GENERAL INTRODUCTORY TEXT PROVIDING BACKGROUND INFORMATION FOR THE CHAPTERS OF THE *TERRESTRIAL ANIMAL HEALTH CODE* ON DISEASES OF BEES

I. Introduction

Veterinarians usually deal with different vertebrate species, species that do not differ greatly amongst themselves in their bodily functions but that do differ hugely from insects in their anatomy and morphology. Although the individual honey bee exhibits all essential bodily functions, it is unable to survive alone. It is one among thousands of individuals within a highly complex society: the bee colony. Depending on the season, a bee colony consists of 10,000 to 50,000 infertile worker bees, one sexually mature female (the queen) and, in spring and summer, some additional male reproductive (the drones). As honey bees can only exist as a colony, from the biological and veterinary–medical point of view, the colony as a whole is regarded as the animal and the apiary (i.e. a group of beehives each containing a colony) as a single epidemiological unit.

In nature, bees construct their nests in hollow tree trunks and in other hollow spaces. The combs fixed on the roof of the cavity hang vertically, more or less in parallel. The number and shape of the combs is limited by the strength of the colony, as well as by the size of the cavity. The combs contain brood and provisions, with the brood placed at the centre and pollen and honey at the periphery. This same comb arrangement is maintained in beehives used by beekeepers, with the bees building their combs in movable wooden frames. This facilitates inspection of the brood nest and honey harvesting without damaging the comb construction.

All over the world, beekeeping is an integral part of agriculture. It is practised either as a main activity or as a secondary part-time activity. Beekeeping is often practised on a small scale and represents a traditional way of animal husbandry in most cultures. The size of a beekeeping enterprise run by a full-time farmer depends essentially on the socio-economic situation in the country concerned. In some countries, 20 bee colonies may be sufficient to earn a living for one family, whereas in other countries, one enterprise may comprise more than 2000 colonies. In beekeeping, land ownership is virtually unnecessary, and beekeeping can be practised in both cultivated landscapes and in natural habitats. Beekeeping practices can either be stationary, or migratory, where the beekeeper moves colonies of bees in pursuit of honey flows or for the commercial pollination of crops.

With migratory beekeeping, disease management of honey bee populations is nearly impossible without regular disease reporting and the participation of beekeepers themselves in this management. Honey bees are typically kept in an environment where wild honey bee populations can also be present. In regions with large wild honey bee populations such as Africa, Asia, Central and South America, there is a more or less permanent exchange and contact between managed and wild populations. This severely complicates and often prevents the implementation of veterinary–medical measures such as disease control and surveillance programmes. Even without wild bees, it is very difficult to avoid the spread of diseases. Bee colonies have a flight radius of at least 3 kilometres. Moreover, bee colonies multiply by swarming when one part of the colony leaves the old nest to look for a new dwelling. Depending on availability of the food and the density of the bee population, distances of many kilometres can be covered. Swarms can also settle down in transportable repositories, such as containers, and in this way, bees can reach other regions by truck or train, and by ship they can even reach other continents.

The diagnosis and control of honey bee diseases at the colony level is quite difficult. More than with other animals, the possibilities and the methods applied for clinical observation and diagnosis depend on seasonal conditions. This is aggravated in regions with reduced rearing of brood at certain times of the year, normally in winter, leading to a reduction or interruption in the production of bee products. Both the prevalence of pathogens and potential control strategies depend on this seasonal cycle. When considering treatment with medication and the application of chemical disinfection methods, it is imperative to ensure that bee products, such as honey, wax and pollen, will not be contaminated.

Honey bees are important pollinators of wild and cultivated plants. The agronomic, environmental and economic value of this service rendered by the bees is many times greater than the value of the bee products produced, and is a critical ecosystem service. Furthermore, world demand for honey bee pollinated crops is increasing more rapidly than is the population of honey bees, putting increasing demands on existing honey bee populations, and resulting in an increase in migratory beekeeping, further aggravating the control of bee diseases. Additionally,

traditional honey bee diseases are increasingly being found to be only one factor in multi-factorial syndromes affecting honey bee health, with honey bee nutrition, pesticide use and environmental change being among the other factors.

II. Bee species and bee diseases considered in the *Terrestrial Animal Health Code*

There are approximately 17,000 named species of bees in the world, with an estimated 30,000 species existing in total. These include the social bees *Apis* (honey bees), *Bombus* (bumble bees) and *Meliponini* (stingless bees) as well as other solitary or communal-dwelling bees. In the genus *Apis* there are five recognised species of cavity-nesting bees with medium-sized workers (*A. mellifera, A. cerana, A. nigrocincta, A. koschevnikovi* and *A. nuluensis*), two species of dwarf bees (*A. florea* and *A. andreniformis*) and at least two species of giant bees (*A. dorsata* and *A. laboriosa*). The dwarf and giant honey bee species live on single-comb open nests, rather than in cavities.

Colonies of *A. mellifera, A. cerana*, various *Bombus* species, many Meliponines and some communal nesting species (*Osmia* spp) are managed for the commercial pollination of crops, and for the production of hive products. The same hive products are sometimes also harvested from unmanaged colonies of other bee species.

The OIE *Terrestrial Animal Health Code* (*Terrestrial Code*) primarily considers pests and diseases of *A. mellifera* and to a lesser extent those of *A. cerana, A. dorsata, Bombus spp*. and others as they may serve as reservoirs or may contain new and emerging pests. Pathogens and pests of *A. mellifera* can affect other bee species; an example is the small hive beetle invading both bumble bees and stingless bee nests. A major pest of *A. mellifera, Varroa spp.*, is a good example of host-shift as it moved from *A. cerana* to become a major health issue with *A. mellifera*.

The **Western honeybee** (***A. mellifera***) is native to the continents of Europe and Africa and is the largest of the cavity-nesting honey bees. It is found in almost every country in the world. There are 24 races of *A. mellifera.* At least two subspecies of *A. mellifera* are of concern to managed beekeeping. The African bee, *A.m. scutellata*, was accidentally introduced into South America and is known for its aggressive defensive behaviour. The Cape bee, *A.m. capensis*, is a potential threat to other races of *A. mellifera* in a commercial beekeeping context, as a social parasite of these races.

Honey bees are susceptible to diseases caused by parasites, fungi, bacteria and viruses. Honey bee colonies may also be affected by various pests, predators and adverse environmental factors (including human activity). As many honey bee diseases have only a limited health and economic impact on bee species used in beekeeping and for commercial pollination, at the present, the *Terrestrial Code* only considers six pests and diseases of bees.

American foulbrood and European foulbrood are caused by bacterial agents and are considered of major importance because they can be spread through many bee products including honey, which is internationally widely traded.

Varroosis is caused by mites of the *Varroa spp.* in combination with viruses transmitted by these mites. The disease is distributed virtually worldwide and has a great economic impact worldwide through both colony losses and loss of honey production in *A. mellifera.*

Acarapisosis is also caused by a mite (*Acarapis woodi*) and, although it is not at present described as a disease of high incidence in major bee-producing countries, it may have a significant impact on the health of infested adult honey bees.

Tropilaelaps spp. infestation is caused by different mite species. This parasite is still confined to regions of Asia, but the honey bee trade could favour its spread to other continents.

Aethina tumida is a beetle that directly affects the colony environment by consuming pollen and bee brood, and indirectly interferes with apiculture production. From its place of origin, Sub-Saharan Africa, it was introduced into other continents, due probably to the movement of live honey bees or of products, such as soil, plants and fruits.

It is important to provide OIE Member Countries with consistent science-based recommendations relating to the exchange of live honey bees, their genetic material and bee products so that they can preserve bee health in their territories. The chapters in the *Terrestrial Code* provide such information.

Importantly, the Veterinary Services and other key players in the beekeeping sector in each country should be involved and support the implementation of measures and activities related to the health of honey bees (see in particular Chapter 4.14. of the *Terrestrial Code*). This requires an appropriate regulatory framework, based on scientific principles, to be adapted by each Member Country according to its particular characteristics for disease control and secure exchange of bees, their genetic material and bee products.

III. Commodities related to bees and international trade

The risk of transmission of pathogens to honey bees through the international trade of bee products can be reduced if their future use is restricted to humans and not to bee culture.

For the importation of bee products (as described below), specific requirements are detailed in chapters 9.1. to 9.6. of the *Terrestrial Code*.

For the purpose of the *Terrestrial Code*, the following commodities are considered:

A. BEE PRODUCTS

Bee products (obtained from apiculture or otherwise harvested) that can be traded are the following: honey, bee-collected pollen, propolis, beeswax, royal jelly and honey bee venom.

Honey:

For the purpose of the *Terrestrial Code*, honey is the natural sweet substance produced by honey bees from the nectar of plants or from secretions of living parts of plants or excretions of plant–sucking insects on the living parts of plants, which the bees collect, transform by combining with specific substances of their own, deposit, dehydrate, store and leave in the honey comb to ripen and mature (*Definition from the Codex Alimentarius, Revised Codex Standard for Honey, CODEX STAN 12-1981, Rev.1 [1987], Rev.2 [2001]*). Three forms of honey can be found in the *Terrestrial Code* chapters: extracted honey, comb honey and strained honey.

Extracted honey: any honey removed from the comb.

Comb honey: honey kept inside the comb.

Strained honey: extracted honey that has at a minimum passed through a filter of pore size not greater than 0.42 mm diameter (35 mesh standard, see Townsend G.F. (1975) Processing and storing liquid honey. In **Honey - a comprehensive survey**, ed. E Crane, Heinemann, London, pp. 269-292).

When the term honey is used, it refers to all the three forms.

Honey is traded mainly for human consumption. It may also be used externally (wound healing) and be further processed into a multitude of products. Honey can be traded to feed honey bee colonies.

Bee-collected pollen:

Pollen consists of the male reproductive cells of flowering plants. Bees use nectar or honey and salivary secretions to agglutinate and preserve pollen grains. For the purpose of the *Terrestrial Code*, bee-collected pollen is the pollen dislodged from the pollen basket of foraging honey bees and collected in a pollen trap or removed from the cells of honey bee or stingless bee colonies (bee bread).

Pollen is traded mainly for human consumption, but may also be used for animal consumption (including bee consumption).

Propolis:

For the purpose of the *Terrestrial Code*, propolis is a sticky material used by bees to seal gaps, encapsulate foreign objects and disinfect hive materials. It is derived from resins collected from plants and consists of a mixture of terpenes and other volatile substances. Two forms are found in the *Terrestrial Code* chapters: processed propolis and unprocessed propolis. Processed propolis is either alcohol extracted (tincture) or powdered.

Beeswax:

For the purpose of the *Terrestrial Code*, beeswax is a complex mixture of lipids and hydrocarbons that is produced by the wax glands of honey bees. Two forms are found in the *Terrestrial Code* chapters: processed and unprocessed beeswax. Processed beeswax is beeswax produced by heating the raw wax to at least 60°C and then allowing it to solidify. Unprocessed beeswax is any wax coming from bees that has not followed the process described above. When the term beeswax is used, it refers to both forms.

Royal jelly:

For the purpose of the *Terrestrial Code*, royal jelly is a glandular secretion of honey bee worker that is placed in queen cells to feed queen-destined larvae. It is harvested and preserved by freezing or lyophilisation. Royal jelly is traded mainly for use in the cosmetic industry and in the human health food market.

Honey bee venom:

For the purpose of the *Terrestrial Code*, bee venom is a complex mixture of proteins and low molecular components secreted by the venom glands of honey bees and used to defend the colony. It is collected by special collectors that are placed in or outside the hive, electrically stimulating the bees to sting through a membrane on a glass plate. Venom is used in the treatment of certain human medical conditions (apitherapy).

B. USED APICULTURAL EQUIPMENT

Used equipment is any item previously used in beekeeping activities that can be traded, for example bee-boxes and protective clothing. As pathogens may be carried on such equipment, it is necessary that it be cleaned and disinfected prior to importation. Specific treatment requirements are provided in chapters 9.1. to 9.6. of the *Terrestrial Code*.

C. LIVE BEES AND GENETIC MATERIAL

International trade in live bees and their genetic material includes at present *Apis mellifera*, as well as various species of *Bombus*, *Megachila* and *Osmia*. Additional bee species may be traded in the future. Trade in live honey bees takes many forms, including: queen bees with attendant workers in a queen cage, package bees (queen with workers), whole colonies including brood, queen banks (comprising several queens and many attendants), queen cells, worker bees, drones, larvae, pupae, eggs and semen.

Honey bee semen:

Honey bee semen is an organic fluid that contains spermatozoa. It is secreted by the sexual glands of drones (male honey bees). It is used for artificial insemination of honey bee queens only.

Honey bee eggs:

Eggs are laid by queen honey bees and may be used for breeding in apiculture.

Risks posed by such imports may be reduced by selecting low-risk commodities (e.g. semen poses the lowest risk), or by managing the risk before or after importation. For example, creating an artificial swarm by shaking all the live bees from a colony onto new combs without brood will minimise the risk of foulbrood, while queens with a small number of attendants pose a lower risk than whole colonies. Pre-export risk management may involve the treatment of the bees or sourcing the bees from a certified disease-free population. Inspection of bees prior to shipment or on arrival may allow the risk of mites to be managed, but this is not possible for package bees or whole colonies. Treatment of the bees with miticides during shipping is common. An advantage of queen cages is that the attendant workers can be killed and analysed for specific diseases, and be replaced by workers in the importing country at the same time as closely inspecting the queen.

Post-arrival quarantine requires specific facilities (e.g. a closed room, known as a flight room). Such facilities are expensive and are rarely available in importing countries.

For the importation of live bees (as described above), all the requirements are detailed in chapters 9.1. to 9.6. of the *Terrestrial Code*.