period. SHB eggs could survive too but they are more fragile than larvae and adults (see Section 2.1.4).		All larvae stages and adults are likely to survive transport (normally three to five days without food and water) (see Appendix C). The available ripe fruits could act as a suitable food source and extend the survival period. SHB eggs could survive too but they are more fragile than larvae and adults (see Section 2.1.4).	SHB pupae are likely to survive even very long transport periods since they emerge from soil in average after three to four weeks. SHB adults are likely to survive transport of three to five days in the absence of food and water, but this period is extended in the presence of suitable food (see Sections 2.1.4 and 2.1.5).
Risk	H	H	H	H
Uncertainty	L	L	L	L
Conditions during transport	No specific conditions are applied to reduce SHB infestation during transport (risk reduction options are not taken into account in the risk assessment; see Section 2.3).	No specific conditions are applied to reduce SHB infestation during transport (risk reduction options are not taken into account in the risk assessment; see Section 2.3).	Ripe fruit is transported in refrigerated conditions, but the transport conditions are not expected to be lethal to SHB. No specific conditions are applied to reduce SHB infestation (Council Directive 2000/29/EC[30]).	No specific conditions are applied to reduce SHB infestation (Council Directive 2000/29/EC[30]).
Risk	H	H	H	H
Uncertainty	L	L	L	L
Ease of pest detection during transport	Detection and identification of SHB life stages by untrained persons is very unlikely (see Section 2.1.6).			
Risk	H	H	H	H
Uncertainty	L	L	L	L
Possibility of escape	Mature SHB can fly away in search of food, but it is not known if the availability of food might reduce the probability of flying away (Appendix D). Escape is very unlikely for other SHB life stages.	Mature SHB can fly away in search of food (Appendix D). Escape is very unlikely for other SHB life stages.		
Risk	H	H	H	H
Uncertainty	M	L	L	L

Summary Risk	H	H	H	H
Uncertainty	L	L	L	L

Table 39: Transfer of SHB to a suitable host

Risk factor	Bee products	Beekeeping equipment	Non-bee products	Soil
Ease of pest detection at arrival	In the case of high infestation levels, clinical signs are visible (e.g., fermented smell of honey, larvae destroy the structure of beeswax) and infestation is easy to detect. In the case of low infestation levels, there are no clear visual signs of damage. Destruction of the consignment is necessary to rule out infestation (e.g., bee brood). A low infestation level is more likely to be missed in the consignment since it is more difficult to detect than a high infestation level (see Section 2.1.6 and Appendix D).	SHB has a small size, hides from light or flies away (see Section 2.1.6).	There are inspections but not regarding SHB (Council Directive 2000/29/EC[30]).	There are inspections but not regarding SHB (Council Directive 2000/29/EC[30]).
Risk	H	H	H	H
Uncertainty	L	L	L	L
Flow of consignment after arrival	SHB can be present in the consignment, escape, fly, be attracted to bees and actively search out bee colonies.			
Risk	H	H	H	H
Uncertainty	L	L	L	L
Summary Risk	H	H	H	H
Uncertainty	L	L	L	L

3. Pathway: 'Natural means and flight

Table 40: Association of SHB with the pathway at origin

Risk factor	Wind (natural means)	Dispersal of flying SHB and bees	Dispersal of flying SHB alone
Species that are considered	SHB (see Section 2.1.1).	SHB (see Section 2.1.1); *Apis* spp. and *Bombus* spp. (see Section 2.1.4).	SHB (see Section 2.1.1).
Dangerous life stages of the pest at origin	SHB adults and wandering larvae leave the hive and can be present at the origin of the pathway (see Section 2.1.5).	SHB adults can fly with bees and can be present at the origin of the pathway (see Appendix D).	SHB adults can fly and can be present at the origin of the pathway (see Appendix D).
Risk	H	H	H
Uncertainty	L	L	L
Level of infestation	By definition, SHB is present.		
Risk	H	H	H
Uncertainty	L	L	L
Number of bees or amount of products imported into the risk assessment area	SHB is not reported in countries neighbouring the risk assessment area at present (see Section 2.1.3) (only one case has been reported to OIE or in the scientific literature in the past). No data are available on dispersal distance of SHB by wind.	SHB is not reported in countries neighbouring the risk assessment area at present (see Section 2.1.3) (only one case has been reported to OIE or in the scientific literature in the past), SHB can fly with swarms but no data are available on how far they fly together (see Appendix D).	SHB is not reported in countries neighbouring the risk assessment area at present (see Section 2.1.3) (see Section 2.1.5) (only one case has been reported to OIE or in the scientific literature in past). No clear data are available on dispersal distance of SHB via flight of the beetle alone (see Appendix D).
Risk	L	L	L
Uncertainty	H	M	H
Summary Risk	M	M	M
Uncertainty	H	H	H

Table 41: Transfer of SHB to a suitable host

Risk factor	**Wind (natural means)**	**Dispersal of flying SHB and bees**	**Dispersal of flying SHB alone**
Ease of pest detection at arrival	There is a low probability that swarms entering the risk assessment area by wind or natural flight will be detected. The probability that these swarms will be checked for SHB is negligible.		
Risk	H		
Uncertainty	L		
Flow of consignment after arrival	SHB can fly, are attracted to bees and actively seek bee colonies (see Section 2.1.5).		
Risk	H	H	H
Uncertainty	L	L	L
Summary Risk	H	H	H
Uncertainty	L	L	L

APPENDIX H. DETAILED TABLES ON PROBABILITY OF ENTRY OF *TROPILAELAPS*

1. Pathway: 'Bee import'

1.1. Intentional bee import

Table 42: Association of *Tropilaelaps* with the pathway at origin

Risk factor	***Apis mellifera***		
	Queens	**Swarms**	**Colonies**
Dangerous life stages of the pest at origin	Only adult mites, and only during the phoretic stage, which accounts for only a small part of the total life cycle, can be in the consignment. Other life stages can be excluded since they lack the protective environment of brood (see Section 2.2.5). This is well documented in the scientific literature.		Only adult mites, and only during phoretic stage, can be in the consignment. All other life stages have to be considered as well in the presence of brood (see Section 2.2.5). This is well documented in the scientific literature.
Risk	L	L	H
Uncertainty	L	L	L
Level of infestation	No more than one mite per bee has been detected. The pest survives only about eight days in the absence of honey bee brood (see Section 2.2.5 and Appendix E)	The pest survives only about eight days in the absence of honey bee brood (see Section 2.2.5)	The rate of infestation increases with increased availability of brood (see Section 2.2.5 and Appendix E).
Risk	L	L	H
Uncertainty	L	L	L
Number of bees or amount of products imported into the risk assessment area	Import data are available from TRACES (see Figure 10, appendix F); in addition there are indications from pedigrees[28] that illegal import has taken place.		Import of swarms and colonies is not permitted according to the actual legislation (see Section 2.3).
Risk	H	H	L
Uncertainty	L	L	L
Summary Risk	L	L	M
Uncertainty	L	L	L

Table 43: Survival of *Tropilaelaps* during transport

Risk factor	***Apis mellifera***		
	Queens	**Swarms**	**Colonies**
Vulnerability of life stage(s)	Only a small number of bees are present in the consignment (see Section 2.3).	A large number of bees but small number of *Tropilaelaps* adults might be present since the mites cannot survive long without honey bee brood (see Sections 2.2.5 and 2.3).	A large number of honey bees and combs could be present in the consignment (see Section 2.3). Adult *Tropilaelaps* might be present in honey bee brood combs (see Section 2.2.5).
Risk	L	M	H
Uncertainty	L	L	L
Conditions during transport	Adult mites survive in the same environmental conditions as the imported honey bees, but they survive only about eight days in the absence of honey bee brood (see Section 2.2.5). There are no specific measures applied since the risk assessment did not take into account risk reduction options that could be applied to eradicate *Tropilaelaps* (see Section 2.3).		All *Tropilaelaps* life stages survive in the same environmental conditions as the imported bees. Adult mites may survive up to 50 days in the presence of brood (see Section 2.2.5). There are no specific measures applied since the risk assessment did not take into account risk reduction options that could be applied to eradicate *Tropilaelaps* (see Section 2.3).
Risk	L	L	H
Uncertainty	L	L	L
Ease of pest detection during transport	This is difficult because of the impossibility of opening honey bee cages during transport for detection of *Tropilaelaps*. Owing to the small size of the pest, inspection inside the cage is required as the pest is attached to bees and visible only by taking the honey bee between the fingers and looking carefully. In a honey bee colony or swarm, it is even more difficult to find *Tropilaelaps* among all the honey bees present in the consignment (see Section 2.2.6).		
Risk	H	H	H
Uncertainty	L	L	L
Possibility of escape	Low risk owing to immobility of *Tropilaelaps* life stages. Only mature mites in the phoretic life stage are considered to be at risk for escape (see Section 2.2.5 and Appendix E).		
Risk	L		
Uncertainty	L		
Summary Risk	L	L	H
Uncertainty	L	L	L

Table 44: Transfer of *Tropilaelaps* to a suitable host

Risk factor		*Apis mellifera*		
		Queens	**Swarms**	**Colonies**
Ease of pest detection per life stage at arrival		Control requires new attendants, a person able to transfer bees, plus an equipped and closed room. Even in cases where intensive inspection takes place, there is still a possibility that adult mites will be undetected since they are very small and hard to see with the naked eye. This could lead to a false-negative result. Current rules are adequate to detect the pest in consignments of honey bee queens at arrival, if correctly applied. However, transport time might influence the risk of *Tropilaelaps* entry since less time would be available for pest detection. In addition, variation in awareness on bee pests might also influence the capacity to detect *Tropilaelaps*.	There is no control procedure in the regulation since import is not permitted according to the actual legislation (see Section 2.3).	
	Risk	M	H	H
	Uncertainty	H	L	L
Flow of consignment after arrival		At present, procedures associated with import of bees into the risk assessment area are clear.	Honey bees go out foraging and come in contact with other honey bees. Only observational data in other bee species and other mites are available (see Appendix E).	Honey bees go out foraging and come in contact with other honey bees. Only observational data with other bee species and other mites; colonies contain honey bee brood combs on which mites could be present (see Appendix E).
	Risk	M	M	H
	Uncertainty	H	H	H
Summary	Risk	M	M	H
	Uncertainty	H	H	H

1.2. Accidental bee import

Table 45: Association of *Tropilaelaps* with the pathway at origin

Risk factor	**Colonies and swarms of *Apis* spp.**
Dangerous life stages of the pest at origin	Only adult mites, and only during the phoretic stage, which accounts for only a small part of the total life cycle, can be present in the consignment. Other life stages have to be considered in the presence of brood (see Section 2.2.5). This is well documented in the scientific literature.
Risk	H
Uncertainty	L
Level of infestation	The rate of infestation increases with increased availability of honey bee brood (see Appendix E).
Risk	H
Uncertainty	L
Amount of bees or products imported into the risk assessment area	Swarms of *A. mellifera* in various transport means are reported in the risk assessment area (personal communication, 21 November 2012, Mike Brown, National Bee Unit, UK) as well as in other countries.[29]
Risk	H
Uncertainty	L
Summary Risk	H
Uncertainty	L

Table 46: Survival of *Tropilaelaps* during transport

Risk factor		Colonies and swarms of *Apis* spp.
Vulnerability of life stage(s)		A large number of honey bees and honey bee brood combs might be present in the consignment. Adult mites could be present in honey bee brood combs (see Appendix E).
	Risk	H
	Uncertainty	L
Conditions during transport		Conditions will vary depending on the transported commodity. Frequently, there are no conditions applied to reduce SHB infestation.
	Risk	H
	Uncertainty	L
Ease of pest detection during transport		It is possible, although difficult, to detect a swarm or colony during transport. Examination of honey bees is very unlikely. In addition, detection and identification of *Tropilaelaps* life stages by untrained persons is very unlikely (see Section 2.2.6).
	Risk	H
	Uncertainty	L
Possibility of escape		Low risk owing to the immobility of *Tropilaelaps* life stages. Only mature mites in the phoretic life stage are considered to be at risk for escape (see Section 2.2.5).
	Risk	L
	Uncertainty	L
Summary	Risk	H
	Uncertainty	L

Table 47: Transfer of *Tropilaelaps* to a suitable host

Risk factor	Colonies and swarms of *Apis* spp.
Ease of pest detection at arrival	Detection of colonies and swarms is reported (personal communication, 21 November 2012, Mike Brown, National Bee Unit, UK) but it is less likely that brood combs will be found in the consignment. Bees could be checked for pest presence but a negative result does not mean that their brood is negative.
Risk	H
Uncertainty	L
Flow of consignment after arrival	Honey bees go out foraging and come into contact with other honey bees. Only observational data in other bee species and other mites are available; honey bee colonies contain brood combs on which mites could be present (see Appendix E).
Risk	H
Uncertainty	H
Summary Risk	H
Uncertainty	H

2. Pathway: 'Non-bee import'

Table 48: Overview of bee products and comments on their inclusion/exclusion from the risk assessment

Bee-collected pollen	*Tropilaelaps* does not survive on bee-collected pollen. Therefore, bee-collected pollen is not included in the risk assessment.
Honey	It is unlikely that *Tropilaelaps* would survive in extracted or filtered honey; only unprocessed honey comb is included in the risk assessment.
Royal jelly	Royal jelly is in most cases processed and frozen before transport, making it unlikely that *Tropilaelaps* will survive in it; only fresh royal jelly is considered.
Propolis	*Tropilaelaps* is not attracted to pure or processed propolis, which are, therefore, safe and not considered in the risk assessment. Only propolis with beeswax is included in the risk assessment.
Beeswax	It is unlikely that *Tropilaelaps* can survive in melted beeswax; only beeswax in the form of combs is included in the risk assessment.
Brood	Bee brood might be imported as food source but the amounts are negligible at present. Only brood combs are included in the risk assessment.
Bee bread	Not considered as it is not imported at present.
Semen	*Tropilaelaps* cannot survive in semen. Therefore, semen is not included in the risk assessment.
Venom	*Tropilaelaps* cannot survive in venom. Therefore, venom is not included in the risk assessment.
Beekeeping equipment	'New' beekeeping equipment is not included in the risk assessment because the probability of infestation is negligible. Only 'used' beekeeping equipment is included in the risk assessment.

Table 49: Association of *Tropilaelaps* with the pathway at origin

Risk factor	**Bee products**	**Beekeeping equipment**
Products that are considered	Brood comb, unprocessed honey comb, fresh royal jelly, comb beeswax and propolis with beeswax were considered in the risk assessment (see Table 48).	Used beekeeping equipment was considered in the risk assessment (see Table 48).
Dangerous life stages of the pest at origin	Honey bee brood comb: all life stages (see Section 2.2.5). All other honey bee products (e.g., honey comb, propolis with beeswax, fresh royal jelly): only adult mite—*Tropilaelaps* reproduces only in sealed brood combs but adults have limited mobility and therefore can also be found on honey bee products other than brood comb.	Adult mites, in both the phoretic and non-phoretic stage, can enter the consignment attached to honey bees or through movement of the pest itself. Limited data are available on the possibility that adult mites in a non-phoretic stage could enter the consignment (see Section 2.2.5).
Risk	H	M
Uncertainty	L	M
Level of infestation	High in honey bee brood comb: the percentage of infested brood comb cells can reach levels of more than 50 % and up to 14 mites per cell have been described (see Appendix E). Low in other products, certainly after about eight days in the absence of honey bee brood (see Section 2.2.5).	The rate of infestation increases with increase in availability of honey bee brood (see Appendix E).
Risk	H	M
Uncertainty	L	M
Amount of bees or products imported into the risk assessment area	Import of bee products and bee equipment is reported (see Figure 11, Appendix F) and trade volumes of honey bee products are higher than those of used honey bee equipment.	
Risk	H	M
Uncertainty	L	L
Summary Risk	H	M
Uncertainty	L	M

Table 50: Survival of *Tropilaelaps* during transport

Risk factor	Bee products	Beekeeping equipment
Vulnerability of life stage(s)	All *Tropilaelaps* life stages will die in about eight days in the absence of honey bee brood. Adult mites may survive up 50 days in the presence of honey bee brood combs. Honey bee brood combs with a large number of adult mites could be present in the consignment (see Section 2.2.5 and Appendix E)	The number of adult mites increases with increased availability of honey bee brood (see Appendix E).
Risk	H	M
Uncertainty	L	L
Conditions during transport	No specific conditions are applied that reduce *Tropilaelaps* infestation since the risk assessment did not take into account risk reduction options that could be applied to eradicate *Tropilaelaps* (see Section 2.3). The pest could survive up to 50 days in honey bee brood comb (see Section 2.2.5).	No specific conditions are applied that reduce *Tropilaelaps* infestation since the risk assessment did not take into account risk reduction options that could be applied to eradicate *Tropilaelaps* (see Section 2.3). The mite will die in conditions with an unfavourable relative humidity (60 % is optimal) but may survive longer at lower temperatures (Woyke, 1984; Rinderer et al., 1994).
Risk	H	L
Uncertainty	L	L
Ease of pest detection during transport	Detection and identification of *Tropilaelaps* life stages is very unlikely by untrained persons (see Section 2.2.6).	
Risk	H	H
Uncertainty	L	L
Possibility of escape	There is a low risk owing to immobility of *Tropilaelaps* life stages. Only mature mites in the phoretic life stage are considered to be at risk for escape (see Appendix E).	
Risk	L	L
Uncertainty	L	L
Summary Risk	M	L
Uncertainty	L	L

Table 51: Transfer of *Tropilaelaps* to a suitable host

Risk factor	Bee products	Beekeeping equipment
Ease of pest detection at arrival	In the case of a high infestation level, clinical signs are visible (e.g., the colour and structure of brood will be changed) and easy to detect. In the case of low infestation, there are no clinical signs and destruction of the consignment is necessary to rule out infestation. Low infestation is more likely to occur in a consignment than high infestation (see Section 2.2.6 and Appendix E).	Even if intensive inspection takes place, there is still the possibility that adult mites will not be detected since they are very small and difficult to see with the naked eye (see Section 2.2.6).
Risk	H	H
Uncertainty	L	L
Flow of consignment after arrival	Honey bees emerging from brood combs are attracted to new colonies and could distribute adult mites to a beehive (see Section 2.2.5); no clear data are available.	There is a low risk owing to the immobility of *Tropilaelaps* life stages. Only mature mites can move to any great extent during their phoretic life stage (see Appendix E).
Risk	H	L
Uncertainty	H	L
Summary Risk	H	M
Uncertainty	H	L

3. Pathway 'natural means and flight

Table 52: Association of *Tropilaelaps* with the pathway at origin

Risk factor	**Dispersal of *Tropilaelaps* by flying bees**
Species that are considered	*Tropilaelaps* spp. (see Section 2.2.1); *Apis mellifera* (see Section 2.2.4)
Dangerous life stages of the pest at origin	Only adult mites, and only during the phoretic stage, which accounts for only a small part of the total life cycle, can be present in the consignment. Other pest life stages can be excluded since they lack the protective environment of honey bee brood. Data are lacking on pest presence on flying honey bees (see Section 2.2.5 and Appendix E)
Risk	L
Uncertainty	M
Level of infestation	By definition, *Tropilaelaps* is present.
Risk	H
Uncertainty	L
Number of bees or amount of products imported into the risk assessment area	*Tropilaelaps* is not reported in countries neighbouring the risk assessment area at present (see Section 2.2.3).
Risk	L
Uncertainty	M
Summary Risk	L
Uncertainty	M

Table 53: Transfer of *Tropilaelaps* to a suitable host

Risk factor		**Dispersal of *Tropilaelaps* by flying bees**
Ease of pest detection at arrival		There is a low probability that swarms entering the risk assessment area by wind or natural flight will be detected. The probability that these swarms will be checked for SHB is negligible.
	Risk	H
	Uncertainty	L
Flow of consignment after arrival		Honey bees go out foraging and can come in contact with other honey bees. Only observational data in other bee species and other mites are available (see Appendix E)
	Risk	M
	Uncertainty	H
Summary	Risk	H
	Uncertainty	H

Appendix I: Risk reduction options for SHB and *Tropilaelaps*

1. Reduce the infestation in third countries

1.1. Monitor the pest status

This risk reduction option means the implementation of a passive monitoring system. An example is the compulsory notification and the relevant legislative framework for SHB throughout the whole territory of the third country. A practical example is given below:

For SHB and *Tropilaelaps*

- Both infestations are compulsory notifiable in the EU (Council Directive 62/65/EEC[30]).

[30] OJ L 268, 14.9.1992, p. 54.

Table 54: Evaluation of the risk reduction option 'monitor the pest status' in third countries for SHB. H: high; M: moderate; L: low; N: negligible; NA: not applicable

Risk pathway			Effectiveness	Technical feasibility	Uncertainty on scoring	Comment
Intentional bee import	Queens	*A. mellifera*	L	H	L	This risk reduction option is applied in many countries but its effectiveness is influenced by variation in coverage, number of farmers reporting/submitting data and the number of countries reporting data to the international community.
		Bombus spp.				
	Swarms and colonies	*A. mellifera*				
		Bombus spp.				
Accidental bee import	Swarms and colonies	*Apis* spp.	NA	NA	NA	In this pathway, bees are a contaminant of the consignment. This risk reduction option is not applicable to consignments and therefore cannot be applied to this pathway.
Bee products			L	H	L	This risk reduction option is applied in many countries but its effectiveness is influenced by variation in coverage, number of beekeepers reporting/submitting data and the number of countries reporting data to the international community.
Beekeeping equipment						
Non-bee products						
Soil						

Table 55: Evaluation of the risk reduction option 'monitor the pest status' in third countries for *Tropilaelaps*. H: high; M: moderate; L: low; N: negligible; NA: not applicable

Risk pathway			Effectiveness	Technical feasibility	Uncertainty on scoring	Comment
Intentional bee import	Queens	*A. mellifera*	L	H	L	This risk reduction option is applied in many countries but its effectiveness is influenced by variation in coverage, number of beekeepers reporting/submitting data and the number of countries reporting data to the international community.
	Swarms					
	Colonies					
Accidental bee import	Swarms and colonies	*Apis* spp.	NA	NA	NA	In this pathway, bees are a contaminant of the consignment. This risk reduction option is not applicable to consignments and therefore cannot be applied to this pathway.
Bee products			L	H	L	This risk reduction option is applied in many countries but its effectiveness is influenced by variation in coverage, number of beekeepers reporting/submitting data and the number of countries reporting data to the international community.
Beekeeping equipment						

1.2. Prevent, control or reduce infestation by the pest

This risk reduction option means that best practices and/or active monitoring programmes without certification (e.g., private initiative) are performed to ensure that the pest is absent. Some practical examples are given below:

For SHB

- Maintain good hygiene around the apiary and honey house. Key to SHB prevention is the ability to extract the honey within two to three days (Somerville, 2003; Draft review on the importation of queen honey bees, February 2012, Australian Government[31]).
- Keep colonies strong (specifically, maintain a high honey bee to comb ratio)—beekeepers avoid weak colonies (Draft review on the importation of queen honey bees, February 2012, Australian Government[32]).
- Use in-hive traps for early detection and treatment (Draft review on the importation of queen honey bees, February 2012, Australian Government[32]; Torto et al., 2010b; de Guzman et al., 2011; Arbogast et al., 2012).
- Modify the hive entrance to prevent entry of SHB into a beehive (Ellis et al., 2002b); however, this may cause problems with overheating (personal communication, 21 November 2012, Jeff Pettis, USDA, US).

For *Tropilaelaps*

- A simple field diagnostic test that simply bumps mites from brood combs for identification can be used (Jeff Pettis, unpublished data).

For SHB and *Tropilaelaps*

- All signs suggestive of SHB or *Tropilaelaps* infestation should be subjected to field and laboratory investigations (OIE Terrestrial Manual 2011[32,33])
- Avoid the use of contaminated equipment (Draft review on the importation of queen honey bees, February 2012, Australian Government[32]).
- Keep records of bee movements (BeeBase record: see FERA National Bee Unit[34]).
- Process bee products: propolis should be processed so that it is free of pollen, honey and wax, pollen can be imported in capsules and beeswax should be processed into blocks or foundation so that all honey and pollen is removed (Import risk analysis, 2002, New Zealand[35]).
- Clothing, smokers, artificial insemination equipment, honey extractors should be washed so they are free of honey and wax (Import risk analysis, 2002, New Zealand[36]).

[31] http://www.daff.gov.au/__data/assets/pdf_file/0010/2132776/2012-04_Draft_policy_review_queen_honey_bees_120227.pdf
[32] http://www.oie.int/fileadmin/Home/eng/Health_standards/tahm/2.02.05_SMALL_HIVE_BEETLE.pdf
[33] http://www.oie.int/fileadmin/Home/eng/Health_standards/tahm/2.02.06_TROPILAELAPS.pdf
[34] FERA best practices; http://www.fera.defra.gov.uk/healthybeesplan
[35] http://www.biosecurity.govt.nz/files/regs/imports/risk/ira-honey-products-and-equip.pdf

Table 56: Evaluation of the risk reduction option 'prevent, control or reduce infestation by the pest' in third countries for SHB. H: high; M: moderate; L: low; N: negligible; NA: not applicable

Risk pathway			Effectiveness	Technical feasibility	Uncertainty on scoring	Comment
Intentional bee import	Queens	*A. mellifera*	NA	NA	NA	For bees in third countries, this option is applicable only at the colony level.
		Bombus spp.				
	Swarms and colonies	*A. mellifera*	L	M	H	Detection systems rely mainly on training individuals to carry out visual inspection. Even with trained staff, there is the possibility of missing infestation. No data are available on how the risk reduction option is applied.
		Bombus spp.	H	H	L	This scoring is valid for bumble bees coming from a closed, controlled veterinary system. Otherwise, no measures are applied and consequently the risks are high.
Accidental bee import	Swarms and colonies	*Apis* spp.	NA	NA	NA	In this pathway, bees are a contaminant of the consignment. This risk reduction option is not applicable to consignments and therefore cannot be applied to this pathway.
Bee products			M	M	H	Extracting honey as soon as possible or measures for beeswax reduce but cannot eradicate the pest. They are not applied systematically at present and expert opinion varies on the effectiveness of this risk reduction option.
Beekeeping equipment			H	L	L	When this risk reduction option is applied, it minimises the risk of entry.
Non-bee products			NA	NA	NA	SHB can be present inside fruit.
Soil			NA	NA	NA	There are treatments that can be applied in front of the beehive but they cannot be applied in larger areas.

Table 57: Evaluation of the risk reduction option 'prevent, control or reduce infestation by the pest' in third countries for *Tropilaelaps*. H: high; M: moderate; L: low; N: negligible; NA: not applicable

Risk pathway			**Effectiveness**	**Technical feasibility**	**Uncertainty on scoring**	**Comment**
Intentional bee import	Queens	*A. mellifera*	NA	NA	NA	Applicable only at the level of colonies in third countries.
	Swarms		M	M	H	Even with trained persons, there is a possibility of missing infestation. The system relies on training individuals to carry out visual inspection. There are no data on how the risk reduction option is applied in practice.
	Colonies		L	M	H	
Accidental bee import	Swarms and colonies	*Apis* spp.	NA	NA	NA	In this pathway, bees are a contaminant of the consignment. This risk reduction option is not applicable to consignments and therefore cannot be applied to this pathway.
		Bee products	NA	NA	NA	Brood has a high risk for *Tropilaelaps* infestation and can be controlled only at the colony level.
		Beekeeping equipment	H	H	L	Several preventative methods can be applied.

1.3. Guarantee pest freedom/conduct surveillance programmes

This risk reduction option means that a surveillance programme is in place and a certificate is provided by an authority in case of a negative result for pest presence. An official pest-free status is given for a country or zone. Some practical examples are given below:

For SHB

- Country or zone free from SHB (text fragment from OIE Terrestrial Animal Health Code chapter 9.4 SHB[36]):
    1. Historically free status. A country or zone may be considered free from the pest after conducting a risk assessment but without formally applying a specific surveillance programme if the country or zone complies with the provisions of the OIE Chapter 1.4.
    2. Free status as a result of an eradication programme. A country or zone which does not meet the conditions of point 1 above may be considered free from SHB infestation after conducting a risk assessment when:
        a) The Veterinary Authority or other Competent Authority with responsibility for reporting and control of diseases of honey bees has current knowledge of, and authority over, all domesticated apiaries existing in the country or zone.
        b) *A. tumida* infestation is notifiable in the whole country or zone, and any clinical cases suggestive of SHB infestation are subjected to field and laboratory investigations; a contingency plan is in place describing controls and inspection activities.
        c) For the five years following the last reported case of SHB infestation, an annual survey supervised by the Veterinary Authority, with negative results, has been carried out on a representative sample of apiaries in the country or zone to provide a confidence level of at least 95 % of detecting SHB infestation if at least 1 % of the apiaries were infested at a within-apiary prevalence rate of at least 5 % of the hives; such surveys may be targeted towards areas with a higher likelihood of infestation.
        d) To maintain free status, an annual survey supervised by the Veterinary Authority, with negative results, is carried out on a representative sample of apiaries to indicate that there have been no new cases; such surveys may be targeted towards areas with a higher likelihood of infestation.
        e) All equipment associated with previously infested apiaries has been destroyed, or cleaned and sterilised to ensure the destruction of *A. tumida* spp.
        f) The soil and undergrowth in the immediate vicinity of all infested apiaries has been treated with a soil drench or similar suitable treatment that is efficacious in destroying incubating SHB larvae and pupae.
        g) The importation of the commodities listed in this chapter into the country or zone is carried out, in conformity with the recommendations of this chapter.

For *Tropilaelaps*

- Country or zone/compartment (under study) free from *Tropilaelaps* spp. (text fragment from OIE Terrestrial Animal Health Code, Chapter 9.5[37]):
    1. Historically free status. A country or zone/compartment (under study) may be considered free from the disease after conducting a risk assessment as referred to in Article 9.5.3. but without formally applying a specific surveillance programme if the country or zone/compartment (under study) complies with the provisions of Chapter 1.4.
    2. Free status as a result of an eradication programme. A country or zone/compartment (under study) which does not meet the conditions of point 1 above may be considered free from *Tropilaelaps* infestation after conducting a risk assessment as referred to in Article 9.5.3 and when:

[36] http://www.oie.int/fileadmin/Home/eng/Health_standards/tahc/2010/chapitre_1.9.4.pdf
[37] http://www.oie.int/fileadmin/Home/eng/Health_standards/tahc/2010/chapitre_1.9.5.pdf

a) The Veterinary Authority or other Competent Authority with responsibility for reporting and control of diseases of honey bees has current knowledge of, and authority over, all domesticated apiaries existing in the country or zone/compartment (under study).
b) *Tropilaelaps* infestation is notifiable in the whole country or zone/compartment (under study), and any clinical cases suggestive of *Tropilaelaps* infestation are subjected to field and laboratory investigations.
c) For the three years following the last reported case of *Tropilaelaps* infestation, an annual survey supervised by the Veterinary Authority, with negative results, have been carried out on a representative sample of apiaries in the country or zone/compartment (under study) to provide a confidence level of at least 95 % of detecting *Tropilaelaps* infestation if at least 1 % of the apiaries were infected at a within- apiary prevalence rate of at least 5 % of the hives; such surveys may be targeted towards areas with a higher likelihood of infestation.
d To maintain free status, an annual survey supervised by the Veterinary Authority, with negative results, is carried out on a representative sample of apiaries in the country or zone/compartment (under study) to indicate that there has been no new cases; such surveys may be targeted towards areas with a higher likelihood of disease.
e) (Under study) There is no self-sustaining feral population of *A. mellifera*, *A. dorsata* or *A. laboriosa*, or other possible host species in the country or zone/compartment (under study).
f) The importation of the commodities listed in this chapter into the country or zone/compartment (under study) is carried out, in conformity with the recommendations of this chapter.

For SHB and *Tropilaelaps*

- In each country, official health control of bee diseases should include (text fragment from OIE Terrestrial Animal Health Code, Chapter 4.14[38]):
  a) an organisation for permanent health surveillance;
  b) approval of breeding apiaries for export trade;
  c) measures for cleaning, disinfection and disinfestation of apicultural equipment;
  d) rules precisely stating the requirements for issuing an international veterinary certificate.
- Organisation for permanent official sanitary surveillance of apiaries (text fragment from OIE Terrestrial Animal Health Code, Chapter 4.14[39]):
- Permanent official sanitary surveillance of apiaries should be under the authority of the Veterinary Authority and should be performed either by representatives of this Authority or by representatives of an approved organisation, with the possible assistance of beekeepers specially trained to qualify as 'health inspectors and advisers'. The official surveillance service thus established should be entrusted with the following tasks:
  1. Visit apiaries:
     a) annual visits during the most appropriate periods for the detection of diseases;
     b) unexpected visits to apiaries where breeding or transport operations are carried out for trade or transfer to other regions, or any other purpose whereby diseases could be spread, as well as to apiaries located in the vicinity;
     c) special visits for sanitary surveillance to sectors where breeding apiaries have been approved for export purposes.
  2. Collect the samples required for the diagnosis of contagious diseases and dispatch them to an official laboratory; the results of laboratory examinations must be communicated with the shortest delay to the Veterinary Authority;
  3. Apply hygiene measures, comprising, in particular, treatment of colonies of bees, as well as disinfection of the equipment and possibly the destruction of affected or suspect colonies and of the contaminated equipment so as to ensure rapid eradication of any outbreak of a contagious disease.

[38] http://www.oie.int/fileadmin/Home/eng/Health_standards/tahc/2010/chapitre_1.4.14.pdf

Table 58: Evaluation of the risk reduction option 'guarantee pest freedom/conduct surveillance programmes' in third countries for SHB. H: high; M: moderate; L: low; N: negligible; NA: not applicable

Risk pathway			Effectiveness	Technical feasibility	Uncertainty on scoring	Comment
Intentional bee import	Queens	*A. mellifera*	H	H	L	When this risk reduction option is applied, it minimises the risk of SHB entry. However, the effectiveness of this risk reduction option is influenced by variation in awareness of bee pests and the available diagnostic capacity.
		Bombus spp.				
	Swarms and colonies	*A. mellifera*				
		Bombus spp.				
Accidental bee import	Swarms and colonies	*Apis* spp.	NA	NA	NA	In this pathway, bees are a contaminant of the consignment. This risk reduction option is not applicable to consignments and therefore cannot be applied to this pathway.
Bee products			H	H	L	When this risk reduction option is applied, it minimises the risk of SHB entry. However, the effectiveness of this risk reduction option is influenced by variation in awareness of bee pests and the available diagnostic capacity.
Beekeeping equipment						
Non-bee products						
Soil						

Table 59: Evaluation of the risk reduction option 'guarantee pest freedom/conduct surveillance programmes' in third countries for *Tropilaelaps*. H: high; M: moderate; L: low; N: negligible; NA: not applicable

Risk pathway			Effectiveness	Technical feasibility	Uncertainty on scoring	Comment
Intentional bee import	Queens	*A. mellifera*	H	H	L	When the risk reduction option is applied, it minimises the risk of *Tropilaelaps* entry. However, the effectiveness of this risk reduction option is influenced by variation in awareness of bee pests and the available diagnostic capacity.
	Swarms					
	Colonies					
Accidental bee import	Swarms and colonies	*Apis* spp.	NA	NA	NA	In this pathway, bees are a contaminant of the consignment. This risk reduction option is not applicable to consignments and therefore cannot be applied to this pathway.
Bee products			H	H	L	When the risk reduction option is applied, it minimises the risk of *Tropilaelaps* entry. However, the effectiveness of this risk reduction option is influenced by variation in awareness of bee pests and the available diagnostic capacity.
Beekeeping equipment						

1.4. Apply any treatment to eradicate the pest

This risk reduction option means the application of a chemical, biological, physical or possible alternative treatment to eradicate SHB or *Tropilaelaps*. Some practical examples are given below:

For SHB

- Chemical treatments: e.g., acaricides, organophosphates, organic acids (Schäfer et al., 2009; Buchholz et al., 2011), bleach and fumigants (Elzen et al., 2002; Park et al., 2002; Hood, 2004; Levot and Haque, 2006a, b; Ellis and Delaplane, 2007; Cuthbertson et al., 2010). These could be used, for instance, in honey houses or in soil to kill the pupal stage (Hood, 2004; Levot and Haque, 2006a, b), but they are less effective in apiaries.
- Biological treatments: not able to eradicate the pest.
- Physical treatments: e.g., irradiation, freezing, heating.

For *Tropilaelaps*

- Chemical treatment: chemicals used to control *Varroa* (e.g., fluvalinate or formic acid) will kill *Tropilaelaps* (e.g., Sharma et al., 1994, 1996, 2003).
- Biological treatment: e.g., keep bees, bee products, non-bee products and beekeeping equipment without brood for 21 days. The current OIE Terrestrial Code specifies seven days, but it is likely that this will be changed to 21 days in the future, based on the possibility of longer survival periods at lower temperatures and including a safety margin (personal communication, 21 November 2012, Wolfgang Ritter, CVUA-Freiburg, Germany, Jeff Pettis, USDA, US).
- Physical treatment: e.g., irradiation, freezing, heating.

For SHB and *Tropilaelaps*

- Conditions for sanitation and disinfection of apicultural equipment (text fragment from OIE Terrestrial Animal Health Code, Chapter 4.14[39]):
- Veterinary Authorities of exporting countries are requested to regulate the use of products and means for sanitation and disinfection of apicultural equipment in their own country, taking into account the following recommendations.
    1. Any apicultural equipment kept in an establishment which has been recognised as being affected with a contagious disease of bees shall be subjected to sanitary measures ensuring the elimination of pathogens.
    2. In all cases, these measures comprise the initial cleaning and scraping of the equipment, followed by sanitation or disinfection depending on the disease concerned.
    3. The kind of equipment (e.g., hives, small hives, combs, extractor, small equipment, appliances for handling or storage) shall also be taken into account in the choice of procedures to be applied.
    4. Infected or contaminated equipment which cannot be subjected to the above-mentioned measures must be destroyed, preferably by burning. Any equipment in bad condition, especially hives, as well as larvae in combs affected with varroosis, American foulbrood or European foulbrood, must be destroyed by burning.
    5. The products and means used for sanitation and disinfection shall be recognised as being effective by the Veterinary Authority. They shall be used in such a manner as to exclude any risk of contaminating the equipment which could eventually affect the health of bees or adulterate the products of the hive.
    6. When these procedures are not performed, the products shall be kept away from the bees and any contact with apicultural equipment and products must be prevented.
    7. Waste water from the cleaning, sanitation and disinfection of apicultural equipment shall be kept away from the bees at all times and disposed of in a sewer or in an unused well.

Table 60: Evaluation of the risk reduction option 'Apply any treatment to eradicate the pest' in third countries for SHB. H: high; M: moderate; L: low; N: negligible; NA: not applicable

Risk pathway			**Effectiveness**	**Technical feasibility**	**Uncertainty on scoring**	**Comment**
Intentional bee import	Queens	*A. mellifera*	NA	NA	NA	Treatments would kill the bees.
		Bombus spp.				
	Swarms and colonies	*A. mellifera*				
		Bombus spp.				
Accidental bee import	Swarms and colonies	*Apis* spp.	NA	NA	NA	In this pathway, bees are a contaminant of the consignment. This risk reduction option is not applicable to consignments and therefore cannot be applied to this pathway.
Bee products			H	H	L	There are treatments available for bee products except for brood combs (treatment will destroy brood, e.g., queen cells). SHB larvae are very resistant to treatment (brood combs were not included in the scoring here).
Beekeeping equipment			H	H	L	Treatments will kill all living organisms.
Non-bee products			M	N	H	Some treatments are applicable (e.g., fumigation), whereas other treatments are not applicable since they will damage ripe fruit (e.g., heating, freezing). There are no data available.
Soil			H	H	L	Treatment will kill all living organisms.

Table 61: Evaluation of the risk reduction option 'apply any treatment to eradicate the pest' in third countries for *Tropilaelaps*. H: high; M: moderate; L: low; N: negligible; NA: not applicable

Risk pathway			**Effectiveness**	**Technical feasibility**	**Uncertainty on scoring**	**Comment**
Intentional bee import	Queens	*A. mellifera*	H	H	L	Biological treatment is already systematically implemented.
	Swarms					
	Colonies					
Accidental bee import	Swarms and colonies	*Apis* spp.	NA	NA	NA	In this pathway, bees are a contaminant of the consignment. This risk reduction option is not applicable to consignments and therefore cannot be applied to this pathway.
Bee products			H	H	L	Biological treatment is already systematically implemented. Other treatments which will kill all living organisms, are also available.
Beekeeping equipment						

2. Reduce infestation of the consignment during transport

2.1. Isolate the bee or product to avoid exchange of the pest with the environment

This risk reduction option means the application of any measure to prevent escape of the pest from the consignment or from transport material after arrival at the final destination to prevent contact with the environment. However, no relevant measure could be identified for *Tropilaelaps*. Some practical examples are given below:

For SHB

- The consignment of honey bees is covered with fine mesh through which a live SHB cannot enter (OIE Terrestrial Animal Health Code, Chapter 1.9.4, SHB[37]).
- Isolation of bees to be shipped by holding them within an insect-proof building will minimise the risk of SHB getting into queen shipments (personal communication, 21 November 2012, Jeff Pettis, USDA, US).
- Veterinary certificate requirements for consignments of queens (*A. mellifera* and *Bombus* spp.) (text fragment from Commission Regulation (EU) No 206/2010[39]; the only element mentioned that is relevant to SHB and this specific risk reduction option):

- The packaging material, queen cages, accompanying products and food are new and have not been in contact with diseased bees or brood combs, and all precautions have been taken to prevent contamination with agents causing diseases or infections of bees.

[39] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:073:0001:0121:EN:PDF

Table 62: Evaluation of the risk reduction option 'isolate the bee or product to avoid exchange of the pest with the environment' during transport for SHB. H: high; M: moderate; L: low; N: negligible; NA: not applicable

Risk pathway			Effectiveness	Technical feasibility	Uncertainty on scoring	Comment
Intentional bee import	Queens	*A. mellifera*	H	H	L	This risk reduction option is already applied. The choice of the material (mesh) is important.
		Bombus spp.				
	Swarms and colonies	*A. mellifera*	L	L	H	It is more difficult to reduce the size of ventilation holes for transport of colonies without causing problems of bee survival.
		Bombus spp.				
Accidental bee import	Swarms and colonies	*Apis* spp.	NA	NA	NA	It is not known how this option could be applied to this pathway.
Bee products			H	N	L	Although this risk reduction option would have a high effectiveness, it is very unlikely that these types of consignments could be made insect-proof.
Beekeeping equipment						
Non-bee products						
Soil						

2.2. Control pest freedom of bee or product

This risk reduction option means that a consignment is controlled for SHB or *Tropilaelaps* presence and that a positive consignment will not be shipped or will be destroyed. Some practical examples are given below:

For SHB

- The *A. tumida* status of a country or zone can only be determined after considering the following criteria (text fragment from OIE Terrestrial Animal Health Code, Chapter 1.9.4, SHB[37]):
  1. *A. tumida* infestation should be notifiable in the whole country, and all signs suggestive of *A. tumida* infestation should be subjected to field and laboratory investigations.
  2. On-going awareness and training programmes should be in place to encourage reporting of all cases suggestive of *A. tumida* infestation.
  3. The Veterinary Authority or other Competent Authority with responsibility for reporting and control of diseases of honey bees should have current knowledge of, and authority over, all domesticated apiaries in the country.
- When authorising import or transit of the following commodities (text fragment from OIE Terrestrial Animal Health Code, Chapter 1.9.4, SHB[37]), Veterinary Authorities should not require any SHB infestation-related conditions, regardless of the *A. tumida* status of the honey bee and bumble bee population of the exporting country or zone:
  1. honey bee semen and honey bee venom;
  2. packaged extracted honey, refined or rendered beeswax, propolis and frozen or dried royal jelly. When authorising import or transit of other commodities listed in this chapter, Veterinary Authorities should require the conditions prescribed in this chapter relevant to the *A. tumida* status of the honey bee and bumble bee population of the exporting country or zone.
- Recommendations for the importation of eggs, larvae and pupae of honey bees or bumble bees (text fragment from OIE Terrestrial Animal Health Code, Chapter 1.9.4, SHB[37]): Veterinary Authorities of importing countries should require the presentation of an international veterinary certificate attesting that:
  1. the products were sourced from a country or zone free from *A. tumida* infestation; or
  2. the products have been bred and kept under a controlled environment within a recognised establishment which is supervised and controlled by the Veterinary Authority;
  3. the establishment was inspected immediately prior to dispatch and all eggs, larvae and pupae show no clinical signs or suspicion of the presence of *A. tumida* or its eggs or larvae or pupae; and
  4. the packaging material, containers, accompanying products and food are new and all precautions have been taken to prevent contamination with *A. tumida* or its eggs, larvae or pupae.
- Recommendations for the importation of used equipment associated with beekeeping (text fragment from OIE Terrestrial Animal Health Code, Chapter 1.9.4, SHB[37]): Veterinary Authorities of importing countries should require the presentation of an international veterinary certificate attesting that:
  1. the equipment: either
     a) comes from a country or zone free from *A. tumida* infestation; and
     b) contains no live honey bees or bee brood; or
     c) contains no live honey bees or bee brood; and
     d) has been thoroughly cleaned, and treated to ensure the destruction of *A. tumida* spp.; and
  2. all precautions have been taken to prevent infestation/contamination.
- Recommendations for the importation of honey -bee collected pollen and beeswax (in the form of honeycomb) (text fragment from OIE Terrestrial Animal Health Code, Chapter 1.9.4, SHB[37]): Veterinary Authorities of importing countries should require the presentation of an international veterinary certificate attesting that:
  1. the products: either
     a) comes from a country or zone free from *A. tumida* infestation; and

   b) contains no live honey bees or bee brood; or
   c) contains no live honey bees or bee brood; and
   d) has been thoroughly cleaned, and treated to ensure the destruction of *A. tumida* spp.; and
2. all precautions have been taken to prevent infestation/contamination.

- Recommendations for the importation of comb honey (text fragment from OIE Terrestrial Animal Health Code, Chapter 1.9.4, SHB[37]): Veterinary Authorities of importing countries should require the presentation of an international veterinary certificate attesting that the products:
  1. come from a country or zone free from *A. tumida* infestation; and
  2. contain no live honey bees or bee brood; or
  3. were subjected to a treatment at a temperature of –12 °C or lower in the core of the product for at least 24 hours.
- Recommendations for the importation of live worker bees, drone bees or bee colonies with or without associated brood combs or for live bumble bees (text fragment from OIE Terrestrial Animal Health Code, Chapter 1.9.4, SHB[37]): Veterinary Authorities of importing countries should require the presentation of an international veterinary certificate attesting that:
  1. the bees come from a country or zone officially free from *A. tumida* infestation; and
  2. the bees and accompanying packaging presented for export have been inspected and do not contain *A. tumida* or its eggs, larvae or pupae; and
  3. the consignment of bees is covered with fine mesh through which a live beetle cannot enter.

For *Tropilaelaps*

- Determination of the *Tropilaelaps* status of a country or zone/compartment (text fragment from OIE Terrestrial Animal Health Code, Chapter 1.9.5[38]):
- The *Tropilaelaps* status of a country or zone/compartment (under study) can only be determined after considering the following criteria:
  1. a risk assessment has been conducted, identifying all potential factors for *Tropilaelaps* occurrence and their historic perspective;
  2. *Tropilaelaps* infestation should be notifiable in the whole country or zone/compartment (under study) and all clinical signs suggestive of *Tropilaelaps* infestation should be subjected to field and laboratory investigations;
  3. an on-going awareness programme should be in place to encourage reporting of all cases suggestive of *Tropilaelaps* infestation;
  4. the Veterinary Authority or other Competent Authority with responsibility for reporting and control of diseases of honey bees should have current knowledge of, and authority over, all domesticated apiaries in the country.
- Recommendations for the importation of live queen honey bees, worker bees and drones with associated brood combs (text fragment from OIE Terrestrial Animal Health Code, Chapter 1.9.5[38]): Veterinary Authorities of importing countries should require the presentation of an international veterinary certificate attesting that the bees come from a country zone/compartment (under study) officially free from *Tropilaelaps* infestation.
- Recommendations for the importation of live queen honey bees, worker bees and drones without associated brood combs (text fragment from OIE Terrestrial Animal Health Code, Chapter 1.9.5[38]): Veterinary Authorities should require the presentation of an international veterinary certificate attesting that the bees have been held in isolation from brood and bees with access to brood, for a period of at least seven days, but it is likely that this will be changed to 21 days in the future based on the possibility of longer survival periods at lower temperatures and including a safety margin (personal communication, 21 November 2012, Wolfgang Ritter, CVUA-Freiburg, Germany, Jeff Pettis, USDA, US).
- Recommendations for the importation of used equipment associated with beekeeping (text fragment from OIE Terrestrial Animal Health Code, Chapter 1.9.5[38]): Veterinary Authorities of importing countries should require the presentation of an international veterinary certificate attesting that the equipment:
  1. comes from a country or zone/compartment (under study) free from *Tropilaelaps* infestation; or

2. contains no live honey bees or bee brood and has been held away from contact with live honey bees for at least 7 days prior to shipment; or
3. has been treated to ensure the destruction of *Tropilaelaps* spp.

- Recommendations for the importation of honey-bee collected pollen, beeswax (in the form of honeycomb), comb honey and propolis (text fragment from OIE Terrestrial Animal Health Code, Chapter 1.9.5[38]): Veterinary Authorities of importing countries should require the presentation of an international veterinary certificate attesting that the products:
  1. come from a country or zone/compartment (under study) free from *Tropilaelaps* infestation; or
  2. contain no live honey bees or bee brood and has been held away from contact with live honey bees for at least seven days prior to shipment; or
  3. have been treated to ensure the destruction of *Tropilaelaps* spp.

For SHB and *Tropilaelaps*

- Allow import into the EU only from third countries where the presence of SHB is subject to compulsory notification throughout the whole territory of the third country or territory concerned (text fragment from Commission Regulation (EU) No 206/2010[40]).
- Consignments of bees shall consist of either (1) cages of queen bees (*Apis mellifera* and *Bombus* spp.) each containing one single queen bee with a maximum of 20 accompanying attendants or (2) containers of bumble bees (*Bombus* spp.) each containing a colony of a maximum of 200 adult bumble bees (text fragment from Commission Regulation (EU) No 206/2010).
- Bees are from hives or come from hives or colonies_(in the case of bumble bees), which were inspected immediately prior to dispatch and show no clinical signs or suspicion of disease including infestations affecting bees (text fragment from Commission Regulation (EU) No 206/2010[40]).
- Detailed examinations took place to ensure that all bees and packaging do not contain the SHB or their eggs and larvae or *Tropilaelaps* (text fragment from Commission Regulation (EU) No 206/2010[40]).
- Requirement of an appropriate health certificate drawn up in accordance with the relevant model veterinary certificate and completed and signed by an official inspector of the exporting third country (text fragment from Commission Regulation (EU) No 206/2010).
- Veterinary certificate requirements for consignments of queens_(*A. mellifera* and *Bombus* spp.) (the only elements mentioned that are relevant to SHB) (text fragment from Commission Regulation (EU) No 206/2010[40]):
  – they come from a territory in which American foulbrood, and SHB are notifiable diseases/pests;
  – they come from a breeding apiary which is supervised and controlled by the Competent Authority;
  – they come from an area of radius at least 100 km which is not subject to any restrictions associated with the occurrence of SHB, and where these infestations are absent;
  – they are from hives or come from hives or colonies (in the case of bumble bees) which were inspected immediately prior to dispatch and show no clinical signs or suspicion of disease including infestations affecting bees;
  – they have undergone detailed examinations to ensure that all bees and packaging do not contain SHB or their eggs and larvae;
  – the packaging material, queen cages, accompanying products and food are new and have not been in contact with diseased bees or brood combs, and all precautions have been taken to prevent contamination with agents causing diseases or infections of bees.
- Veterinary certificate requirements for consignments of colonies of bumble bees (*Bombus* spp.) (text fragment from Commission Regulation (EU) No 206/2010[40]; the only elements mentioned that are relevant to SHB or *Tropilaelaps*):
  – The bumble bees have been bred and kept under a controlled environment with a recognised establishment which is supervised and controlled by the competent authority.

   – The establishment was inspected immediately prior to dispatch and all bumble bees and breeding stock show no clinical sign or suspicion of disease including infestation affecting bees.
   – All colonies for import into the EU have undergone detailed examination to ensure that all bumble bees, brood stock and packaging do not contain SHB or its eggs and larvae or *Tropilaelaps*.
   – The packaging material, queen cages, accompanying products and food are new and have not been in contact with diseased bees or brood combs, and all precautions have been taken to prevent contamination with agents causing diseases or infections of bees.
- Apiculture by-products intended exclusively for use in apiculture must (text fragment from Commission Regulation (EU) No 142/2011[40]; the only elements mentioned that are relevant to SHB or *Tropilaelaps*):
   1. not come from an area which is subject of a prohibition order associated with an occurrence of small hive beetle (Aethina tumida) or *Tropilaelaps*; and
   2. be accompanied by a health certificate.
- Import of apicultural by-products (text fragment from Commission Regulation (EU) No 142/2011[41]):
   a) In the case of apiculture by-products intended for use in apiculture, other than beeswax in the form of honeycomb:
      i) the apiculture by-products have been subjected to a temperature of –12 °C or lower for at least 24 hours; or
      ii) in the case of beeswax, the material has been processed and refined before importation.
   b) In the case of beeswax, other than beeswax in the form of honeycomb, for purposes other than feeding to farmed animals, the beeswax has been refined or processed before importation.
- Certificates for import of apicultural by-products (text fragment from Commission Regulation (EU) No 142/2011[41]):
   a) in the case of apiculture by-products intended for use in apiculture;
   b) in the case of beeswax for purposes other than feeding to farmed animals: a commercial document attesting the refinement or processing.
- Conditions for approval of breeding apiaries for export trade (text fragment from OIE Terrestrial Animal Health Code, Chapter 4.1439):
   The apiaries must:
   1. be situated in the centre of an area defined as follows and in which:
      a) no case of varroosis has been reported for at least the past two years within a radius of 50 kilometres;
      b) no case of any other contagious disease of bees included in this Terrestrial Code has been reported for at least the past eight months within a radius of five kilometres;
   2. have received, for at least the past two years, visits by a health inspector and adviser, carried out at least three times a year (in spring, during the breeding period and in autumn), for the systematic examination of the hives containing bees and of all the apicultural equipment, and for the collection of samples to be sent to an official laboratory.

   Bee-keepers must:
   1. immediately notify the Veterinary Authority of any suspicion of a contagious disease of bees in the breeding apiary and in other apiaries in the vicinity;
   2. not introduce into the apiary any bee (including larval stages) or apicultural material or product originating from another apiary unless health control has been previously performed by the Veterinary Authority;
   3. apply special breeding and despatch techniques to ensure protection against any outside contamination, especially for the breeding and sending of queen bees and accompanying bees and to enable retesting in the importing country;
   4. collect, at least every 10 days during the breeding and despatch period, samples from breeding material, brood combs, queen bees and bees (including possibly separately raised accompanying bees), to be sent to an official laboratory.

[40] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2011:054:0001:0254:EN:PDF

Table 63: Evaluation of the risk reduction option 'control pest freedom of bee or product' during transport for SHB. H: high; M: moderate; L: low; N: negligible; NA: not applicable

Risk pathway			**Effectiveness**	**Technical feasibility**	**Uncertainty on scoring**	**Comment**
Intentional bee import	Queens	*A. mellifera*	H	H	L	When this risk reduction option is applied, it minimises the probability of entry. However, the effectiveness of this risk reduction option is influenced by variation in awareness of bee pests and the available diagnostic capacity.
		Bombus spp.				
	Swarms and colonies	*A. mellifera*	H	M	H	Swarms and colonies may be imported only from pest-free countries (see Section 2.3). This risk reduction option has high effectiveness. Implementation of this risk reduction option would further reduce the risk of pest entry via this pathway. However, the effectiveness of this risk reduction option is influenced by variation in awareness of bee pests and the available diagnostic capacity. There is a high uncertainty on technical feasibility due to illegal trade.
		Bombus spp.				
Accidental bee import	Swarms and colonies	*Apis* spp.	NA	NA	NA	It is not known how this option could be applied to this pathway.
Bee products			H	H	L	When this risk reduction option is applied, it minimises the probability of entry. However, the effectiveness of this risk reduction option is influenced by variation in awareness of bee pests and the available diagnostic capacity.
Beekeeping equipment						
Non-bee products			NA	NA	NA	The technical feasibility of the option is negligible since SHB can be inside ripe fruit. This means that fruit has to be destroyed to rule out infestation. This risk reduction option will never be applied to this risk pathway.
Soil						It is not possible to control SHB presence in the soil of potted plants or plants for planting.

Table 64: Evaluation of the risk reduction option 'control pest freedom of bee or product' during transport for *Tropilaelaps*. H: high; M: moderate; L: low; N: negligible; NA: not applicable

Risk pathway			Effectiveness	Technical feasibility	Uncertainty on scoring	Comment
Intentional bee import	Queens	*A. mellifera*	H	H	L	When this risk reduction option is applied, it minimises the probability of entry (e.g., veterinary certificate). However, the effectiveness of this risk reduction option is influenced by variation in awareness of bee pests and the available diagnostic capacity.
	Swarms Colonies		H	M	H	Swarms and colonies may be imported only from pest-free countries (see Section 2.3). This risk reduction option has high effectiveness. Implementation of this risk reduction would further reduce the risk of pest entry via this pathway. However, the effectiveness of this risk reduction option is influenced by variation in awareness of bee pests and the available diagnostic capacity. There is a high uncertainty on technical feasibility because of illegal trade.
Accidental bee import	Swarms and colonies	*Apis* spp.	NA	NA	NA	It is not known how this option could be applied to this pathway.
Bee products Beekeeping equipment			H	H	L	When this risk reduction option is applied, it minimises the probability of entry (e.g., veterinary certificate). However, the effectiveness of this risk reduction option is influenced by variation in awareness of bee pests and the available diagnostic capacity.

2.3. Apply any treatment to eradicate infestation during transport

This risk reduction option means the application of a chemical, biological, physical or other treatment to eradicate SHB. Some practical examples are described in Section 1.4 of Appendix I.

Table 65: Evaluation of the risk reduction option 'apply any treatment to eradicate infestation during transport' for SHB. H: high; M: moderate; L: low; N: negligible; NA: not applicable

Risk pathway			Effectiveness	Technical feasibility	Uncertainty on scoring	Comment
Intentional bee import	Queens	*A. mellifera*	NA	NA	NA	Treatments would kill the bees.
		Bombus spp.				
	Swarms and colonies	*A. mellifera*				
		Bombus spp.				
Accidental bee import	Swarms and colonies	*Apis* spp.				Swarms could enter any type of consignment. In some cases this option could be applied (e.g., fumigation), whereas in other situations it will not be possible to apply it (e.g., shipment of new cars).
Bee products			H	H	L	SHB larvae are very resistant to treatment and, although there are treatments available for bee products, there are none for brood combs (treatment would destroy the brood, e.g., queen cells). Therefore, brood combs where not included in the scoring here.
Beekeeping equipment			H	H	L	Treatments will kill all living organisms.
Non-bee products			NA	NA	NA	The technical feasibility of the option is negligible since SHB can be inside ripe fruit. This means that fruit has to be destroyed to rule out infestation. This risk reduction option will never be applied to this risk pathway.
Soil			H	H	L	Treatments will kill all living organisms.

Table 66: Evaluation of the risk reduction option 'apply any treatment to eradicate infestation during transport' for *Tropilaelaps*. H: high; M: moderate; L: low; N: negligible; NA: not applicable

Risk pathway			**Effectiveness**	**Technical feasibility**	**Uncertainty on scoring**	**Comment**
Intentional bee import	Queens Swarms Colonies	*A. mellifera*	H	H	L	Biological treatments are already implemented systematically.
Accidental bee import	Swarms and colonies	*Apis* spp.	NA	NA	NA	Biological and/or other treatments can be applied only in some cases.
Bee products Beekeeping equipment			H	H	L	Biological treatments are already implemented systematically; other treatments will kill all living organisms. There are no treatments for brood combs (treatment would destroy the brood, e.g., queen cells). Therefore, brood combs where not included in the scoring here.

2.4. Hold bee or product under quarantine to guarantee pest freedom

This risk reduction option means that the consignment is placed under quarantine. Some references where quarantine procedures are provided:

For SHB

- Maintaining SHB under quarantine laboratory conditions (Cuthbertson et al., 2008).

For SHB and *Tropilaelaps*

- Draft review on the importation of queen honey bees, February 2012, Australian Government.[32]
- USDA-ARS Honey Bee Quarantine Station (Harris et al., 2002).

Table 67: Evaluation of the risk reduction option 'hold bee or product under quarantine to guarantee pest freedom' during transport for SHB. H: high; M: moderate; L: low; N: negligible; NA: not applicable

Risk pathway			**Effectiveness**	**Technical feasibility**	**Uncertainty on scoring**	**Comment**
Intentional bee import	Queens	*A. mellifera*	H	N	L	Difficult to implement on a large scale, except for research purposes.
		Bombus spp.				
	Swarms and colonies	*A. mellifera*				
		Bombus spp.				
Accidental bee import	Swarms and colonies	*Apis* spp.	NA	NA	NA	It will never be possible to apply this option to any type of consignment.
Bee products			NA	NA	NA	Bee products are fresh products that will be damaged or even destroyed under quarantine (e.g., brood combs).
Beekeeping equipment			H	L	L	This option has a high effectiveness but there are practical issues in applying it systematically.
Non-bee products			NA	NA	NA	Ripe fruits are fresh products that will be damaged or even destroyed by the quarantine procedure.
Soil						This risk reduction option cannot be applied to any type of potted plant or plant for potting without causing damage to the product.

Table 68: Evaluation of the risk reduction option 'hold bee or product under quarantine to guarantee pest freedom' at the border for *Tropilaelaps*. H: high; M: moderate; L: low; N: negligible; NA: not applicable

Risk pathway			**Effectiveness**	**Technical feasibility**	**Uncertainty on scoring**	**Comment**
Intentional bee import	Queens	*A. mellifera*	H	N	L	Difficult to implement on a large scale, except for research purposes.
	Swarms					
	Colonies					
Accidental bee import	Swarms and colonies	*Apis* spp.	NA	NA	NA	It will never be possible to apply this option to any type of consignment.
Bee products			NA	NA	NA	Cannot be applied to brood comb without destroying it.
Beekeeping equipment			H	H	L	This could be done by preventing contact between the consignment and honey bee brood and/or for a minimum of 21 days.

3. Reduce the infestation of the consignment at the border

3.1. Control pest freedom on bee or product

This risk reduction option means that a consignment is controlled for SHB presence and that a positive consignment will be destroyed. Some practical examples are given below:

For SHB
- Methods for SHB identification are described in the OIE Terrestrial Manual.[33]

For *Tropilaelaps*
- Methods for *Tropilaelaps* identification are described in the OIE Terrestrial Manual.[34]

For SHB and *Tropilaelaps*
- In the case of bees and apiculture by-products, the competent authority may authorise the disposal by burning or burial on site, as referred to in Article 19(1)(f) of Regulation (EC) No 1069/2009, provided that all necessary measures are taken to ensure that the burning or burial does not endanger animal or human health or the environment (text fragment from Commission Regulation (EU) No 142/2011[41]).
- Screening of existing or sentinel hives at high-risk locations (e.g., near harbours and airports, queen-rearing operations) (APHIS bee survey, USA[41])

[41] http://www.aphis.usda.gov/plant_health/plant_pest_info/honey_bees/downloads/SurveyProjectPlan.pdf

Table 69: Evaluation of the risk reduction option 'Control pest freedom of bee or product' at the border for SHB. H: high; M: moderate; L: low, N: negligible; NA: not applicable

Risk pathway			Effectiveness	Technical feasibility	Uncertainty on scoring	Comment
Intentional bee import	Queens	*A. mellifera*	M	M	L	Methods are available but have technical problems (detection is difficult, even with well-trained staff). However, the effectiveness of this risk reduction option is influenced by variation in awareness of bee pests and the available diagnostic capacity.
		Bombus spp.				
	Swarms and colonies	*A. mellifera*	NA	NA	NA	There are no reliable and easily applicable methods available to check SHB infestation in *A. mellifera* colonies. No imports are currently permitted according to the actual legislation (see Section 2.3).
		Bombus spp.				There are no methods available to check SHB infestation in colonies. Colonies of bumble bees are produced in a confined, closed system. The only way in which a bumble bee colony consignment can become infested is by entry of SHB during transport, but this is prevented by proper packaging.
Accidental bee import	Swarms and colonies	*Apis* spp.				It is not possible to check any consignment for the presence of SHB.
Bee products			M	M	L	Methods are available but have technical problems (detection is difficult, even with well-trained staff). However, the effectiveness of this risk reduction option is influenced by variation in awareness of bee pests and the available diagnostic capacity.
Beekeeping equipment						
Non-bee products						
Soil						Methods are available but have technical problems (detection is difficult, even with well-trained staff). Only SHB adults which emerged during transport will be detected by visual inspection.

Table 70: Evaluation of the risk reduction option ‘control pest freedom on bee or product’ at the border for *Tropilaelaps*. H: high; M: moderate; L: low; N: negligible; NA: not applicable

Risk pathway			Effectiveness	Technical feasibility	Uncertainty on scoring	Comment
Intentional bee import	Queens	*A. mellifera*	M	M	L	Methods are available but have technical problems (detection is difficult, even with well-trained staff). However, the effectiveness of this risk reduction option is influenced by variation in awareness of bee pests and the available diagnostic capacity.
	Swarms		NA	NA	NA	Import of swarms and colonies is not permitted under current legislation (see Section 2.3).
	Colonies					
Accidental bee import	Swarms and colonies	*Apis* spp.				It is not possible to check any consignment for the presence of *Tropilaelaps*.
Bee products						This option cannot be applied without destroying the consignment (e.g., bee brood).
Beekeeping equipment			M	M	L	Methods are available but have technical problems (detection is difficult, even with well-trained staff). However, the effectiveness of this risk reduction option is influenced by variation in awareness of bee pests and the available diagnostic capacity.

3.2. Apply any treatment to eradicate infestation at the border

This risk reduction option means the application of a chemical, biological, physical or other treatment to eradicate SHB. Some practical examples are described in Section 1.4 of Appendix I.

Table 71: Evaluation of the risk reduction option 'apply any treatment to eradicate infestation at the border' for SHB. H: high; M: moderate; L: low; N: negligible; NA: not applicable

Risk pathway			**Effectiveness**	**Technical feasibility**	**Uncertainty on scoring**	**Comment**
Intentional bee import	Queens	*A. mellifera*	NA	NA	NA	Treatments would kill the bees.
		Bombus spp.				
	Swarms and colonies	*A. mellifera*				
		Bombus spp.				
Accidental bee import	Swarms and colonies	*Apis* spp.	M	M	L	Once a swarm is detected, the bees and pest could be destroyed although some survivors cannot be excluded.
		Bee products	H	H	L	There are treatments available for bee products except for brood combs (treatment will destroy brood, e.g., queen cells). SHB larvae are very resistant to treatment (brood combs were not included in the scoring here).
		Beekeeping equipment				Treatments will kill all living organisms.
		Non-bee products	NA	NA	NA	The technical feasibility of the option is negligible since SHB can be inside ripe fruit. This means that fruit has to be destroyed to rule out infestation.
		Soil	H	H	L	Treatment will kill all living organisms.

Table 72: Evaluation of the risk reduction option 'apply any treatment to eradicate infestation at the border' for *Tropilaelaps*. H: high; M: moderate; L: low; N: negligible;d NA: not applicable

Risk pathway			**Effectiveness**	**Technical feasibility**	**Uncertainty on scoring**	**Comment**
Intentional bee import	Queens	*A. mellifera*	H	H	L	Biological treatment is already implemented systematically.
	Swarms					
	Colonies					
Accidental bee import	Swarms and colonies	*Apis* spp.	NA	NA	NA	Not possible to check any consignment for presence of brood combs.
		Bee products	H	H	L	Biological treatments are already implemented systematically. Other treatments, which will kill all living organisms, are also available.
		Beekeeping equipment				

3.3. Reduce illegal import

This risk reduction option means the implication of any action to reduce illegal import. Scoring of effectiveness, technical feasibility and uncertainty was not possible. Some practical examples are given below:

For SHB and *Tropilaelaps*

- increase awareness on pest (beekeepers and Veterinary Services);
- reinforce implementation of measures already in place.

GLOSSARY

Absconding	Abandoning the beehive because of exposure to stress
Accidental bee import	Unintended import of bees (e.g., bees present in a consignment of cars)
Apicultural by-products	Honey, beeswax, royal jelly, propolis or pollen not intended for human consumption
Apply any treatment to eradicate the pest	This risk reduction option means the application of a chemical, biological, physical or other treatment to eradicate the pest
Association of the pest with the pathway at origin	First step in the risk assessment, considering the life stages of the pest in the consignment, the level of infestation of the consignment and the number of bees or amount products imported
Attendants	Worker bees that have been added to a queen cage to care for and feed the queen during shipment
(honey) comb	The mass of hexagonal cells of wax built by honey bees in which they rear eggs, larvae and pupae and store honey and pollen
Apiary	A beehive or group of beehives whose management allows them to be considered as a single epidemiological unit
Bee bread	The pollen of flowers gathered by the bees, mixed with honey, microflora and enzymes, and deposited in the comb
Beehive	A structure for the keeping of honey bee colonies that is being used for that purpose, including frameless hives, fixed frame hives and all designs of moveable frame hives (including nucleus hives), but not including packages or cages used to confine bees for the purpose of transport or isolation
Bee product	The import of these products for use in an apiary was taken into account since this represents the scenario with the highest risk
Bees	*A. mellifera* and *Bombus* spp.
Beeswax	The wax secreted by honey bees from eight glands within the ventral abdominal segments and used in building their combs.
Border inspection post	Any airport, port, railway station or road checkpoint open to international trade of commodities, where import veterinary inspections can be performed
Brood	Young developing bees in the egg, larval and pupal state, not yet emerged from their cells
Brood comb	One of the combs in the brood chamber
Bumble bees	Bees of the genus *Bombus*.
Cage	Cage, box or container used to ship bees
Closed, contained system	Bee-proof system (greenhouses and tunnels are considered open systems)
Colony	A community of bees having a queen, some thousands of workers on combs; for part of the year may contain drones and brood
Comb honey	Honey in the comb, not extracted
Commodity	Live animals, products of animal origin, animal genetic material, biological products or pathological material
Consignment	A unit of regulated products being moved from one place to another
Containment	The application of measures in and around an infested area to prevent spread of a pest
Control pest freedom of bee or product	This risk reduction option means that a consignment is controlled for pest presence and that a positive consignment will not be transported or will be destroyed
Documentary check	The examination of the veterinary certificate(s) or veterinary document(s) or other document(s) accompanying a consignment
Effectiveness	The level to which the risk is reduced by the risk reduction option

Entry (of a pest)	Movement of a pest into an area where it is not yet present, or present but not widespread
Extracted honey	Honey that has been removed from the comb by an extractor
Forage	Natural food source of bees (nectar and pollen) from wild and cultivated flowers
Fresh royal jelly	Royal jelly that is unprocessed and not frozen
Guarantee pest freedom/conduct surveillance programmes	This risk reduction option means that an active surveillance programme is in place and a certificate is provided by an authority in the case of a negative result for pest presence.
Hibernating state	An inactive or dormant state or period
Hold bee or product under quarantine to guarantee pest freedom	This risk reduction option means that the consignment is placed under quarantine
Honey bees	All bees of the genus *Apis*
Honey house	A building used for honey extraction, storage, etc.
Identity check	A check by visual inspection to ensure that the veterinary certificate(s) or veterinary document(s) or other document(s) provided for by veterinary legislation tally with the product itself
Infestation	The external invasion or colonisation of animals or their immediate surroundings by arthropods, which may cause disease or are potential vectors of infectious agents
Intended bee import	Voluntary import of bees, both legal and illegal
Introduction (of a pest)	Entry of a pest resulting in its establishment
Isolate the bee or product of the consignment to avoid exchange of the pest with the environment	This risk reduction option means the application of any measure to prevent escape of the pest from the consignment or from transport material after arrival at the final destination
Kairomone	A substance released by one species, here honey bees, and detected by another to release a certain behaviour, in this case either finding behaviour in SHB or detection of ready to be capped brood in *Tropilaelaps* mites. Thus, detrimental to the bees and favourable to the pests, when present.
Likely risk reduction option	Risk reduction option with a high score for effectiveness (H), a high score for technical feasibility (H) and a low score for uncertainty (L)
Lot	Unit of control associated with shipment of a consignment
Monitoring the pest status	This risk reduction option means the implementation of a passive monitoring system.
Non-restrictive risk assessment	Risk assessment in which no risk reduction options are taken into account
Oviposition	Act of laying eggs by means of an ovipositor
Package bees	From two to five pounds of adult bees, with or without a queen and usually with a can of sugar syrup, contained in a ventilated shipping case
Parasite	An organism that lives on another organism (its host) and benefits by deriving nutrients at the host's expense
Pest	Any unwanted and destructive insect or other animal that attacks food or crops or livestock
Phoretic stage	Non-reproduction phase of mite attached to adult honey bee
Physical check	A check on the product itself, which may include checks on packaging and temperature and also sampling and laboratory testing
Pollen	Dust-sized grains formed in the anthers of flowering plants within which are produced the male elements or sperm. The protein food essential to bees for raising brood

Prevent, control or reduce infestation by the pest	This risk reduction option means that best practices and/or active monitoring programmes without certification (e.g., private initiative) are performed to ensure that the pest is absent
Propolis	A kind of glue, derived mostly from plant resins collected by the bees and used chiefly to close up cracks and anchor hive plants
Pure propolis	Unprocessed propolis free of beeswax and collected from the beehive
Quarantine	Isolation to prevent spread of a pest
Rendering beeswax	The process of melting combs and cappings to separate the beeswax from its impurities, usually done by means of hot water, steam, a solar beeswax extractor or other equipment
Risk reduction option	Mitigation measure
Royal jelly	A milky white, finely granular substance secreted from the pharyngeal glands of nurse bees, used to feed developing larvae and the queen
Sealed brood	Brood that has been capped or sealed in the brood cells by the bees with a somewhat porous capping, mostly in the pupa stage
Survival during transport	Second step in the risk assessment, considering the vulnerability of the pest, the conditions during transport, pest detection during transport and the possibility of pest escape
Swarm	The aggregate of worker bees, drones and queen that leave the mother colony to establish a new colony or formed by the beekeeper (artificial). Neither the natural nor the artificial swarm (package bees) contains combs and brood
Technical feasibility	The availability of technology and knowledge exists necessary for practical application of risk reduction option proposed
Transfer to suitable host	Third step in the risk assessment, considering pest detection at arrival and the flow of the consignment after arrival
Transport	A two-phase process of moving a consignment. The first stage starts with the preparation of the consignment and ends with arrival of the consignment at the border inspection post of the risk assessment area. Here, a check of the consignment takes place and a decision is made regarding approval to enter the risk assessment area. After approval, a second transport phase takes place to bring the consignment to its final destination
Intentional bee import	Any legal and illegal bee import, except accidental bee import
Wandering larvae	Crawling larvae seeking soil to pupate

ABBREVIATIONS

HHL	High score for effectiveness (H), high score for technical feasibility (H) and a low score for uncertainty (L)
OIE	World Organisation for Animal Health
SHB	Small hive beetle
TRACES	Trade Control and Expert System
TOR	Term of reference