World Organisation for Animal Health
SUB-REGIONAL REPRESENTATION FOR SOUTHERN AFRICA
Gaborone • Botswana

DISEASES OF HONEYBEES

SUB REGIONAL TRAINING SEMINAR

Ezulwini, Swaziland
14 - 17 June 2011

Seminar funded by the OIE and the
European Union (European Commission)

WORLD ORGANISATION FOR ANIMAL HEALTH

REPORT

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"Diseases of honeybees"

14.06.2011 – 17.06.2011

Ezulwini ▼ Swaziland

OIE Sub-regional representation for Southern Africa

Gaborone ▲ Botswana

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AFB	American Foulbrood
AI	Avian Influenza
AIV	Apis Iridescent Virus
ARC	Agricultural Research Council (South Africa)
ARS	Agricultural Research Service (USA)
AU	African Union
ANSES	Bee Reference Laboratory (France)
BSE	Bovine Spongiform Encephalopathy
BTSF	Better Training for Safer Food (programme) [DG SANCO]
CBPV	Chronic Bee Paralysis Virus
CC	Collaborative Centre (OIE)
CCD	Colony Collapse Disorder
CVO	Chief Veterinary Officer
DAFF	Department of Agriculture Forestry and Fisheries [South Africa]
DNA	deoxyribonucleic acid
EC	European Commission
EFB	European Foulbrood
ELISA	enzyme-linked immunosorbent assay
EU	European Union
EU RL	European Union Reference Laboratory
FAO	Food and Agricultural Organization of the United Nations
FMD	Foot and Mouth Disease
FV	Filamentous Virus
GATT	General Agreement on Tariffs and Trade [WTO]
GMO	Genetically modified organism
HACCP	Hazard Analysis & Critical Control Points
IPM	Integrated Pest Management
NRL's	National Reference Laboratories
NGO	Non-Governmental Organisation
ISSB's	International Standard Setting Bodies
ISSO's	International Standards Setting Organization
OIE	World Organisation for Animal Health
OTC	oxytetracycline
OTCR	oxytetracycline resistant
PCR	polymerase chain reaction
PPRI	Plant Protection Research Institute (South Africa)
PVS	Performance of Veterinary Services
RL	Reference Laboratories (OIE)
RNA	ribonucleic acid
RR	Regional Representation [OIE]
RR-AF	RR for Africa
SABIO	South African Bee Industry Organization
SADC	Southern African Development Community
SAVC	South African Veterinary Council
SOP	Standard Operating Procedure(s)
SPS	[Agreement on the application of] Sanitary and Phytosanitary Measures [WTO]
SRR	Sub-Regional Representation [OIE]
SRR-SA	SRR for Southern Africa
TAHC	Terrestrial Animal Health Code (OIE)
TCP	Technical Cooperation Program
TcR	tetracycline resistant
UK	United Kingdom
USDA	United States Department of Agriculture
WAHID	World Animal Health Information Database [OIE]
WAHIS	World Animal Health Information System [OIE]
WTO	World Trade Organisation

The wording Member (of the OIE) refers to OIE Member Countries and Territories.
All weight units expressed in tonnes are metric tons.
All distance and surface area units are expressed in metric units (km and km²)

Edited by Patrick Bastiaensen, François Diaz, Mike Allsopp, Neo Mapitse & Bonaventure Mtei.

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PREFACE

Swaziland hosted participants from OIE Member countries of the SADC region and experts from OIE Reference Laboratories for a training seminar conducted from June 14 – 17 2011.

The meeting was graced by the Kingdom of Swaziland`s top Ministry of Agriculture officials including Hon Minister Clement Dlamini, Permanent Secretary, Dr Robert Thwala who is past President of OIE Regional Commission for Africa and currently a member of the OIE Working Group on Animal production food safety, and the Director of the Department of Agriculture responsible for Apiculture and the OIE Delegate for Swaziland Dr Roland Dlamini.

In his opening address, Dr Bonaventure Mtei, the Sub Regional Representative for southern Africa, reiterated the need for a closer networking relationship between animal health experts, biologists and entomologists ... a good way of putting the "One Health" concept into actual practice. He alluded to the fact that the OIE greatly values non-traditional partners like bee experts and others whose knowledge and skills contributes to the development of standards published in the OIE Codes and Manuals.

The main objective of the training workshop, which was organised with the financial support of the European Union programme Better Training for Safer Food (BTSF) in Africa, was to share information on diseases of honeybees, bridging the gap between the national OIE sanitary information focal points and honeybee biologists and entomologists in order to enhance reporting of honeybee health to the OIE.

Dr Saley Mahamadou and Dr Yacouba Samaké, recently appointed as President of the OIE Regional Commission for Africa and Regional Representative for Africa respectively, were invited to the seminar to acquaint themselves with key animal health stakeholders in the sub region. In their opening remarks, they highlighted the importance accorded to honeybee health by the OIE and thanked the Government of the Kingdom of Swaziland for agreeing to host the seminar and appreciated traditional Swaziland's hospitality.

In his official opening address, Hon Minister of Agriculture, Mr Clement Dlamini observed that "honey bees are wonderful creatures that contribute immeasurably to food security and therefore human existence and least to say honeybees are an integral part of biodiversity". The Minister's speech captured and put in perspective the messages the OIE has been sending out with respect to animal health, food security and biodiversity conservation in relation to benefits of pollinators including honeybees.

The seminar was structured such that it introduced the participants to beekeeping, to the biology of bees, to the OIE standards related to honey bees (included in the Terrestrial Animal Health Code and the Manual of Diagnostic Tests and Vaccines for Terrestrial Animals) and other relevant OIE tools, and to the OIE World Animal Health Information System (WAHIS) and the World Animal Health Information Database (WAHID).

This was followed by detailed presentations on the diseases of honeybees from experiences in some southern African countries and from the OIE reference laboratories. Private sector perspectives were highlighted by the Chairperson of the South African Bee-Industry Organisation (SABIO) complemented by valuable contributions from a representative from the Bees for Development organisation.

A panel discussion on whether available tools, standards and guidelines were appropriate for the honeybee health in the SADC region raised several issues. It was interesting to note that the African honeybee sub-species are fairly tolerant to some parasites such as Varroa mites and a number of other diseases because of their biological and behavioural characteristics. It was therefore recommended that southern African countries should discourage the importation of honeybees from other continents. Importation of these bees may introduce parasites and brood diseases such as American and European Foulbrood, viral diseases and protozoa such as Nosema.

The meeting was resolute that surveillance and monitoring of honeybee diseases should be initiated and/or strengthened accordingly in all the SADC Member States. Lack of diagnostic capacity on honeybee diseases was cited on many occasions and participants were keen for this gap to be closed, in particular through the OIE Twinning mechanism with the existing OIE Reference Laboratories in Argentina, Germany, and France.

The establishment of a network on apiculture in Southern Africa was discussed to encompass both private and public stakeholders to complement Honeybee Councils already established in some of the countries like South Africa, Swaziland and Zambia.

The participants benefitted from a field trip as part of the training in which the participants witnessed beekeeping in the field. Collaboration between extension officers and beekeepers was evident in areas such as in the development of training manuals and troubleshooting at production level.

A small group of participants visits the facilities of the ESK honey processing and packaging plant *Picture © Neo Mapitse (oie) 2011*

The visit to a honey processing and packaging plant confirmed in principle that a processing plant does not necessarily have to be large to implement quality management systems and does not need to cover a large number of producers. The plant visited was supplied with honey from a few producers and the processed products are marketed locally in the supermarkets.

The four days workshop was officially closed by the Under Secretary of the Ministry of Agriculture Mr. Sabelo Masuku who emphasized that the end of the workshop was only the beginning of a better networking and urged the participants to implement what they have learnt in Swaziland to improve the livelihoods of communities in their respective countries

More information : http://www.rr-africa.oie.int/en/news/20110617.html

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This report is available for download on the OIE Africa website

http://www.rr-africa.oie.int/docspdf/en/2011/BEE/Report.pdf

WELCOMING ADDRESS BY THE OIE SUB-REGIONAL REPRESENTATIVE FOR SOUTHERN AFRICA

Bonaventure J. Mtei

Representative
Sub-Regional Representation for Southern Africa
OIE
Gaborone, Botswana

Honourable Minister, Mr Dlamini,

Permanent Secretary Dr Robert Thwala,

President of the OIE Africa Commission, Dr Saley Mahamadou

OIE Regional Representative Dr Yacouba Samaké

Invited Speakers – All protocol observed

Dear Participants

Ladies and gentlemen,

I would like to join the OIE Delegate for Swaziland, Dr Roland Dlamini in welcoming you to Swaziland and I believe you all travelled well. I would also like through you Hon Minister, on behalf of the Director General of the OIE, Dr Bernard Vallat, to sincerely thank the Government of the Kingdom of Swaziland for agreeing to host this meeting and to you in particular for availing yourself to came and grace this occasion.

I thank everybody here present for finding the time amidst your busy schedule to come to this seminar which I reckon is another milestone as far as OIE activities are concerned in Southern Africa. Today there is mounting pressure to improve delivery of animal health and welfare services as a prerequisite to enter the competitive arena of trade in animals and animal products which includes non-traditional aspects like honeybees and their products, the subject of this seminar.

Requirements in terms of the *World Trade Organisation* (WTO) Agreement on *Sanitary and Phytosanitary* (SPS) measures and guidelines of international standard-setting organisations (ISSOs), OIE, IPPC and Codex have a direct linkage with the eventual acceptance and or refusal of bees and bee products by importing countries. On the one hand, there is a threat of importing countries requiring standards that are unattainable and on the other, the need for supporting exporting countries to comply with trade protocols.

Constraints facing animal health services are well known and adequately identified through the Performance of Veterinary Services (PVS) Pathway embraced by all the SADC Member States. The Director General of the OIE, Dr Bernard Vallat once commented :*" Animals (including honeybees) are everywhere in Africa but health services are nowhere... "*. Animal health impacts significantly on wealth creation and food safety and honeybee health is no exception, hence the rationale and objectives of this seminar.

Hon Minister, Ladies and Gentlemen,

Collecting honey from wild bee colonies is one of the oldest human activities and is still being practiced by communities in many parts of Africa and other regions of the world. Traditional harvesting of bee products involves destruction of the bee colony along with its precious queen which means loss of valuable resources since there is no continuity of production.

With the evolution of hive designs there has been an explosion of innovations which have perfected the design and production of beehives, systems of bee management and husbandry, stock improvement by selective breeding, honey extraction and marketing to mention a few, and this has changed the whole landscape of apidology and apiculture.

There is ample evidence to show that the irresponsible use of pesticides negatively impact on beekeeping and disorders like *Colony Collapse Disorder* can be addressed more effectively by reversing multifactorial trends that disrespect good management of bees including honeybee diseases.

This seminar is meant to address honeybee health issues which are increasingly becoming a concern in the southern Africa region following reports of *American Foulbrood* (AFB) in South Africa in the Western Cape Province and Varroosis in Madagascar in April 2009 and February 2010 respectively. We are fortunate to have world class experts on honeybee diseases with us today to share their knowledge on the subject.

Dr Bonaventure Mtei (right) in the company of Drs. Roland Dlamini (Swaziland, left) and Yolande Kaurivi (Namibia, middle). *Picture © Neo Mapitse (oie) 2011.*

Hon Minister, Ladies and Gentlemen,

Given the importance of beekeeping in the region, OIE saw it befitting to organise this capacity building seminar on the different aspects of the beekeeping sector in particular raising awareness on honeybee's health to ensure timely and accurate notification of exceptional epidemiological events in line with OIE's mandate.

Bee health disorders impact not only on household income and agricultural production, but also can be trade sensitive. Given the importance of apiculture and the way bee products are harvested and marketed, and given the lack of notification of bee-diseases in general, the national OIE focal points on sanitary information management and National Apiculture Officers from all SADC Member States have gathered here to share experiences and develop common understanding on how to address current and future challenges in the Apiculture industry. We must be more vigilant on investigating causes of mortalities of bees to better prevent and control diseases of honeybees.

As OIE we would like to see closer networking between animal health experts, biologists and entomologists ... a good way of putting the "One Health" concept into actual practise. OIE greatly values non traditional partners like bee experts and others whose knowledge and skills contributes to the development of standards published in the OIE Codes and Manuals to safeguard better and safer trade in animals and commodities thereof.

This meeting has been organised with financial support from the European Union under the *Better Training for Safer Food* (BTSF) in Africa programme which we greatly appreciate. We hope each one of us will have something new to learn from this seminar and your short visit to Swaziland will be memorable. I thank you.

WELCOMING ADDRESS BY THE PRESIDENT OF THE OIE REGIONAL COMMISSION

Saley Mahamadou

Delegate for the Republic of Niger
President
Regional Commission for Africa
OIE
Niamey, Niger

Your Excellency, Honourable Minister of Agriculture

Permanent Secretary of the Ministry of Agriculture

OIE Regional Representative for Africa

OIE Sub-Regional Representative for Southern Africa

Ladies and gentlemen representing international organisations

OIE Delegate for Swaziland

OIE Delegates and focal points

Invited guests

Ladies and gentlemen,

Dear participants,

It is with real pleasure that I take the floor at the occasion of the OIE regional training seminar on the diseases of honey-bees for focal points.

Given this solemn occasion, please allow me in the name of the OIE Regional Commission for Africa to pass our sincere thanks to the Government and to the People of Swaziland for the facilitation from which we have benefited since we have set foot on this hospitable ground of Africa.

I would also want to express our recognition to the Hon. Minister of Agriculture who, in spite of his heavy work schedule, raised the glare of this ceremony by being with us this morning.

I would also like it to thank the Directors of veterinary services of Mozambique and Swaziland for the welcome extended to me.

I also appreciate the efforts made by the Sub-regional office in Gaborone to ensure that I could travel to Ezulwini.

Ladies and gentlemen,

Dear participants,

I will not entertain you on the importance of bee-keeping or on the virtues of honey, in front of such an august assembly, I will simply remind you that bee-keeping, despite of its major relevance for the socio-economic lives of several African populations, and its role in poverty reduction, has so far been poorly represented in policies and development programmes in the majority of African countries.

Furthermore, Veterinary Services are ill-informed with regard to matters regarding the diseases of honey-bees. Disease surveillance systems generally do not integrate these issues. Hence the reports that we submit to the OIE are often mute when it comes to diseases of bees.

It is to say, ladies and gentlemen, dear participants, that this seminar comes at the right time. Indeed, the OIE Regional Commission for Africa considers that this seminar will set the scene for more and better consideration given by veterinary services to diseases of honey - bees.

This is why we ask OIE to extend this kind of training to other parts of the continent where the potential for a honey industry is important.

Ladies and gentlemen,

During four days, you will review the economic, social and even environmental importance of the beekeeping sector.

You will also be informed of matters pertaining to disease surveillance, and related biosecurity issues.

Naturally, I am convinced that given the quality, rich experiences and the diversity of the participants brought together here, as well as the proven expertise of the trainers, the objectives of this seminar will be attained.

The Chairman of the OIE Regional Commission for Africa, Dr Mahamadou Saley, OIE Delegate from Niger (centre). *Picture © Neo Mapitse (oie) 2011.*

Before I finish my speech, I would like to express the profound recognition of Africa to the OIE, for all the ever-increasing efforts made under the guidance of Dr. Bernard Vallat, Director General, so as to ensure that African veterinary services do not miss the boat of challenges facing the new millennium.

I would therefore like to request the OIE Regional Representative for Africa to extend our encouragements to the Director-General and to reassure him of our determination to accompany him in this noble and exciting mission with which we have entrusted him.

Ladies and gentlemen,

Thank you for your kind attention.

WELCOMING ADDRESS BY THE OIE REGIONAL REPRESENTATIVE FOR AFRICA

Yacouba Samaké

Representative
Regional Representation for Africa
OIE
Bamako, Mali

Your Excellency, Honourable Minister of Agriculture

Ladies and gentlemen representing regional and international organisations

Representative of the Interafrican Bureau for Animal Resources of the African Union,

Representative of the OIE Sub-Regional Representation for Southern Africa,

Representative of FAO,

Delegate of Swaziland to the OIE,

Ladies and gentlemen national OIE focal points,

Ladies and gentlemen experts,

Ladies and gentlemen,

First of all, allow me, on behalf of the Regional Representation for Africa of the *World Animal Health Organisation*, to thank, very sincerely, and to congratulate, very cordially, Swaziland to have agreed to host this seminar, for the warmth and fraternity of the welcome, as well as the delicate attentions with which participants were surrounded since their arrival, here, in Ezulwini.

Also, please allow me to thank, very sincerely, the organizers, for the excellent work.

Finally, on behalf of the OIE Regional Representation for Africa, I would like to wish you a cordial and fraternal welcome to the African land of Swaziland.

Ladies and gentlemen,

The OIE, the *Office International des Epizooties,* was established on January 25, 1924, by 28 founding countries. It became the *World Organisation for Animal Health* in 2003, while keeping the acronym "OIE", and its current missions can be summarised as follows:

• As part of the improvement of animal health in the world, OIE collects, analyses and publishes scientific information on animal diseases control methods, including those transmissible to man, and informs the Member Countries in real time, on the situation and the evolution of these diseases,

• The establishment of standards, on the basis of scientific criteria, recognized as world references by the WTO,

• OIE is the international reference organisation on animal welfare because of the close link between animal health and animal wellbeing.

In 2010, OIE represented 178 Member Countries, with a Regional Representation on each continent, including Africa, which comprises of 52 African Member countries out of the 53 which constitute the African continent. The OIE Regional Representation for Africa pursues its main objective, which is to strengthen, in the short to medium term, the capacities of Veterinary Services in terms of improvement of animal health and the fight against the zoonoses, with particular emphasis on good governance of the Veterinary Services, on information on animal diseases and the safety of regional and international trade.

Dr Yacouba Samaké, the OIE Regional Representative for Africa. *Picture © Neo Mapitse (oie) 2011*

It is appropriate to underline the invaluable contributions of the Sub-Regional Representations in attaining the main goals assigned to the Regional Representation : North Africa based in Tunis, East Africa and the Horn from Africa based in Nairobi, and Southern Africa based in Gaborone)

Your Excellency Honourable Minister,

Honourable guests,

The OIE regional training seminar on the diseases of honey - bees for OIE focal points is embedded in the framework of the OIE programme and the implementation of the BTSF programme to strengthen the capacities of Veterinary Services' personnel, amongst which the national Delegates and their focal points.

For OIE, Veterinary Services constitute a *Global Public Good*. They contribute effectively to food security. According to Dr. Bernard Vallat, bees contribute to world food security. This contribution is well illustrated by referring to e.g. honey and royal jelly, both of which are examples of precious food that humanity owes to the bees. But it is especially thanks to their invaluable contribution to pollination of flowers which produce harvests which humanity needs so desperately.

Consequently, the disappearance of bees would represent a terrible biological disaster.

This is why OIE regards the mortality and the diseases of the bees as a priority of its Strategic Planning from 2011 - 2015, still according to Dr. Bernard Vallat, Director General of the OIE.

Honourable Minister,

Ladies and gentlemen,

Resources for better surveillance, the establishment of census - mechanisms and of capacities for inspection, diagnosis and research are lacking in many countries and parts of the world, and there is an important need for international guidelines for the surveillance of bees and control programmes, directed against their diseases, commented Dr. Wolfgang Ritter, President of the ad hoc Group.

Your Excellency,

Ladies and gentlemen,

While thanking you for your kind attention, I wish you every success in the work of the OIE regional training seminar on the diseases of honey bees for OIE focal points.

OPENING ADDRESS BY THE MINISTER OF AGRICULTURE OF SWAZILAND

Hon. Clement Dlamini

Minister
Ministry of Agriculture
Mbabane, Swaziland

Programme director

President of the Africa Commission of the OIE

The OIE Regional Representative for Africa

The OIE Sub-Regional Representative for southern Africa

Principal Secretary

Distinguished delegates

Ladies and gentleman

I greet you all - good morning, *Sanibonani*

It gives me great pleasure to have been invited to officially open this OIE regional training seminar on the diseases of honey bees; under the umbrella of the OIE/European Commission (EC) project *'Better Training for Safer food for Africa'* financed by the EU.

Swaziland is an active member of the OIE having joined in the 1960's. We pride ourselves in participating in almost all the activities of the OIE since that time, which has helped us in improving animal disease control. Application of the OIE standards contained in Terrestrial Animal Health Code has enabled access to lucrative international markets for our products of animal origin, especially beef.

The insistence of the OIE on science based non discriminatory international standards for the control of animal diseases has contributed to the global eradication of rinderpest (cattle plague), a disease that killed millions of cattle particularly in the developing world. I am informed that the OIE during its 79th General Session in May 2011 unanimously adopted a resolution declaring the *'Global Freedom from Rinderpest'.*

Mr President the OIE shares this achievement with the FAO and the veterinary and allied professions, under the *One Health* approach. Such esteemed achievement should now be extended to other diseases of global importance such as *foot and mouth disease* (FMD), *avian influenza* (AI) and *bovine spongiform encephalopathy* (BSE).

I am informed the OIE already has a global strategy for the control of foot and mouth disease with the long term intention of eradicating this menace. There have been some dissenting voices that say FMD cannot be eradicated. Swaziland says FMD can be eradicated if again global resources (human, material etc) can be directed to eliminating the disease at source, as per the *One Health* approach.

As for BSE, to date it has never affected Africa and application of OIE standards globally seems to be eliminating this disease quickly. However, Mr President, the OIE recognition of member countries for the freedom or level of risk as regards to BSE is of concern. The fact that countries that have never had a clinical and/or laboratory case are classified as unspecified risk, yet they apply stringent controls, seems to be at odds with scientific bases for standards.

Coming back to today's topic Mr President; honeybees are wonderful creatures that contribute immeasurably to global food security and therefore human existence. Whilst visiting flowers to get nectar honeybees pollinate plants, effectively they are the main breeders of plants. The annual value of honeybee pollination of agricultural crops globally is estimated at 153 billion Euros.

The Hon. Minister of Agriculture, Mr Clement Dlamini. *Picture © Neo Mapitse (oie) 2011*

Their contribution to the pollination of forests and wild flora can only be greater. Mr President it is therefore no exaggeration to say honey bees are an integral part of biodiversity.

Recognition of the importance of honeybees in Swaziland dates back to the colonial era. The Importation of Bees act 16 /1910 introduced controls on the entry of bees and their products into the country. This legislation was largely to prevent the introduction of American Foulbrood, European Foulbrood and other exotic diseases of honeybees. Swaziland remains free from these diseases; however the country cannot afford any complacency. As such the country recently re-launched commercialization of honeybees and also re-strengthened disease surveillance.

The traditional methodologies of burning rubber, to subdue bees, whilst harvesting honey is one of the major causes of forest fires here in Swaziland. In recent years such fires affected the agro- forestry industry in the country almost to the point of collapse. Just to put things into perspective; Swaziland had 120,000 hectares covered by commercial forests, and agro- forestry was the second largest employer.

Commercialization of honeybee farming, and training farmers and communities the modern methods of honey harvesting greatly reduces forest fires. Therefore it benefits the economy and preserves biodiversity.

Mr. President, let me conclude my speech by welcoming you to the Kingdom of *Eswatini* and thanking the OIE for choosing Swaziland to host this important seminar. Please feel at home and enjoy the warm ambience of the country.

It is now my singular honour to declare this seminar officially opened.

May the Good Lord Bless you.

Structure and operation of the OIE

GENERAL PRESENTATION OF THE OIE

Neo J. Mapitse

Deputy-Representative
Sub-Regional Representation for Southern Africa
OIE
Gaborone, Botswana

The *Office International des Epizooties (*OIE) is an intergovernmental Organisation funded in 1924 by 28 countries, with the aim to prevent spreading of animal diseases around the world. In May 2003 the *International Committee*, currently the *World Assembly of Delegates,* adopted the new name of the *World Organisation for Animal Health* maintaining its original acronym, to better reflect its role, responsibilities and field of action. The OIE is funded by ordinary contributions from Member Countries and by voluntary contributions for specific activities, as well as by the *World Fund for Animal Health and Welfare*. By March 2010 the OIE had 178 Member Countries : Africa 52, Americas 30, Asia, Far East and Oceania 36, Europe 53 and Middle East 20. Some members belong to more than one region. OIE objectives are directed to:

- Ensure transparency in the global animal disease situation, disseminating information on animal diseases reported by affected countries, to allow other countries to take preventive measures;
- Collect, analyse and disseminate the latest veterinary scientific information on animal disease control, in order to support Member Countries to improve the methods to control and eradicate animal diseases.
- Encourage international solidarity in the control of animal diseases, providing technical support to Member Countries and maintaining permanent contact to international, regional and national financial organizations in order to convince them to invest on the control on animal diseases and zoonoses.
- Safeguard world trade by publishing health standards for international trade in animals and animal products, which can be used to protect Member countries from the introduction of diseases and pathogens, without setting up unjustified sanitary barriers.
- Improve the legal framework and resources of National Veterinary Services, considered by the OIE as a Global Public Good, to enable Member Countries to benefit from WTO *Sanitary and Phytosanitary Agreement* (SPS Agreement) while at the same time providing greater protection for animal health and public health.
- Provide a better guarantee of food of animal origin and to promote animal welfare to a science based approach, focusing on eliminating potential hazards existing prior to the slaughter of animals or the primary processing of their products that could be a source of risk for consumers.

The functioning of the OIE is based in its structure comprising: i) the *World Assembly of Delegates,* which is its highest authority comprised of all OIE Delegates; ii) the *Council*, which examines technical and administrative matters to be presented for approval of the World Assembly of Delegates; iii) the *Director General*, elected for a 5 years period; iv) the *Specialist Commissions*, which address scientific and technical issues and develop international standards; v) the *Regional Commissions*, which address regional needs in terms of prevention, control and eradication of diseases of regional concern by proposing regional policies for further endorsement and support; vi) the *Reference Centres* (*Collaborating Centres and Reference Laboratories),* as centres of expertise and worldwide standardization; vii) the *Ad hoc groups* and *Working groups* as key players for preparing recommendations for Specialist Commissions and World Assembly of Delegates.

The OIE through its 5th Strategic Plan (2011-2015), addresses important new elements being; (i) contribution of animal health and veterinary public health to food security, (ii) application of the "One Health" concept and (iii) animal production and the environment including the impact of climate and environmental changes to diseases and contribution of animal production practices to climate and environmental changes.

The Headquarters of the OIE in Paris.
Picture © D. Mordzinski (oie).

Beekeeping and bee products

BEEKEEPING WORLDWIDE WITH A SPECIAL FOCUS ON BEEKEEPING IN AFRICA

Nicola Bradbear

Director
Bees for Development
Monmouth, United Kingdom

Bees and the reasons why people keep them are not the same everywhere. In the past people in every part of the world utilised indigenous bee resources. Today there exists a widely used method of beekeeping using *Apis mellifera* honey bees (often imported stock) and frame hives, and this is practised in many countries. This can be regarded as intensive beekeeping, and as in all forms of intensive agriculture, there is need to maintain disease free stock. However no beekeeping is practised in enclosed systems, and this a form of intensive agriculture where the livestock are free to forage and mate in the wild. Recent years have seen increasing problems with this 'globalised' beekeeping as exotic pathogens have been increasingly spread world-wide.

Apicultural practises in some countries of sub-Saharan Africa are evidently sustainable and are retaining some of the world's only intact populations of indigenous *Apis mellifera* honey bees. The beekeeping practises (usually named 'traditional beekeeping') are extensive and remain poorly understood and appreciated by the wider beekeeping and scientific community. Intensive and extensive beekeeping practices are different. In the intensive beekeeping commonly practised with *Apis mellifera* in many world regions, the focus of the beekeeper is at the level of the honey bee colony. In extensive beekeeping, the focus is not at the colony level, but rather on the local population of honey bee colonies. Where beekeeping is practised extensively, for example in some countries of sub-Saharan Africa, the populations of honey bees remain apparently intact and healthy. Some of the reasons may be: because the bees and their pathogens are living and evolving in a natural way; because the bees select their own nesting sites and food sources; because the bees build their nest naturally and undisturbed by humans (until harvest). Africa's abundant natural resources allow large numbers of people to practise this extensive, low input beekeeping. Because no medicines are used on the bees, the produce (honey and beeswax) are residue-free and find ready markets (for example in the EU). Rather than being discouraged, these practises deserve scientific study and appraisal.

Intensive beekeeping *Pictures © Nicola Bradbear* Extensive beekeeping

BEEKEEPING IN SWAZILAND

Thembinkosi Ndlangamandla

Regional Veterinary Officer
Department of Veterinary & Livestock Services
Ministry of Agriculture
Mbabane, Swaziland

Swaziland is a land-locked country of 17 000 km^2 with an average temperature of 20^0 C and rainfall 550-1450 mm per annum. Beekeeping is well developed in Swaziland, and based on the availability of bee forage throughout the year. Bee forage is made up of indigenous bee plants (aloes and acacias), and the extensive eucalypt plantations and citrus orchards in the country. Swaziland may be divided into 4 regions: the Highveld region has only commercial forestry, both the lowveld and middle-veld regions have both commercial forestry and citrus, and the Lubombo mountain region has only natural forests.

The honey produced in Swaziland is of very high quality, and honey hunting is part of Swazi culture. There are at present 1107 beekeepers in Swaziland, keeping some 3860 hives of bees. There are two major honey companies in Swaziland, 4 major beekeeping associations, and 2 plants to extract and process honey. The honeybees found in Swaziland are *Apis mellifera scutellata* and *Apis mellifera litorea*, and colonies are kept in both Langstroth and Top-bar hives.

Swaziland has a relatively high consumption of honey, consuming 126 tons of honey annually, most of it locally produced. Most locally produced honey is traded in informal markets, with imported honey being found in the supermarkets.

Beekeeping is considered to be important for the development of Swaziland, and the government is active in the beekeeping sector. The government regulates the importation of honey and bee products (Importation of Bees Act 1910) and provides veterinary services and extension officers in all regions of Swaziland to assist beekeepers. The major challenges facing the beekeepers of Swaziland is the shortage of beekeeping equipment, the loss of bees to forest fires, and the prevention of pests and diseases. At present there is no American Foulbrood in Swaziland.

Swazi honey
Picture © Thembinkosi Ndlangamandla (2011)

GENERAL INTRODUCTION TO REPRODUCTION AND LIFE STAGES

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In honeybees, gender is normally determined depending on the fact if the egg is fertilized or not; and not by the presence of a certain type of sex chromosome like in humans. Unfertilized eggs normally develop into males; they have only the maternal set of chromosomes and no father (haploid). The females develop from fertilized eggs so they have paternal and maternal sets of chromosomes (diploid). This mode of sex determination, called *haplodiploidy*, is not unique to honeybees and can be found in ants and wasps as well.

So, the fertilized egg either develops into a worker or a queen, into one of the two castes, which we find in a honeybee colony. This caste differentiation is controlled by the nutritional intake of the female larvae in the first three days of its life. Larvae destined to become queens receive around 10-15% more food in the first three days and they consume around 20% more royal jelly than larvae destined to become workers.

The development of the females is slightly, around 2 days, faster in African honeybees than in the European subspecies. African queens take around 14 days, workers 19-20 days and drones (males) 24 days. The first stage is the egg stage that lasts for 3 days, which in the case of the males is followed by the open brood stage for around 7 days and a period of 14 days as sealed brood. Hatching of the males is then after a total of 24 days. In the case of the queens, the open brood stage is around 5 days and is followed by 7 days as sealed brood, hatching around day 15. For a worker the sealed brood stage lasts longer (11-12) so that the adult worker hatches after 19-20 days.

A honeybee swarm *Picture © Christian Pirk*

Although the queen is reproductively dominant, workers also have the ability to reproduce. Since they do not mate, they only produce unfertilized eggs, which in most subspecies normally develop into males. However, the Cape honeybee is the exception, in which workers are able to lay diploid eggs that then develop into females. In general, worker reproduction can be seen as one aspect of colony reproduction. In the case of queen loss, and where no replacement queen can be raised from extant queen-derived brood, worker reproduction is the last opportunity of a colony to disseminate genes via the males that are produced, into the next generation.

The reproduction of colonies follows a simple cycle. If a colony has the resources to issue a swarm, it will start raising several new queens. Shortly before the emergence of the new virgin queens, the old queen leaves, together with a proportion of the colony, to found a new colony at a new nest site. As soon as the first virgin queen emerges, she tries to kill all her sister queens. After this she will go on her mating flights, on which she mates with 10-25 males, and up to 54 males, and then returns to her nest and start laying eggs for the rest of her life.

Bee populations in Southern Africa

SWAZILAND : BEEKEEPING WITH *APIS MELLIFERA SCUTELLATA*

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Taxonomic name: *Apis mellifera scutellata* (Lepeletier)

Common names: African honeybee, also nicknamed the killer bee

Description: Compared to other *Apis mellifera* sub-species, the most distinguishing trait of *Apis mellifera scutellata* is their more defensive behaviour around their nests and their propensity to sting in large numbers. *A. m. scutellata* are also slightly smaller than *A. m. ligustica*, but this can only be ascertained with the aid of a microscope. European races such as *A. m. ligustica* can withstand colder temperatures than *A. m. scutellata*. While European honeybees only reproduce two or three times a year, *A.m. scutellata* can reproduce up to 17 times per annum.

Distribution: *A. m. scutellata* is distributed throughout SADC countries. This species is limited by the Sahara desert, the South Western Cape, the highest mountain peaks, and East coast of Southern Africa. *A. m. scutellata* is restricted by the Eastern coast line stretching from Mozambique to Somalia which is occupied by *A.m. litorea*. It is also limited by altitude on the mountain peaks which are above 2000 m above sea level. These mountain peaks are occupied by *A. m. monticola.* A large part of the Western coast and central Africa is occupied by *A. m. adansoniil,* and *A. m. capensis* is found to the south in the Cape. *A. m. scutellata* was also taken to South America in 1957 and the queens of several colonies were accidentally released, and it has been gradually spreading ever since.

Scutellata beekeeping *Picture © Daniel Nkhambule*

Uses: *Apis mellifera scutellata* provides pollination services in the tropics. *A. m. scutellata* does not hoard honey over the winter. Instead they depend on colony mobility (absconding and swarming) to find new sources of food, water, or space if one or all run out. Therefore sugar syrup feeding becomes handy if such a condition prevails and the beekeepers want to maintain his colonies.

Reproduction: The queen mates with multiple drones during her mating flight. Queens then store the sperm internally, allowing them to fertilize eggs for their entire lifetime. It lays fertilised eggs, which becomes female honeybees or worker bees. The queen also produces unfertilised eggs, which become drones or male honeybees. Fertilized eggs become queens if they are fed (when they less than three days old) large quantities of royal jelly. One queen can produce and lay from 600 - 1500 eggs a day.

General Management: The general goal for honeybee management is to increase the profitability of the colony. For tropical and subtropical regions this amounts to four major tasks, namely: preventing the loss of colonies during dearth periods, preventing the loss of honeybees from swarming, protecting the honeybee colony from pest attacks, and ensuring that good honeybee traits are well maintained. Honeybee management aims at maximizing hive products and production, the protection of honeybees against diseases and intruders, improving product quality, and ensuring and maintaining quality standards as defined by ISSBs.

WESTERN CAPE : *APIS MELLIFERA CAPENSIS*

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A brief explanation of the unique Cape honeybee is provided:

- its ability to lay diploid eggs without having mated, thereby reproducing by means of parthenogenesis;
- How this influences colony behaviour.
- The identification of typical *'Cape Bee'* symptoms.
- The distribution areas of *Apis mellifera capensis* .
- The 'Cape Bee Problem' in the 1990's and the role commercial beekeeping played in creating this scenario.
- Present legislation and control measures in place.
- Some recent research papers investigating the following factors: drift of workers, queen pheromones and commercial apiaries vs. colonies in nature reserves.
- The identification by means of DNA analysis of the 'pseudo-clone' worker bee.

IMPORTING BEES INTO SOUTH AFRICA, AND THE *CAPENSIS* PROBLEM

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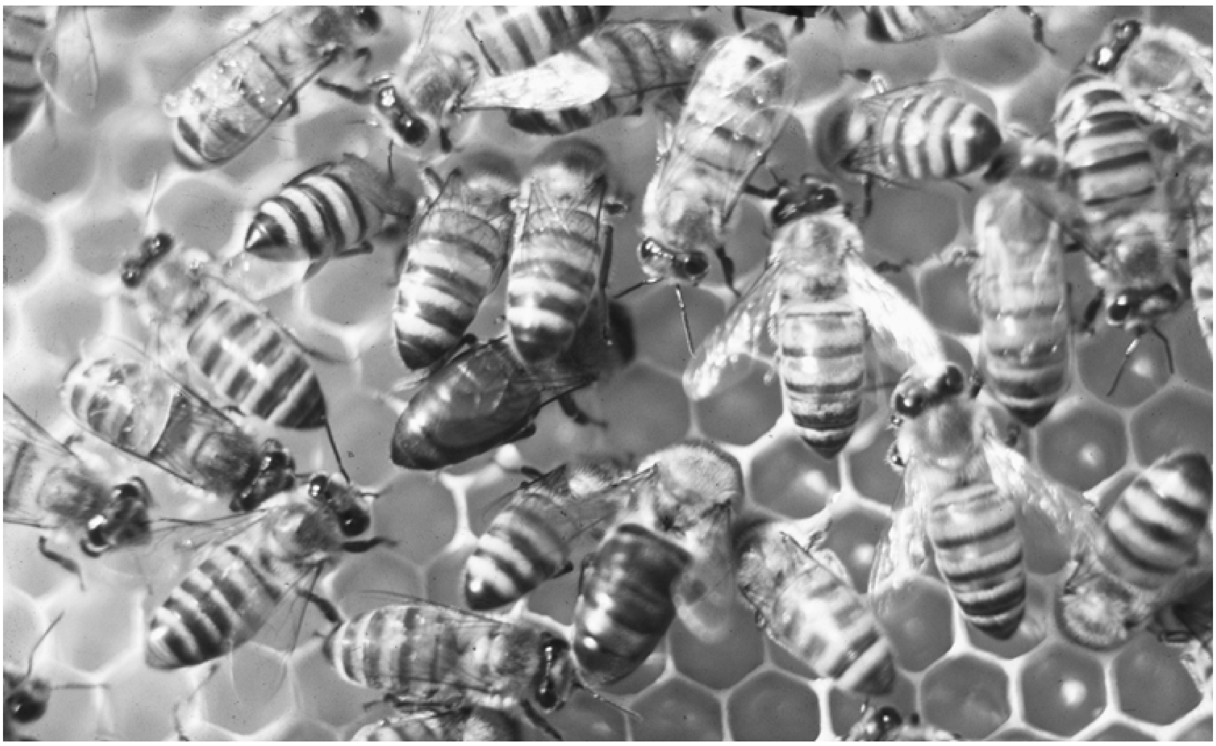
Only in recent years has the introduction of foreign honeybees into South Africa been prohibited. In earlier years such introductions were allowed and even encouraged. European honeybees introduced into South Africa and other parts of Africa, however, have had no lasting effect and European genes are hardly present in population.

Not all such translocations of honeybees are so harmless, as the *'Capensis Problem'* illustrates. Cape honeybees (*Apis mellifera capensis*) are found naturally along the south-western coast of South Africa and are a unique honeybee race in many respects. Cape worker bees have behavioural and physiological adaptations allowing them to be social parasites within the Cape honeybee population, and lethal parasites when exposed to other races of honeybee. The movement of Cape honeybee colonies outside their natural range in 1989/90 therefore resulted in the *Capensis Problem,* with hundreds of thousands of colonies of *A. m. scutellata* lost to date. These losses continue to the present day, and despite many years of research as well as extensive regulation, no solution to the problem has yet been found.

Cape honeybees are suggested to be a substantial threat to SADC countries, and no live honeybees should be imported from South Africa. They are also a lesson with regards to the movement of honeybees anywhere in the world, and the strongest motivation to work to indigenous honeybees whenever possible.



Black *Apis mellifera capensis* workers parasitise yellow *A. m. scutellata* colonies, causing the Capensis problem *Picture © ARC*

Bees and the environment

Bees and human development

POLLINATION AND BIODIVERSITY

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Human life and our world would be bleak without the abundance of flowers, agricultural and medicinal plants, all of which heavily rely on pollinators. Substituting the efforts of pollinators in general is impossible, even with the most advanced technologies we have in hand. All animal-mediated pollination contributes to the production of goods relevant to humans such as agricultural crops. Furthermore, wild plants lower in the food web highly benefit and depend on the pollinators and therefore other important organisms depend indirectly on pollinators. More than 33% of our crops depend on pollinators and over 85% of plant species depend on pollinators.

The co-evolution of plants and animals ensures that plants have to rely on animals, like honeybees, for their sexual reproduction; whereas plants provide food and rewards in the form of nectar, pollen, oils and plant resins. Hence, the process of pollination sustains biodiversity in terms of the plants, which get pollinated and the animals, which pollinate, thereby contributing significantly to global crop production and securing our food supplies. Pollinators like, bees, butterflies, beetles, birds, mammals, bats and marsupials account for a major share of the overall biodiversity. Beside honeybees, some 30,000 wild bee species, many other hymenopterans and most of the 150,000 known fly species play a role as pollinators.

Therefore protecting pollinators plays a fundamental part in conserving biodiversity on out planet. Indeed, data from the Netherlands and the UK indicate a functional link between pollinator decline and plant species decline. The decline of honeybees in the USA, Canada and Mexico in the 5 years prior to 1998 was already so dramatic that the numbers of honeybees were on the level of the 1950s.

30% of global food production depends on honeybee pollination
Picture © Wikipedia

Beside the observed decline on pollinators, especially honeybees, the increasing demand of commercially valuable pollinators further widens the “gap” between the demand and supply of pollinators. In consequence, if the agricultural industry has to rely more on alternative pollination methods and/ or managed pollinators it will result in increased production costs. The pollination service of crops, around 10% of the world food production, has a value of ~150 billion Euros per annum.

In South Africa large scale decline of pollinators has not yet been observed, however, agricultural usage, pollution, and land transformation can critically threaten natural habitats and their pollination services. A recent study on sunflower pollination in South Africa showed that although honeybees are the most abundant visitors, the diversity of flower visitors enhances honeybee movement, which further enhances productivity. Conservation of natural patches combined with promoting flowering plants within crops can maximize productivity and, therefore, reduce the need for cropland expansion, contributing towards sustainable agriculture.

BEEKEEPING AND CONSERVATION OF WILD HONEYBEES

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Beekeeping is an almost global agricultural activity, which can be implemented in almost every climate ranging from deserts to alpine habitats. Honeybee populations are typically composed of managed colonies but also of colonies living in the wild, either as endemic or feral colonies. In the industrialized countries the managed honeybee colonies outnumber those colonies living in the wild by far. Hence the introduction of specific breeding lines has been suggested to put the conservation of endemic honeybee subspecies at risk.

In contrast, in most African regions the wild colonies outnumber the managed by far resulting in a limited biodiversity risk, and wild honeybee populations in Africa are larger and more diverse than those of Europe. Africa should work to conserve its indigenous bees, and not import bees from other parts of the world. Also the introduction of the invasive dwarf honeybee, *Apis florea,* from Asia in the African continent has had no impact on endemic honeybee populations so far.

Catching drone honeybees in Jonkershoek, Western Cape, South Africa to estimate honeybee population levels *Picture © Vintcent Dietemann*

PESTICIDES AND INSECTICIDES : GENERAL OVERVIEW

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Pollinators are essential for pollinating 35% of the agricultural crops of global importance which are food for humans. They also play an important role in the pollination of natural areas. Among the pollinators, the social honeybees (*Apis mellifera*) have an economic value mainly due to their marketable products, as well as their pollination activity in agricultural areas. In many countries now, decreases of several species of bees from crop fields and from other areas have been described worldwide.

Several reasons have been reported for bee losses, mainly classified in three categories: pesticide exposure, disease outbreaks and environment alteration. All these three main factors also interact between themselves. *A. mellifera* has been -and still is- the subject of many studies because it is the only ubiquitous bee species that can be easily reared. However, other bee species should not be neglected. Since the massive use of pesticides after the Second World War, much concern has been raised regarding the insecticide interactions with honeybees. Pesticide in the honeybee environment is a widespread occurrence, and apicultural matrices are particularly affected. Pesticide concentrations in apicultural matrices reflect anthropogenic activities whether they emanate from agricultural treatments or from veterinary drugs. Scientific studies have focused on developing techniques to lower the limits of detection of some insecticides. However, little research has been performed on pesticide residues in apicultural matrices from field samples. Monitoring the residues and assessing the impact of small amounts of pesticides on honeybee health are the key issues that should be studied more frequently concomitantly with other factors in order to explain bee losses.

Many pesticides are deleterious to honeybees, resulting in mortality *Picture © ANSES*

The impact of large-scale monocultures (agriculture with extended surfaces of a single cultivated species) on honeybees is the availability of pollen that is the only source of proteins and lipids in *A. mellifera* diet, and is crucial for their survival and development. Agricultural trends towards larger monoculture farming systems can place pollinating honeybees in situations where they have restricted pollen dietary choice. In these unnatural conditions, factors such as feeding preference and nutrition can deeply affect the behaviour and health of the bees.

Honeybee exposure to some pesticides may result in colony adverse health outcomes. The chemicals may affect the synthesis, transport, action or elimination of natural molecules such as hormones or enzymes that are responsible for maintaining development, immune mechanisms and behaviour. Although these patterns are less known in insects than in mammals, several studies have shown their importance in honeybee biology. Laboratory tests have shown adverse effects on honeybee biology when taken as individuals. The honeybee colony taken as an organism has never been studied in such a detailed way. This research could provide useful information regarding the impact of pesticide residues at the colony level. Honeybee sensitivity to pesticides is dependent on various factors. One of them is the bee health status. Although very few data are available on this matter, a recent study has shown that *Nosema* infection could worsen the sensitivity of summer bees as adults get older. More work should be done on deleterious effects from concomitant stresses on honeybee colonies.

PESTICIDES AND INSECTICIDES IN SOUTHERN AFRICA

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Agriculture in most southern African countries has shifted from subsistence to commercial production in response to increased population and the migration of people from rural to urban centres. While in the past, production in smallholder farms was able to supply the needs of the relatively small population living in rural communities, the current increase in demand for food and fibres caused by population increases and migration from rural to urban centres has resulted in an increase in the sizes of farms.

The commercialization of agricultural production has resulted in frequent outbreaks of serious crop and livestock pests and diseases and a change in farmers' perception of pests and diseases. Commercialization has also led to a shift from "low value" staple crops to "high value" horticultural crops. The primary objective of farmers engaged in production of food crops and high value cash crops like cotton, vegetable and fruits is to obtain maximum yield and profit. Most farmers believe that they can only grow their crops profitably if they apply pesticides frequently and keep the crop absolutely pest free. Pesticide application frequencies of once or twice a week are not uncommon among such farmers in southern Africa. The most commonly used pesticides in crop production include: insecticides, acaricides, fungicides, herbicides, and nematicides. The majority of farmers involved in farming in the region lack knowledge on the proper and safe use of pesticides. This has led to problems of pollution of the environment in farms and surrounding areas and also hazards to humans and other non-target organisms.

Beneficial insects such as honey bees are highly susceptible to most of the pesticides that are applied to control major pests and diseases. They face a serious threat of poisoning in crop production areas of southern Africa where continuous and intensive use of pesticides is practiced. In large farms, pesticides are applied using aircraft or tractor drawn spray equipment in order to cover the cultivated area in a relatively short period. Pesticide spray droplets from such operations are prone to drift to non-target areas and ultimately cause serious pollution of the environment. In southern Africa, aerial spraying is also used against migratory pests like the Red locust, the Brown locust, the African army worm and Quelea birds. Outbreaks of these occur frequently in some countries. Aerial sprays applied against these pests cause pollution of both cultivated and uncultivated areas, resulting in mortality of foraging bees in farms as well as in natural vegetation. It is difficult to maintain healthy bee colonies in such intensively treated farms and natural ecosystems.

The use of DDT against mosquitoes poses another difficult challenge in southern Africa. Although DDT is banned for agricultural use because of its persistence in the environment, it is allowed for use against the malaria vector. There is urgent need to find alternatives to the use of persistent pesticides like DDT in order to protect the environment. In some developed countries, pesticides are estimated to pose a greater threat to beekeeping than all other beekeeping problems (including bee diseases). However, their impact on beekeeping in most southern African countries has not been properly investigated. There is need to reduce pesticides poisoning of honey bees in order to protect and strengthen colonies.

BEEKEEPING AS A WAY OUT OF POVERTY

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There is increasing interest and awareness of beekeeping as a tool for development: most of the world's poorest people depend on subsistence agriculture, and a significant number of these are beekeepers.

This talk will describe the value and role of beekeeping within the livelihoods of rural people, and will provide understanding of the types of interventions that can help people to move out of poverty, and gain other benefits too. The products of beekeeping, honey and beeswax can be of high value, with good markets, while they bring also social status, provide valuable nutrition where diets are poor, and are widely used for local medicines. At the same time, pollination by bees helps to improve crop yields and maintain biodiversity. Beekeeping therefore offers a safety net for the poor, and can deliver wealth. It is a low risk, sustainable, household-level enterprise that is feasible for people who are too financially poor to invest in more cash-intensive crops.

Bees for Development's ten recommendations for successful beekeeping development :

1. Identify the true constraints facing beekeepers
2. Use local bees wherever possible
3. Gain knowledge of local bee biology and behaviour
4. Never ignore local apicultural skills
5. Understand the issues around technology choice
6. Be prepared to invest in training & follow-up support
7. Consider issues of market access
8. Understand the issues around honey quality
9. Add value to products. Fully explore and saturate the domestic market before considering export
10. Aim to build a business that is sustainable in every aspect

Picture © Nicola Bradbear

Global bee health

GENERAL OVERVIEW OF BEE DISEASES

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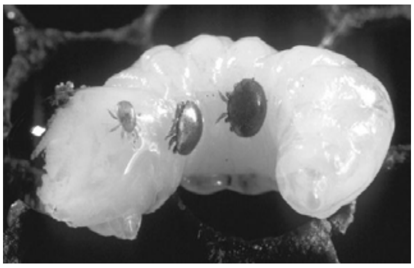
Bee health is a central concern and responsibility in beekeeping, no matter if practiced professionally or as leisure-time activity only, because only healthy bees are able to pollinate successfully and achieve a good honey harvest. Changes in management and environmental conditions continue to affect bee health considerably.

There are many different factors influencing the health of bee colonies. Certainly the beekeeper himself influences the living conditions of the bees. By breeding and selection he interferes with the natural processes by regulating them. The management method, however, summarized under the term “good beekeeping practice” is much more important. Constantly repeated interventions and frequent reorganization of nest arrangement are the mistakes most often made by beekeepers. An animal that constantly has to submit to the will of its master will feel uncomfortable. Honey is harvested by the beekeeper and often replaced by food of low quality like sugar water. Even good foraging plants like rape and sunflowers cannot cover alone the bees’ demand. Bees resistant to diseases rely on food diversity. Regarding pollen, it is true that protein provision only represents one important part of the bees’ nutritional needs. The individual pollen types possess different components, among which there are bacteria and fungi, so called antagonistic substances. Basically, they play an important role in improving the bees’ resistance capacity against diseases. As a rule, intensive agriculture and monocultures require the application of pesticides. For bee health this is certainly the biggest problem.



A honeybee pupae parasitized by a *Tropilaelaps* mite (left) and *Varroa* mites *Picture © Denis Anderson*

The bacterial diseases of the bee brood American and European *Foulbrood* are well known in most parts of the world. AFB has recently been detected in some parts of the African continent south of the Sahara desert just as the parasite *Varroa* destructor was some years ago. Certainly, the *Varroa* mite is the most disastrous example how quickly a new parasite can spread. From its first transfer in the fifties of the past century until its nearly world-wide spread, less than 50 years have passed. Because of the unbalanced parasite-host relation there is still the danger that the host population i.e. the honey bees, could be exterminated. Our struggle to stop this process by repeated intensive control measures is only partly successful. The *Varroa* mite, however, can only cause limited damage to the bee brood. Its function of transferring viruses, however, seems to be much more important. The chitin coat of bees skin offers a quite effective protection against virus infections. Only the *Varroa* mite is able to overcome this barrier by injecting certain viruses into the bee blood while sucking. The most famous and most widely spread one is the *Deformed Wing Virus.* The actual importance of many bee viruses is based on this circumstance. Another parasite, *Nosema ceranae*, has even spread more rapidly all over the world than the *Varroa* mite. With the new pathogen the clinical symptoms of this parasitosis also changed. The new *Nosema* type obviously causes more damage in warmer climatic zones than in cooler ones. But little is known about the pathogeneity and pathogenesis of this new parasite. In Asia there is another parasite at the edge of being introduced to Europe, America and Africa, the *Tropilaelaps* mite species. Its adoption to the host, the honeybee, is as perfect as with the Varroa mite. This parasite changed as well from an Asian bee species to *Apis mellifera*. Why it hasn’t spread as quickly as the Varroa mite is still not definitely clarified. Its handicap is certainly that it only infests brood but not the bee. Therefore, it cannot survive for a longer time without brood. More diseases may affect bee colonies in future as a result of global trade and climatic changes.

COLONY COLLAPSE DISORDER (CCD)

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Starting in late 2006, commercial migratory beekeepers along the East Coast of the United States began reporting sharp declines in their honeybee colonies. Because of the severity and unusual circumstances of these colony declines, scientists named this phenomenon *colony collapse disorder* (CCD). Reports indicate that beekeepers in most states have been affected. Overall, the number of managed honeybee colonies dropped an estimated 35.8% and 31.8% in the winters of 2007/2008 and 2006/2007, respectively. Preliminary loss estimates for the 2008/2009 winter are reported at 28.6%. To date, the precise reasons for the colony losses are not yet known.

Many beekeepers observed for the first time in the USA that no dead bees remained either in front of or inside the hives. They found empty hives and combs with brood of all ages and plenty of food and in certain cases, the queen along with some young bees, was still strolling over the combs. Current theories about the cause(s) of CCD include increased losses due to the invasive *Varroa* mite; new or emerging diseases, especially mortality by a new *Nosema* species (related to fungi); and pesticide poisoning (through exposure to pesticides applied for crop pest control or for in-hive insect or mite control).

A small cluster of bees is often all that is left in a CCD colony *Picture © ANSES*

In addition to these suspects, perhaps the most highly-suspected cause of CCD is a potential immune-suppressing stress on bees, caused by one or a combination of several factors. Stresses may include poor nutrition (due to apiary overcrowding, pollination of crops with low nutritional value, or pollen or nectar dearth), drought, and migratory stress brought about by the increased need to move bees long distances to provide pollination services (which, by confining bees during transport, or increasing contact among colonies in different hives, increases the transmission of pathogens). Researchers suspect that stress could be compromising the immune system of bees, making colonies more susceptible to disease.

The *U.S. Department of Agriculture* (USDA) is leading the federal government response to CCD. In 2007, USDA established a CCD Steering Committee with representatives from other government agencies and academia. The Steering Committee has developed the Colony Collapse Disorder action plan with four main components:

1. Survey/data collection to determine the extent of CCD and the current status of honeybee colony production and health;
2. Analysis of bee samples to determine the prevalence of various pests and pathogens, bee immunity and stress, and exposure to pesticides;
3. Hypothesis-driven research on four candidate factors including new and re-emerging pathogens, bee pests, environmental and nutritional stresses, and pesticides; and
4. Mitigative/preventive measures to improve bee health and habitat and to counter mortality factors.

EFFORTS ON BREEDING RESISTANT HONEY BEES

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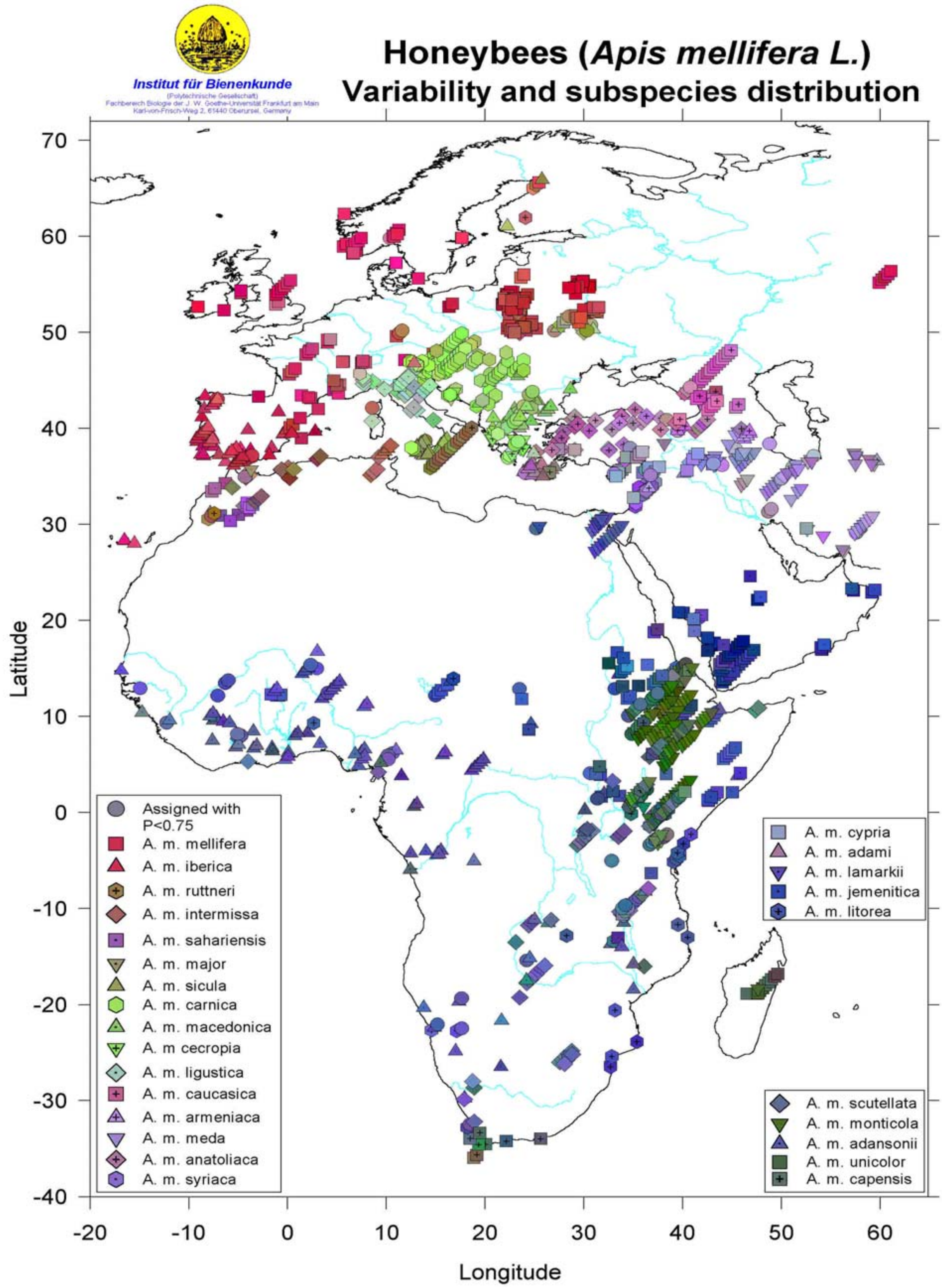
Classical breeding has produced several honeybee populations that are resistant to selected diseases in the past decades. The availability of the complete honeybee genome has opened a new era in honeybee genetics. DNA tools allow for the identification of genes that are important for colony health. The function of immune genes in the honeybee has been unravelled for several infections. The use of haploid drones in genetic studies further facilitates progress in the identification of genes that are relevant to colony health. Marker assisted selection can greatly accelerate the propagation of desirable stock. The wealth of genetic tools available, establish the honeybee as a model system for genetic research. Nevertheless, in spite of all these novel tools and innovative approaches, honeybee breeding will remain to be a difficult, labour intensive and time consuming task.



There are a great number of honeybee subspecies and types
Map © Stefan Fuchs / Institut für Bienenkunde Oberursel

OIE standards and tools with regard to diseases of honey bees

SPECIFIC CHAPTERS ON DISEASES OF BEES IN THE CODE AND THE MANUAL

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The World Organisation for Animal Health (OIE) is an intergovernmental organisation established in 1924 with 178 Member Countries (as of September 2011). Its mandate is to improve animal health, veterinary public health and animal welfare world-wide. The health of bees is included in the OIE remit.

Under this general mandate, the OIE is dedicated to:

- ensuring transparency of the animal disease situation world-wide, including diseases transmissible to humans (see paper on the World Animal Health Information System),
- collecting, analysing and disseminating veterinary scientific information,
- providing expertise and promoting international solidarity for the control of animal diseases,
- guaranteeing the sanitary safety of world trade in animals and animal products,
- improving food safety from the farm to the abattoir,
- promoting animal welfare through a science-based approach,
- improving the legal framework and resources of national Veterinary Services.

The scientifically based international standards, guidelines and recommendations (Standards) developed by the OIE in all fields covered by its mandate, are adopted, through a transparent process, by the World Assembly of Delegates[1] following the principle of "one country – one vote". OIE Standards are regularly updated to incorporate advances in the relevant science. Since the establishment of the World Trade Organization (WTO) in 1994, they are recognised as the international point of reference for animal health and zoonoses in the framework of the WTO Agreement on the Application of Sanitary and Phytosanitary Measures.

The OIE has published different Standards related to bee diseases. They are mainly laid down in two publications: the *Terrestrial Animal Health Code*[2] (*Terrestrial Code*) and the *Manual of Diagnostic Tests and Vaccines for Terrestrial Animals*[3] (*Terrestrial Manual*).

The *Terrestrial Code* is intended to assure the sanitary safety of international trade in terrestrial animals and their products. This is achieved through detailing the health measures to be used by the veterinary authorities of importing and exporting countries to avoid the transfer of agents pathogenic to animals or humans, while avoiding unjustified sanitary barriers. It is also an essential tool for supporting the mandate of the OIE in the area of improving animal health and welfare world-wide through the application of Standards on animal disease surveillance and recommended control methods. The relevant chapters of the *Terrestrial Code* for bee diseases are: Chapter 4.14. on hygiene and disease security procedures in apiaries, which states how the official health control of bee diseases should be organised at the national level; Chapter 5.10. which provides, in particular, model certificates for international trade in products of honey bee origin and in bees and brood combs; and the disease specific chapters 9.1. to 9.6. covering the six bee diseases listed by the OIE (acarapisosis, American and European Foulbrood, small hive beetle infestation, *Tropilaelaps* infestation, and varroosis). OIE is currently updating all the *Terrestrial Code* chapters on bee diseases through an OIE *ad hoc* Group.

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1 Delegates are the representatives of the OIE Member Countries. They are usually the chief veterinary officer (CVO) and are officially nominated by the Government of their country.
2 All the chapters are downloadable from the OIE website: http://www.oie.int/eng/normes/mcode/en_sommaire.htm, website consulted 01/07/2011.
3 All the chapters are downloadable from the OIE website: http://www.oie.int/eng/normes/mmanual/A_summry.htm, website consulted 01/07/2011.

As a companion volume to the *Terrestrial Code*, the *Terrestrial Manual* provides internationally agreed diagnostic laboratory methods and, when relevant, requirements for the production and control of vaccines and other biological products for all OIE listed diseases as well as several other diseases of global importance. There is a chapter on each of the six bee diseases listed by the OIE, as well as an additional one on nosemosis of honeybees.

The missions of the OIE rely heavily on the Veterinary Services of each Member Country. It is the reason why in parallel and in synergy with the development of Standards, the OIE provides a continuing support to Veterinary Services and laboratories to enable OIE Member Countries to implement them. One example of OIE support is the OIE Laboratory Twinning Programme. Launched in 2006, it creates opportunities for the staff of the laboratories in developing and in-transition countries to improve their scientific knowledge on laboratory diagnostic tests method and to successfully implement the OIE Standards. The programme aims at mobilising the existing expertise of the whole network of the OIE Reference Laboratories and Collaborating Centres[4] to develop capacities in geographical areas that are currently under-represented.

For bee diseases, the OIE and its Member Countries can benefit from the support and expertise of several OIE Reference Laboratories (two on bee diseases in general, one in France and one in Germany, and one for American Foulbrood of honey bees in Argentina).

The OIE also provides veterinary scientific information worldwide. A publication on the veterinarians and the bees (OIE Technical Series [n°12]) is in preparation and is planned to be published for the end of 2012.

The importance of bee health in the future OIE activities was recently highlighted by the Director General of the OIE, Dr Bernard Vallat, who stated that "OIE considers bee mortality and bee diseases to be a priority in its Fifth Strategic Plan 2011–2015"[5].

4 265 OIE Reference Laboratories and Collaborating Centres in May 2011, the list of the Reference Laboratories is available at: http://www.oie.int/en/our-scientific-expertise/reference-laboratories/list-of-laboratories/ and the list of Collaborating Centres is available at: http://www.oie.int/en/our-scientific-expertise/collaborating-centres/list-of-centres/, website consulted 01/07/2011.

5 OIE press release issued 28 April 2010 on "Health problems of bees are due to multiple factors", available on the OIE website at: http://www.oie.int/en/for-the-media/press-releases/detail/article/health-problems-of-bees-are-due-to-multiple-factors, website consulted 01/07/2011.

REFERENCE LABORATORIES AND COLLABORATING CENTRES : INTRODUCTION

Neo J. Mapitse

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OIE Reference Centres is a term encompassing both OIE Reference Laboratories and Collaborating Centres which are spread globally and form a network of expertise at the disposal of the OIE. OIE Reference Laboratories are designated to pursue all the scientific and technical problems relating to a named disease or specific topic. The Expert, responsible to the OIE and its Members with regard to these issues, should be a leading and active researcher helping the Reference Laboratory to provide scientific and technical assistance and expert advice on topics linked to surveillance and control of the designated disease. They may also provide scientific and technical training for personnel from Members, and coordinate scientific and technical studies in collaboration with other laboratories or organisations, including through OIE Laboratory Twinning. There are specific mandates for reference laboratories and these are assessed and the reports published annually. In 2010, 99% of the RL had tests in use or available for the specified disease and 89% produced and distributed diagnostic reagents, and delivered presentations and publications.

Screen-capture of the OIE Africa webpage dedicated to Reference Laboratories in Africa *© oie (2011)*

The OIE Collaborating Centres deal with a specific designated sphere of competence relating to the management of general questions on animal health issues ("specialty"). Examples of these specialties include epidemiology, risk analysis, training of veterinary officials and veterinary products. Their activities are also assessed and published annually on the OIE website.

In 2011, the OIE has a global network of 225 Reference Laboratories with 166 experts covering 111 diseases/topics in 37 countries, and 40 Collaborating Centres covering 38 topics in 21 countries. The African region has 11 RL in 4 countries and 3 CC in 2 countries. More details on the individual centre may be uploaded from the OIE website and the OIE Africa websites.

THE REFERENCE LABORATORY FOR BEE DISEASES (SOPHIA ANTIPOLIS)

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On 29 October 2010, the European Commission (*Directorate General for Health and Consumers*) appointed the ANSES Sophia-Antipolis laboratory as the European Union Reference Laboratory for bee health. This was made official by publication in the Official Journal on 2 February 2011.

The 2009 EFSA project entitled *"Bee mortality and bee surveillance in Europe"* highlights the variety of factors involved in the decline of the honeybee population. These include bee diseases and parasites, poisoning from pesticides, the potential impact of genetically modified crops and stress related to changes in food and climatic conditions. Until now, no direct causal link has been established between the rise in honeybee mortality and specific pathogenic substances or agents. Monitoring programmes must be conducted which give precedence to these areas. One of the priority missions of the EU Reference Laboratory for honeybee health will be to provide scientific and technical support to the European commission for the implementation of an *ad hoc* pilot epidemiological surveillance programme.

Lastly, the EU RL for bee health will cover a broad scope based on the main parasitic, bacterial and viral bee diseases, as well as on the invasive species (insects and mites) threatening the bee population. The laboratory will address the aspect of colony poisoning through research on the most dangerous pesticide residues for bees.

Tests on living honeybees *Picture © ANSES*

The EU RL for honeybee health shall have, as duties and functions, to coordinate, in consultation with the Commission, the methods employed in the Member States for diagnosing the relevant bee diseases, specifically by: typing, storing and, where appropriate, supplying strains of the pathogenic agents to facilitate the diagnostic service in the EU. These will be used for example for epidemiological follow-ups or verification of diagnosis. The EU RL will also have to supply standard materials to the *National Reference Laboratories* (NRLs) in order to standardise the test used in each Member State. The EU RL will organise periodic comparative tests of diagnostic procedures at EU level with the NRLs designated by the Member States, in order to provide information on the methods of diagnosis used and the result of the test carried out in the EU. Lastly, the EU RL will retain expertise on the *Tropilaelaps* mites and the small hive beetle (*Aethina tumida*) and other pertinent pathogenic agents to enable rapid differential diagnosis;

The EU RL shall assist actively in the diagnosis of outbreaks of the relevant disease in Member States by receiving pathogen isolates for confirmatory diagnosis, characterisation and epizootic studies. The EU RL will also facilitate the training or retraining of experts in laboratory diagnosis with a view to harmonising diagnostic techniques throughout the EU. It will organise workshops for the benefit of national reference laboratories.

THE REFERENCE LABORATORY FOR BEE DISEASES (FREIBURG)

Wolfgang Ritter

Head of Bee branch
Chemisches und Veterinäruntersuchungsamt
Institute for Animal Health
Freiburg, Germany

Freiburg is found in the south-west of Germany, near the borders with France and Switzerland. It is a university town of 220 000 inhabitants, and with a university that is already more than five hundred years old. Included in the town is the Institute for Animal Health and Disease Control, an EU certified reference facility.

The Institute for Animal Health and Food Control at Freiburg *Picture © Wolfgang Ritter*

Part of the Institute is the Bee laboratory, which has 8 permanent employees as well as a number of students. 600 bee inspectors are trained by the lab, spread all over the country and paid by the German government, and are used in the collection of samples and inspection of apiaries.

The Bee lab also

- Processes about 5 00 samples per annum;
- Conducts about 10 000 field inspections per annum;
- Holds about 20 training courses per year, mostly for veterinarians;
- Holds symposia and workshops;
- Offers diagnosis of bee diseases for samples from all over the world;
- Assists with establishment of National Reference Laboratories and National Surveillance Programmes for other counties.

THE REFERENCE LABORATORY FOR AMERICAN FOULBROOD (LA PLATA)

Adriana M. Alippi

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Since March, 2008, the UB-CIDEFI has been proposed as OIE Reference Laboratory for American Foulbrood, with Adriana M. Alippi as designated expert.

Current research projects are:

- American Foulbrood of honeybees: development of new methods for diagnosis and control.
- Study of the biodiversity of the larval honeybee pathogen *Paenibacillus larvae*.
- Study of the molecular basis of tetracycline resistance in *Paenibacillus larvae* and other spore-forming bacteria commonly found in honey and other apiary sources.
- Study of virulence factors of *Bacillus cereus* and *Bacillus megaterium* isolates from honey.
- Study of the epidemiology of tetracycline-resistant *P. larvae* strains.

The Faculty of Agricultural Sciences building in La Plata *Picture © Adriana Alippi*

The main objectives are:

- Investigate the degree of diversity of *Paenibacillus larvae* populations from different geographical areas by means of microbiological and molecular markers.
- Characterize antagonistic compounds produced by different spore-forming bacteria isolated from honey and other apiary sources that were biologically active against *P. larvae.*
- Characterize antibacterial biocides by biological activities, toxicity to larvae and adult honeybees and *in vitro* toxicity to human intestinal cells.
- Evaluate alternative non-contaminant natural biocides to prevent and control AFB in infected colonies.
- Investigate the tetracycline and oxytetracycline resistance determinants in populations of *P. larvae* and other related genera isolated from honey and honeybees.
- Characterize natural tetracycline resistant plasmids from *P. larvae* and other *Paenibacillus* and *Bacillus* species that share the same ecological niche.

Other activities conducted by the laboratory are:

- Supply of reference bacterial strains: the laboratory boasts a collection of more than 1 000 specimens of *Paenibacillus* larvae and other spore-forming bacterial species isolated from honey and other apiary sources, characterized by microbiological and molecular techniques.
- Provision of diagnostic testing facilities on AFB to other OIE members on an individual level (Research Institutes, Universities, Government agencies, etc.).
- Consultant in relation to AFB.
- Adviser of scholars and researchers.
- Training courses for diagnosis of AFB and other bacterial diseases.

Laboratory equipment used in the detection and determination of honeybee pathogens
Pictures © Adriana Alippi

TWINNING

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The concept was launched at the first conference of the OIE Reference Centres in 2006 and a resolution on twinning was adopted in May 2007. A twinning manual to guide the process, project management, agreements etc is published and can be accessed from the OIE website. The aim of the OIE Laboratories Twinning Programme is to build expertise for the most important animal diseases and zoonoses in priority regions, in direct support of the OIE's strategy to improve global capacity for disease prevention, detection, and control through better veterinary governance. Through twinning, OIE aims to provide a more balanced north-south distribution of advanced expertise, for a better global geographic coverage allowing more countries to access high quality diagnostic testing and technical knowledge within their own region, thus facilitating early disease detection and rapid control. A high level of scientific expertise is also essential to allow countries to formulate science-based animal health control strategies and to maintain veterinary scientific communities to support the standard setting process and improve compliance to OIE standards.

Twinning : candidate laboratories and collaborating centres. Map © oie (2011)

Key : ● Ongoing twinning : candidate laboratories
● Completed twinning : candidate laboratories
▲ On going twinning : candidate collaborating centres
▲ Twinning due to commence : candidate laboratories

Each twinning project links an existing OIE Reference Centre with a selected candidate laboratory. Knowledge and skills are exchanged over a determined project period. Twinning projects provide mutual benefits for both laboratories including through creating collaborative research opportunities, and the benefits from stronger global disease surveillance networks.

By May 2011, there were 38 projects ongoing of which 16 were in Africa. 12 of the 29 approved and ongoing projects were in Africa. 3 of 6 approved and due to commence twinning projects were also in Africa, showing the importance of an improvement of laboratory diagnostic capacity and expertise for Africa in the OIE. Diseases or topics include CBPP, HPAI, Bluetongue, Brucellosis, AHS, Rabies, Trichinellosis, ovine chlamydiosis, African Animal Trypanosomosis, EUS, food safety, improved diagnostic capacity and veterinary products. Since there is no ongoing twinning project to improve capacity in Southern Africa or the entire continent on honeybee health, the twinning programme may provide opportunities to close the gap in the ever increasing growth of the honey industry and the demand for more knowledge on honeybee health.

THE WORLD ANIMAL HEALTH INFORMATION SYSTEM (WAHIS)

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Since its creation both the OIE and its Members are required to report all relevant information in animal diseases. These obligations are stated in the OIE Organic Statutes and in the OIE Standards (*Terrestrial Animal Health Code and Aquatic Animal Health Code*).

The World Animal Health Information System (WAHIS) was launched in 2005 and it enables the OIE Members to process data on animal diseases and enables OIE to spread worldwide alert messages on all relevant epidemiological events in OIE Members and changes in the animal health situation relating to more than 93 terrestrial animal diseases (including six bee diseases) and 26 aquatic animal diseases.

Information generated by the system is available through the World Animal Health Information Database Interface, WAHID.

Only authorised users have a secure access to WAHIS, namely OIE Delegates and their authorised representatives (OIE Focal Points) that use WAHIS to notify the OIE of any relevant animal disease information.

WAHIS can be divided into two components: an early warning system and a monitoring system.

The early warning system provides alert messages on exceptional epidemiological events to enable rapid responses. The monitoring system monitors the presence/absence of diseases over time along with the control measures for each disease in each country.

Whenever an exceptional epidemiological event is confirmed, including those relating to bee diseases, Members inform the OIE within 24 hours providing an immediate notification report containing the following information: the reason for the notification, the name of the disease, the species affected, the geographic coordinates of the outbreak(s), the control measures applied and any the laboratory tests carried out or in progress.

The reasons for immediate notification of a disease of terrestrial animals are the following:

- First occurrence of a listed disease and/or infection in a country, a zone or a compartment;
- Re-occurrence of a listed disease and/or infection in a country, a zone or a compartment following a report declared the outbreak ended;
- First occurrence of a new strain of a pathogen of an OIE listed disease in a country, a zone or a compartment;
- A sudden and unexpected increase in the distribution, incidence, morbidity or mortality of a listed disease prevalent within a country, a zone or a compartment;
- An emerging disease with significant morbidity or mortality, or zoonotic potential;
- Evidence of change in the epidemiology of a listed disease (including host range, pathogenicity, strain) in particular if there is a zoonotic impact.

After immediate notification have been received, verified and validated by the OIE, they are published and distributed by email to OIE Delegates and to the subscribers on the OIE open distribution list (currently there are more than 8000 emails distributed).

Members that have sent an immediate notification report must then provide follow-up reports on a weekly basis in order to monitor the evolution of the event. When the event has been either resolved or the disease has become endemic Members have to submit a Final report explaining the reason for closing the event. If the disease is an OIE-listed disease and has become endemic, information will be submitted in the six-monthly reports.

Six-monthly reports provide information on the presence/absence of OIE-listed diseases, on the prevention and control measures applied if the disease is present or that would be applied if the disease occurs in the country. For diseases reported to have been present during a given six-month period, countries must provide quantitative data on the number of outbreaks, the mortality and morbidity rates, and/or the number of affected animals.

In 2002 the OIE introduced an active search procedure to track non-official information and rumours on animal health including bee diseases and zoonosis in humans. Information obtained from various sources is evaluated in the context of the animal health situation. Active search of unofficial sources improves the OIE's early warning system. Information is verified with OIE Delegates and only officially confirmed information is published by the OIE.

The data and information provided by Members are accessible via the Web interface WAHID (World Animal Health Information Database) and can be accessed by the public through the OIE website.

Table 1 – occurrence of bee diseases in Africa in year 2009

Disease [6]	Country [6]	Occurrence
Acarapisosis of honey bees	Kenya	Suspected
American Foulbrood of honey bees	Algeria	Clinical disease
	South Africa	Clinical disease
Small hive beetle infestation *(Aethina tumida)*	Congo (Dem. Rep. of)	Suspected
	Sudan	Infection without clinical manifestation
Tropilaelaps infestation of honey bees	Congo (Dem. Rep. of)	Suspected
Varroosis of honey bees	Algeria	Clinical disease
	Mozambique	Infection without clinical manifestation
	Swaziland	Suspected
	Zimbabwe	Clinical disease

[6] In alphabetical order

Six bee diseases are included in the OIE-list, namely: Acarapisosis of honeybees (*Acarapis woodi*), American Foulbrood of honeybees (*Paenibacillus larvae*), European Foulbrood of honeybees (*Melissococcus plutonius*), Small hive beetle infestation (*Aethina tumida*), Tropilaelaps infestation of honeybees (*Tropilaelaps clareae, T. koenigerum, T. thaii* and *T. mercedesae*), and Varroosis of honeybees (*Varroa destructor*).

According to the data present in WAHID the presence or the suspected presence of bee diseases was notified by 179 Members in year 2009 and by 161 Members in year 2010.

African countries notify the presence of bee diseases (table 1 and 2) but if compared with the scientific information available worldwide it seems that bee diseases are under reported in Africa. An improvement in bee disease notification by Members would further improve the transparency on bee disease situation, would stimulate efficiency of data collection and it will certainly enhance our knowledge of the health situation of bees worldwide.

Table 2 - occurrence of bee diseases in Africa in year 2010

Disease [6]	Country [6]	Occurrence
American Foulbrood of honey bees	Algeria	Clinical disease
European Foulbrood of honey bees	Algeria	Clinical disease
Small hive beetle infestation *(Aethina tumida)*	Sudan	Infection without clinical manifestation
Varroosis of honey bees	Algeria	Clinical disease
	Madagascar	Clinical disease limited to certain zones
	Swaziland	Suspected
	Zimbabwe	Clinical disease

Diseases of honey bees

VIRAL DISEASES OF BEES

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All forms of life are attacked by viruses, and there is a wide variety of virus types. Some virus types are specific to a narrow range of hosts, while others can infect many different hosts. Virus particles are little more than genetic material (DNA or RNA) enclosed in a protective coat of protein, and they multiply only in the living cells of their host. Most are so small that they can be seen only by electron microscopy. The particles of many unrelated viruses, responsible for different diseases, are indistinguishable by electron microscopy and can only be distinguished by indirect methods or occasionally by the symptoms they produce.

In common with many mammalian viruses, most, if not all, of the honeybee viruses persist in the population in covert infection in living individuals. Consequently, many honeybee viruses commonly occur in bee populations from colonies that continue to appear healthy even when several different viruses are present. Such covert infections may be maintained in populations for many generations causing little or no harm, yet in certain circumstances they may be stimulated or activated to replicate rapidly or to infect sensitive stages or organs and initiate overt (acute) and often fatal infections.

Moreover, some bee viruses may be causally associated with other common bee parasites, such as the midgut microsporidian parasite *Nosema* spp. and the ectoparasite *Varroa destructor*. Honeybee viruses have also been detected in other honey bee parasites, predators and pests such as the small hive beetle (*Aethina tumida*), ectoparasitic mites (*Tropilaelaps* spp.), wasps and hornets (*Vespa* spp.).

A dead pupae caused by sacbrood virus
Picture © ANSES

Approximately eighteen distinct viruses were identified historically in the genus *Apis*. Some were isolated only once or were not considered sufficiently important for detailed study. With the exception of *filamentous virus* (FV) and *Apis iridescent virus* (AIV), which have DNA genomes, all are single-stranded RNA viruses with a globally isometric shape. Apart from minor differences in particle size, most are indistinguishable on particle morphology, with the exception of *chronic bee paralysis virus* (CBPV), whose particles are distinctly an-isometric. However, the viruses differ greatly in their genetic and protein composition and these properties form the basis of most of the diagnostic tests.

Many bee viruses are extremely common. Although able to cause severe, even fatal, diseases most bee viruses persist and spread harmlessly within and between bee populations. There are more different types of bee viruses than there are other bee pathogens. This, together with the difficult laboratory virus identification, has historically probably been a major reason for the confusing diagnosis and management of honey bee diseases. Despite the welcome increase in detection accuracy afforded by the current molecular detection methods, their excessive sensitivity presents a different problem: the mere presence of virus in an individual or population does not have inevitable pathological consequences. Virus detection therefore is still in a state of development and still needs to be adapted to thorough quantitative criteria for accurate evaluation of their natural history, epidemiology and pathology.

BACTERIAL BROOD DISEASES : EUROPEAN FOULBROOD (EFB)

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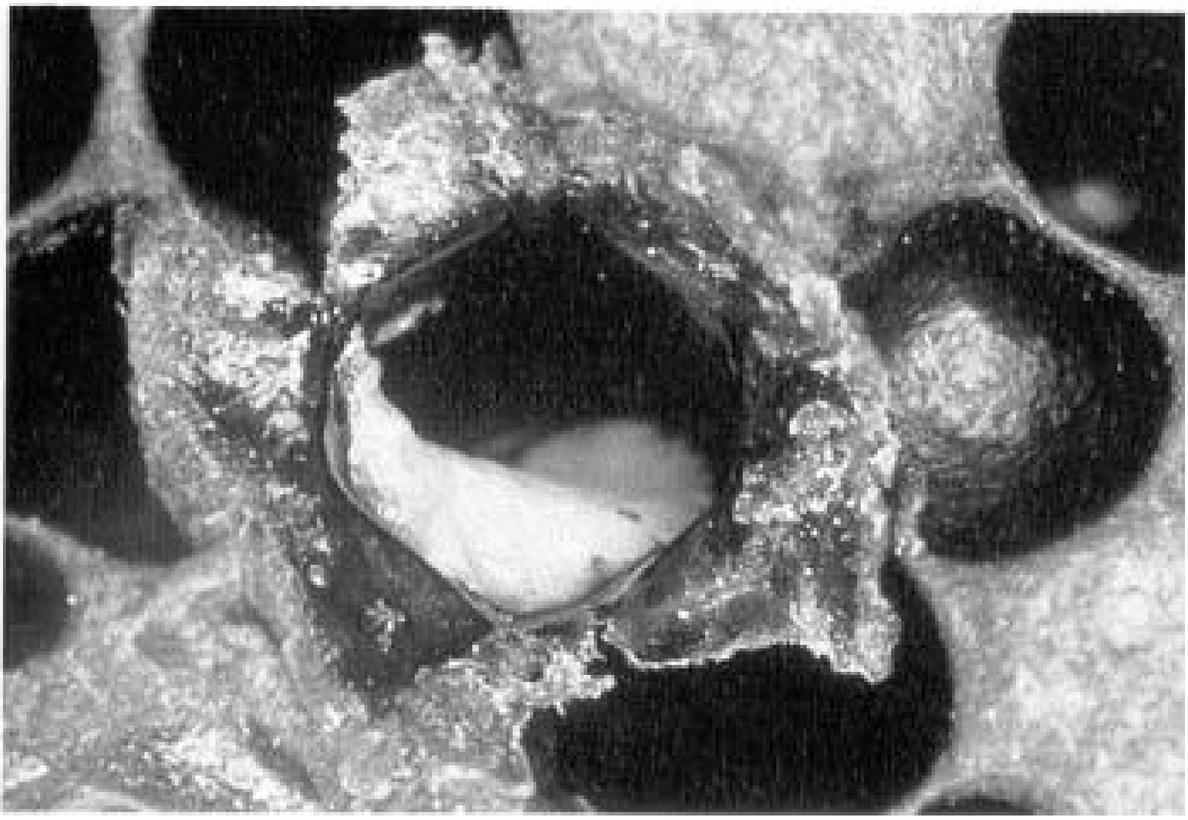
European Foulbrood (EFB) is a bacterial brood disease caused by the Gram-positive non spore-forming bacterium *Melissococcus plutonius.* The bacterium affects larvae of the Western honeybee (*Apis mellifera* including all their subspecies, *A.m. mellifera, A.m. ligustica, A.m. carnica, A. m. scutellata,)* and also *Apis cerana* and *Apis laboriosa.* The disease is widely distributed worldwide except for New Zealand. *European Foulbrood* (EFB) is not considered to be a serious disease by most beekeepers. However, in some areas and under certain conditions, EFB has been known to cause severe losses in brood, resulting in lower honey yields. The disease becomes a real problem in colonies deficient in proteins. The deficiency can be due not only to a lack of pollen but also to an imbalance between the number of nurse bees and the number of larvae to be fed. EFB appears less frequently than AFB, but may be more frequent with certain strains of bees and when the queen is old. EFB is classified within the OIE list (*World Organization for Animal Health*) and considered to be of socio-economic impact and significance in the international trade of bees and bee products.



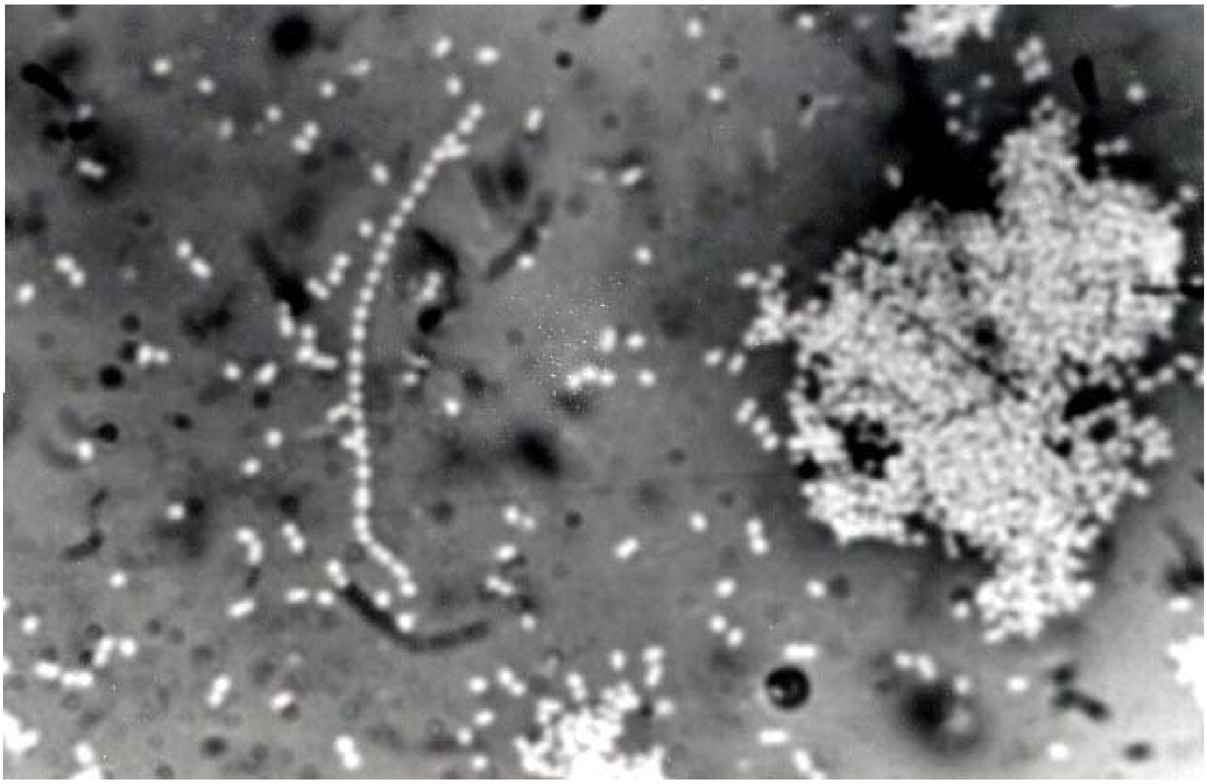
Larvae with EFB have a 'melted' appearance in the cells.
Picture © M.V. Smith, University of Guelph. http://www.wncbees.org/pests/efb.cfm

Often the disease arises in mid to late spring, when colonies are building up to a maximum population. The infectious cycle begins when larvae are contaminated by consuming food with *M. plutonius*. The bacteria multiply rapidly in the midgut competing for food with its host. Normally, larvae are infected during the first 2 days after hatching. Larvae are susceptible at any stage but young larvae are more susceptible. By the time the larva is 5 days old, the area in the midgut that should be occupied by the food mass is occupied by bacteria. As bacteria and larvae compete for food, the appetite of infected larvae increases, and nurse bees usually eject larvae with abnormal food demands. In this way a strong colony can eliminate diseased larvae and keep EFB under control. However, if the ratio of nurse bees to larvae is high, even infected larvae receive enough attention to stay alive, thus prolonging the disease. When nectar flows begin, brood quantity increases, nurse bees are enrolled to foraging duties, larvae receive less individual attention, and infected larvae show EFB symptoms and die. As long as bees clean out dead and infected larvae, the disease usually goes away on its own. Some infected larvae may survive and pupate and bacteria are discharged with the faeces and deposited on the cells, mainly at the base and on the cappings. These surviving larvae produce pupae of subnormal weight, because the bacteria have assimilated much of their food. Transmission of EFB between colonies is the same as for AFB.

EFB usually affects young larvae which die while still coiled. They turned yellow at first and then brown, at which time the tracheal system becomes quite visible. Larvae die at the age of 4 to 5 days, rarely in capped cells. Infected larva move in the brood cell assuming unnatural positions in the cells. The larvae eventually decay to a point where they form dry rubbery scales which are easier to remove than those caused by AFB. The odour of a larvae infected with EFB varies with the presence of saprophytes, but is usually described as a sour smell or rotten fish-like odour. The symptoms vary as several other types of bacteria are often present in the affected brood, and most of them have from one time to another been considered as being the causative agent of EFB. The mechanisms of pathogenesis and the role of secondary bacterial invaders are still poorly understood. These secondary invaders do not cause EFB but do influence the odour and consistency of the dead brood include *Achromobacter eurydice* which occurs in healthy larvae, but appears more frequently in larvae infected with *M. plutonius.* The source of this species seems to be the alimentary canals of adult bees, particularly foragers. Bacteria of the genus *Enterococcus* have been reported from many apiarian sources, with *E. faecalis* being the most commonly found in EFB infected larvae. The presence of *Paenibacillus alvei* spores is normally used as an indicator of EFB, but at the same time, it has been recognized as a saprophytic Gram-positive spore-forming bacterium that germinates, multiplies and survives on the dead remains of larvae. In a similar way, but less frequently, the spore-forming bacteria *Brevibacillus laterosporus* and *Paenibacillus apiarius* can be founded in larval remains affected from EFB.

These bacteria are sometimes considered symbiotic but this has never been clearly established. Each of the microorganisms mentioned above has at one time or another been considered to be the causative agent of EFB, however no experimental data have been presented to justified such claims. In contrast, many infective test causing disease in bee colonies with cultured *M. plutonius* have been reported although more severe clinical symptoms were observed when using extracted naturally infected larvae. This may be partly due to the quick decrease of *M. plutonius* virulence after culturing.

Diagnosis of EFB in the field is based on the visual inspection of brood combs and detection of infected larvae. Diagnosis can be further verified by the microscopic examination of stained smears by carbol fuchsin or nigrosine. Recently, a lateral flow devise for the detection of EFB by using monoclonal antibodies has been developed and is commercially available as a field test. PCR assays has also been developed for the diagnosis of EFB and the detection of *M. plutonius* in bee products and also real time PCR makes quantification possible even though with small numbers of bacterial cells. In addition, selective media for cultivation of *M. plutonius* are also available.



Melissococcus plutonius in a smear prepared from diseased brood
and negatively stained with nigrosin *Picture © Adriana Alippi*

BACTERIAL BROOD DISEASES : AMERICAN FOULBROOD (AFB)

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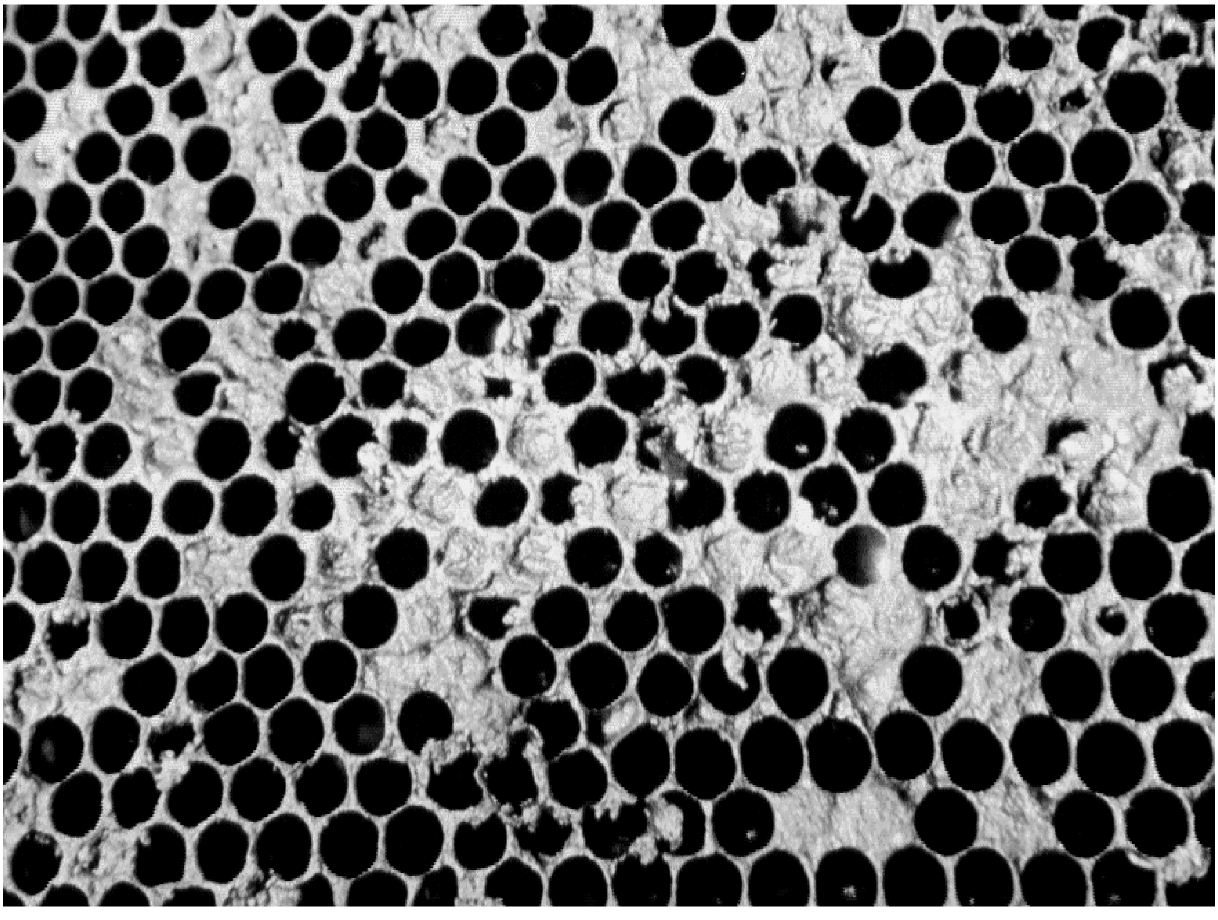
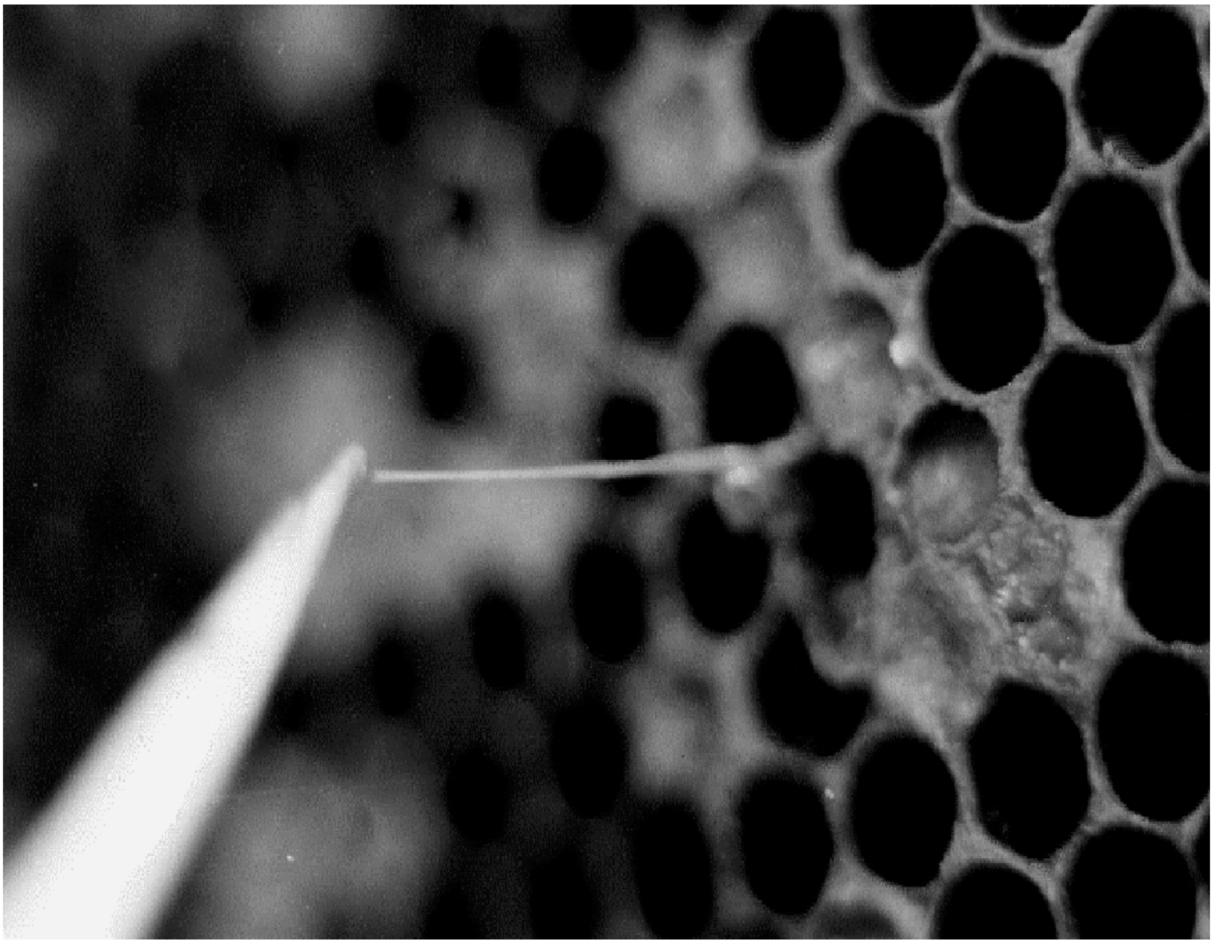
American Foulbrood (AFB) is considered as the most contagious and destructive infectious disease affecting the larval and pupal stages of honeybees. The causative agent is *Paenibacillus larvae*, a Gram-positive and spore-forming bacterium firstly described at the beginning of the 20th century. AFB occurs in temperate and sub-tropical regions throughout the world and leads to huge losses not only in apicultural economy but also in pollination rates, since *A. mellifera* is the most widely used actively managed pollinator in the world. Due to its highly contagious nature and virulence, it is a notifiable disease in many countries. AFB is classified within the OIE list (*World Organization for Animal Health*) and considered to be of socio-economic impact and significance in the international trade of bees and bee products.



Brood comb affected by AFB showing a `patchy appearance` with sunken and discoloured cappings
Picture © Adriana Alippi

AFB possesses unique problems for prevention and control because bacterial spores can remain viable for long periods and survive adverse conditions (desiccation, high temperatures, UV light exposure, and also resist contact with classical disinfectants). Spores transmit the disease and are infectious only for larvae, not for adult bees. Newly emerging larvae (12-36 hours after hatching) are the most vulnerable with as few as 10 spores being sufficient to cause disease, but susceptibility rapidly decreases when they get older. Larvae become infected by consuming spores present in their food; the spores germinate in the larval midgut and vegetative bacteria massively proliferate within the midgut living like commensals from the food ingested by larvae. At this point, the larval gut contains nothing but these pathogenic bacteria that then breach the epithelium and invade the haemocoel causing the larval death. Recent studies revealed that *P. larvae* uses the paracellular route for crossing the midgut epithelium and enter into the organ cavity.



The ‘Ropy’ test is diagnostic for AFB *Picture © Adriana Alippi*

After the infected larvae have died from AFB, the bacteria degrade the remains which increases in viscidity and adhere to an object, such as a toothpick and string out in a thread of gummy substance for a considerable distance (ropy stage), and give the colony a ''foul'' look and smell. As time passes, single not-removed larva or pupa dry to form a hard scale, which adhere firmly to the bottom of the cells and are very difficult for the bees to remove. One single scale contains about 2,500 million spores. Infection is spread by 2 main routes: first, 8-19% of larvae reared in cells, which previously contain infected larvae become infected themselves, and second, cell-cleaner bees transmit spores to larval food when they became nurse bees. Bacteria proliferate in the larval tissues before pupation and infected larvae quickly die and spore form, mostly in propupae 11 days-old after egg hatching.

The transfer of AFB from one colony to another is an essential step in the disease cycle. Transmission of AFB is possible both vertically and horizontally in a number of ways. AFB can be horizontally transmitted by letting bees rob contaminated colonies; the feeding of infected honey and pollen; transferring frames of brood from diseased colonies to healthy ones; using hive equipment which at some time has been contaminated with *P. larvae* spores; installing infected package bees or queens; and, in a minor way, by drifting bees. In addition, vertical transmission of spores between colonies is possible through swarming.

Traditional methods such as the recognition of typical clinical symptoms of infection, culture of *P. larvae* from diseased brood, and microscopy provide effective and inexpensive means of diagnosing the disease. Clinical diagnosis of AFB is based on the identification of the pathogenic agent by microscopic examination of stained smears of dead or sick larvae with 0.2% carbol fuchsin. Apart from the distinctive clinical symptoms, laboratory confirmation of the presence of *P. larvae* is required in most countries where AFB is a notifiable disease. For laboratory diagnosis, spores can be isolated and cultured from various sources including ropy larval remains, scales, honey, pollen, wax and adult bees.

In the last 20 years, considerable progress has been made in the understanding and taxonomic reclassification of the causative agent as well as in the diagnosis of AFB. Diverse genotypes of the pathogen with different virulence have been identified by using rep-PCR fingerprinting and by using exposure bioassays to infect young larvae, respectively. PCR methods for identification and genotyping of the pathogen from brood and bee products have now been extensively developed. Nevertheless, biochemical profiling, bacteriophage sensitivity, immunotechniques and microscopy of suspect bacterial strains are entirely adequate for routine identification purposes.

AFB IN SOUTHERN AFRICA : CURRENT DIAGNOSTIC CAPACITY

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The Bacterial Disease Unit of the ARC-PPRI in Pretoria primarily works on the diagnosis of the bacterial diseases of crops, on designing detection systems for plant pathogenic bacteria, and on the taxonomy of bacteria. The unit first worked on American Foulbrood (AFB) disease of honeybees in 2006 when honey samples from all over South Africa were analysed for the presence of the infectious agent, the bacterium *Paenibacillus larvae larvae*. Samples of hive-collected honey and retail honey were analysed from 2006-2009 by means of various methods; namely biochemical tests such as Biolog API30, the use of selective media, and various PCR methods. Positive samples from Europe were used as controls.

Honey samples from all over South Africa were tested *Picture © Teresa Goszczynska*

All hive collected samples found during this survey were AFB negative, suggesting that there was no clinical American Foulbrood in the colonies of South African honeybees. Some positive retail samples were found, however, suggesting that non-irradiated imported honey was being marketed in South Africa.

A brood sample in February 2009 was the first clinical AFB found in South Africa, and resulted in countrywide sampling by officials of DAFF (Department of Agriculture, Forestry and Fisheries). The basic OIE procedures were followed for the testing of these samples, and honey, brood, bees and debris samples were tested. Type strains and imported AFB positive honey were used as positive controls, and in addition, results were verified by three international laboratories, including two of the OIE Reference Laboratories for honeybee diseases.

A total of 2033 samples were analysed from the DAFF survey, as well as samples from other SADC countries. The Bacterial Disease Unit of the ARC-PPRI is now fully equipped for the diagnosis of AFB, and stands ready to be twinned with an existing OIE Reference Laboratory or registered as an OIE laboratory.

OIE procedures were followed in the testing of honey samples *Picture © Teresa Goszczynska*

AFB IN SOUTHERN AFRICA : HOW FAR HAS IT SPREAD ?

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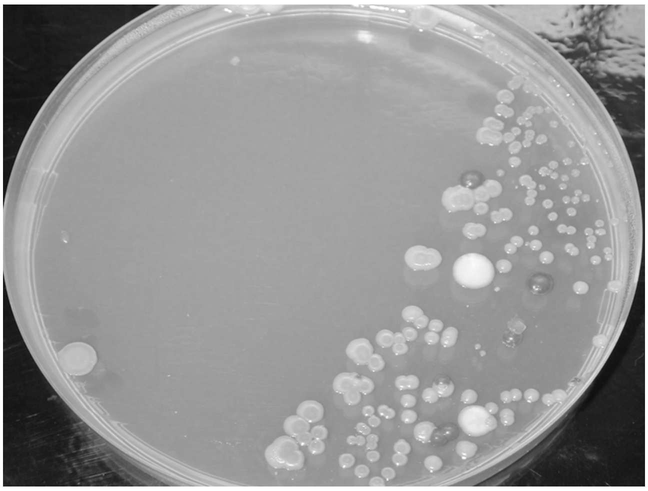
Prior to 2009 American Foulbrood (AFB) had only been found in retail honey samples in South Africa, never in hive collected samples, and no clinical symptoms of the disease had ever been recorded. A national survey from 2005-2009 examined 140 hives from all over South Africa, all of which were negative for AFB. 4 AFB positive results were found in retail samples in the same survey. It was concluded that there was no AFB in the honeybee colonies of South Africa, but that AFB positive honey was being imported into South Africa without the necessary irradiation.

Sampling for AFB in South African apiaries *Picture © Teresa Goszczynska*

The first clinical symptoms of AFB were found in a Cape Town colony in December 2008, and confirmed with laboratory tests in February 2009. This find resulted in a nationwide survey for the disease with more than two thousand colonies being opened, examined and sampled. Clinical AFB was only found in the Western Cape, centred around two loci: Cape Town and Oudtshoorn. North of the "Capensis Line', only sub-clinical AFB positive results were found. That is, colonies that were AFB positive from laboratory results but where no clinical symptoms were present. It can therefore be concluded that the AFB infection was limited to the Western Cape. Furthermore, the outbreak has rapidly diminished in severity, with 17% of inspected colonies being infected in September 2009 and only 1% infected in January 2011.

The AFB disease outbreak in South Africa is concluded to have been limited to the Western Cape, to have being caused by AFB positive honey being introduced into the country, and to have rapidly dissipated in the population, which is essentially tolerant to the disease.

No AFB positive samples were found in surveys of honeybee colonies in Swaziland or Zambia, nor in small numbers of honey samples from other SADC countries. It is not possible, however, to declare the SADC region as AFB free until more comprehensive surveys are completed.



Paenibacillus larvae larvae cultured on J agar plates
Picture © Teresa Goszczynska

AFB IN SOUTH AFRICA - HOW TO MAKE SENSE OF IT ?

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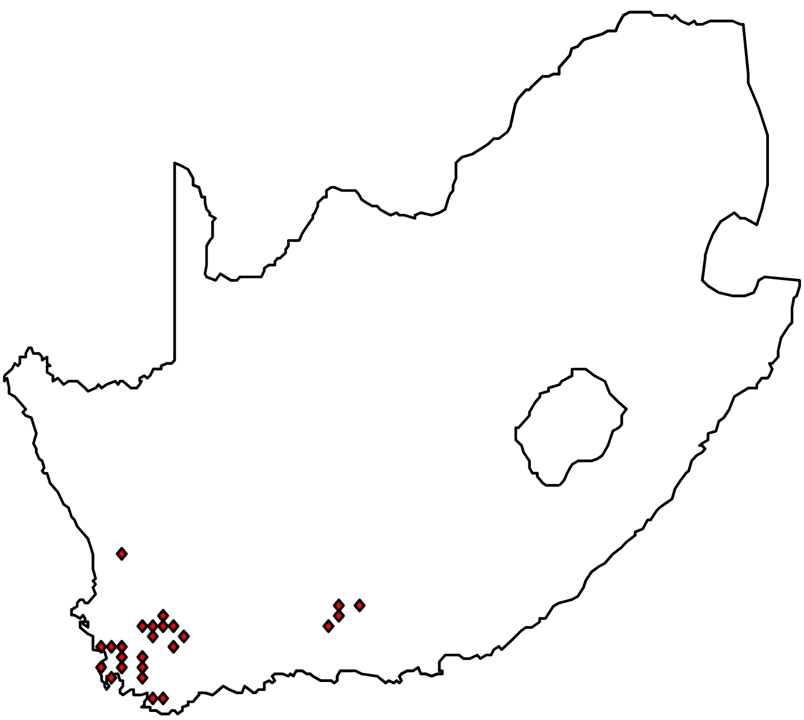
Clinical symptoms of *American Foulbrood* (AFB), a bacterial disease of honeybee brood, had never been reported in sub-Saharan Africa prior to 2009. This was despite AFB positive honey being reported in a number of African countries, and there being no restrictions on the importation of honey or honeybees into almost the whole of Africa. In a substantial survey of hive-collected and retail samples in South Africa from 2005-2009, no AFB positive hive samples were found and only a few positive retail samples, confirming that there was no American Foulbrood in the country.

Concluding that African honeybees were tolerant to AFB therefore seemed appropriate, and hence the outbreak of AFB in the Western Cape in 2009 was a surprise. Various possible explanations for the appearance of AFB in South Africa are discussed, and it is suggested that the presence of *Varroa* mites in African honeybees may have made them more susceptible to AFB than was the case in the past, and this together with exposure to a large inoculum of AFB resulting from substantial uncontrolled honey imports resulted in the disease outbreak.

AFB infection levels in the Western Cape have rapidly decreased since the initial outbreak, from 17% of colonies exhibiting AFB symptoms in September 2009 to only 1% in January 2011. The surprising AFB outbreak notwithstanding, it is likely that African honeybees remain essentially tolerant to American Foulbrood. It is important to note, however, that they are not completely resistant to the disease, and measures to prevent further outbreaks of AFB in Africa are suggested.



AFB positive colonies have only been found in the Western Cape in South Africa.

CONTROL AND ERADICATION OF AFB

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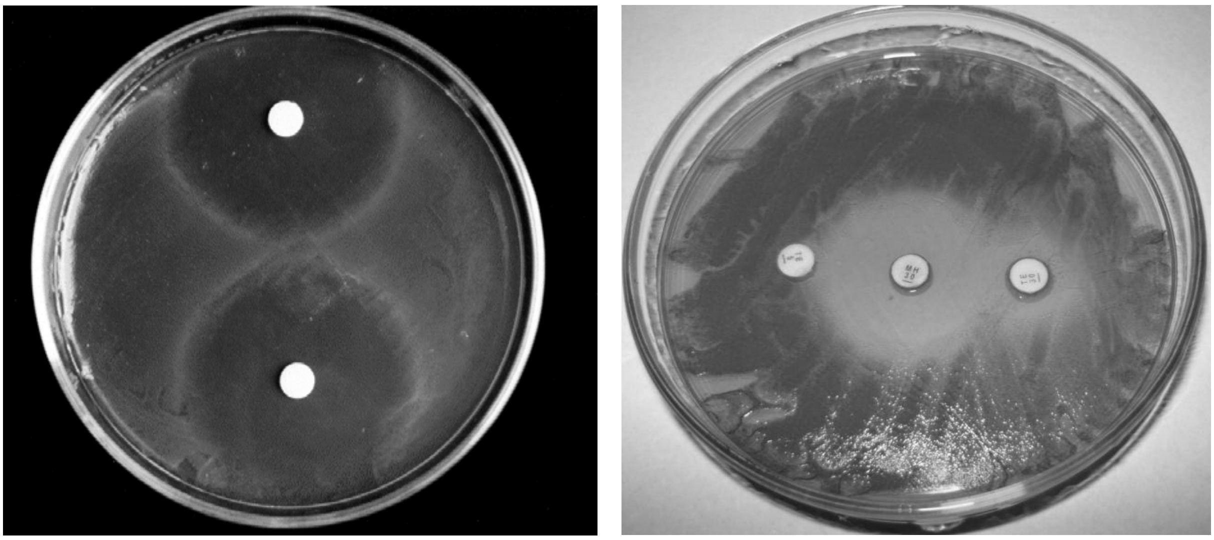
Viable *American Foulbrood* (AFB) spores remain in comb and woodenware for decades. In most countries AFB-infected colonies are always destroyed by burning the bees, brood combs, and all movable parts. Destruction of entire frames, comb, and boxes by fire is the safest method of killing the spores and preventing further infection of colonies. The hive box and other components such us queen excluders can be scorched by fire with a blowtorch completely blackening the surface so that all wax and propolis are removed to destroy any bacteria present.

Several sterilization methods have been tested to reduce spore loads in beehives. Fumigation of bee hive equipment using various chemicals like ethylene oxide or methyl bromide has also been used but is not widely accepted due to residuals being found in both wood and wax. Gamma irradiation from a Cobalt-60 source is a reliable method of sterilizing beekeeping equipment and wax. Contaminated wooden equipment (but not including box or frames) can be immersed for 10 minutes in hot paraffin wax and heated to 150 °C. In addition, boiling woodenware in lye water for 15 minutes can disinfect boxes and scraped frames and sodium hypochlorite can be used to disinfect hive tools and other small items of equipment.

Management and sanitation strategies are directed toward helping bees defend against infection or avoiding infection. These practices include supplemental feeding, replacing storage and brood combs annually and avoiding transfer of combs between colonies.

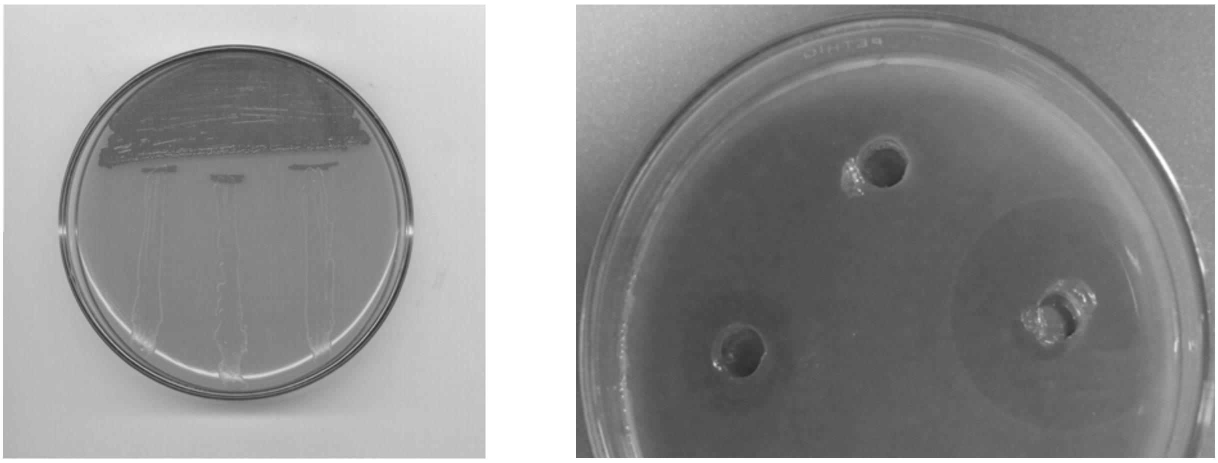


Measuring antibiotic resistance in AFB strains *Pictures © Adriana Alippi*

In some countries, the antibiotic oxytetracycline (OTC) has been used by beekeepers for decades to prevent and control AFB in honeybee colonies as an alternative to the burning of infected beehives in areas where disease incidence is high. However, tetracycline-resistant (TcR) and oxytetracycline-resistant (OTCR) *Paenibacillus larvae* isolates have been detected in USA, Canada and Argentina.

Resistance to tetracycline is mainly due to the acquisition of *tet* determinants frequently associated with mobile elements. Horizontal gene transfer of genetic information between bacterial cells is an integral factor in the generation of genetic variability and evolution in bacteria. Recently, *Paenibacillus larvae* resistant phenotypes have been correlated with the presence of natural plasmids carrying different *Tc* resistance determinants. The widespread use of this and other antibiotics, mainly as a preventive form, favours not only the natural selection of resistant bacterial strains, but also diminishes the expectation of half-life of honeybees, causes disequilibria in the normal microbiota of the beehive , and also generates the extra risks of honey contamination. In addition, antibiotics suppress clinical signs by controlling only vegetative cells, but bacterial spores accumulate in the hive and contaminate honey, remaining infective for many years. This may lead to AFB recurrence later in the life of the colony.

A number of new strategies have been developed and implemented to control AFB. These methods include the use of bee lines with hygienic behaviour, the recourse to biological control agents and the use of natural plant-derived compounds like essential oils, fatty acids and propolis. Several breeding programs have been implemented to develop honeybee populations with hygienic behaviour that is defined as the ability of bees to detect and remove diseased brood. Hygienic bees have an acute sense of smell and able to detect affected cells very soon after infection and to remove them before large number of spores have been produced. The genetic analysis of this behaviour revealed that this trait is recessive and under complex genetic control involving a number of genes whose products interact in a complex way.



Testing bacterial antagonists for the efficacy against the causal agent of AFB
Pictures © Adriana Alippi

Recent studies have showed that the employment of several biological control agents with various modes of action including the production of antibiotics, antibiotic-like compounds, bacteriocins, enzymes and lipopeptides; the stimulation of bees' immune system; and the enhancement of the defence response of honey bees, can be used to control AFB. With the increasing demand on organic honey and the reduction of dependence on antibiotics it is obvious that an *Integrated Pest Management* (IPM) approach is needed to ensure the sustainability of the beekeeping industry. Biocontrol agents, natural compounds, probiotic bacteria and gut microbial communities seem promising and able to combine within an IPM strategy. Nevertheless, more research is needed to examine their mechanisms of action and guarantee their safe employment.

PROTOZOAN DISEASES OF BEES : *NOSEMA*

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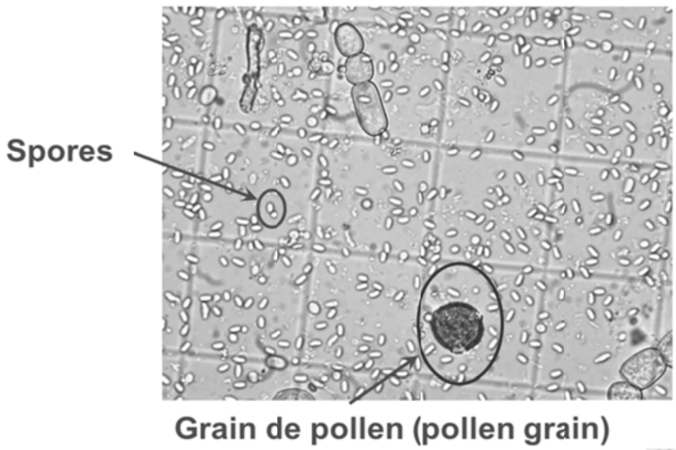
Nosemosis is a disease affecting adult honeybees (*Apis mellifera*). It occurs worldwide and causes depopulation, a decrease in colony strength, a reduction in honeybee longevity, and high colony winter mortality. The agent responsible of the disease is a microsporidia recently reclassified as a fungus. The number of *Nosema* species has been estimated at 650, and they are mainly insect parasites. The intracellular parasite has neither mitochondria nor peroxysome. This makes its developmental cycle within the host epithelial cells obligatory by redirecting the cell machinery at its own profit. The *Nosema* spores have an inner chitin wall and outer proteinaceous wall. When the spore germinates, it produces an extrusive specialized polar tube for host cell penetration.

Most of biological characteristic of the honeybee *Nosema* have been described from *Nosema apis,* the historical species. Two biological forms of the parasite exist. The spore is the resistant and the dissemination form. The spore has three distinct layers which provide the species with excellent survival properties. Honeybees are contaminated by spore ingestion. When the parasite reaches the midgut, the spore starts to germinate thanks to various positive conditions. The spore content is injected into one epithelial cell through a polar tube. The developmental form multiplicates in the host cell. After some multiplication cycles, when the cell resources are lacking, the spore production starts. Mature spores are released from the host cell toward neighbouring cells (auto infection) or toward the midgut lining. The spores are subsequently eliminated through faeces. In this way, the rest of the colony can be contaminated as well as the environment. Honeybees can be contaminated when they drink contaminated water. They also contaminate themselves through food exchanges (*trophallaxis*). *Nosema* spores have been identified in pollen pellets which can constitute a dissemination route.



Nosema spores *Picture © ANSES*

The etiological agent of nosemosis is *Nosema apis.* It has been described in 1909 by E. Zander in European honeybees. Recently another microsporidia, *Nosema ceranae,* has been identified in *A. mellifera. N. ceranae* has been described for the first time in the Asiatic honeybee *Apis cerana* in the 1990's. The jump from *A. cerana* to *A. mellifera* was estimated in the 1990's when the first observations were reported. Today, the frequency of *N. ceranae* seems to depend on climatic conditions. The first reports describe a higher prevalence of *N. ceranae* in honeybees in the south of Europe compared to *N. apis*. In the US, the two species of *Nosema* are now widespread. A recent survey of historical samples collected from across the U.S. suggests that *N. apis* has been largely displaced by *N. ceranae* over the past decade. While the etiology of *N. ceranae* is poorly understood, it has been implicated with recent large-scale losses experienced by Spanish beekeepers. Other pathogens, including bacteria, fungi and viruses, can also significantly impact colony health.

Pests and predators of honey bees

HIVE BEETLES

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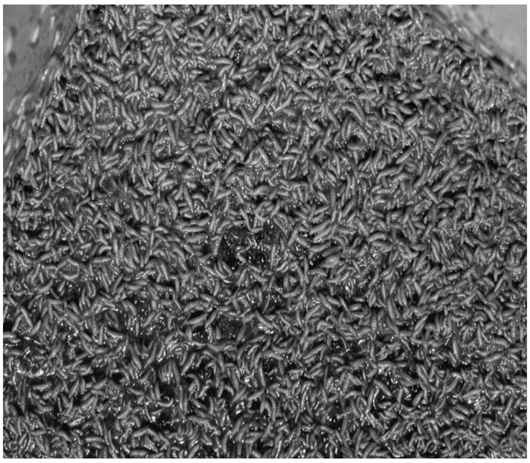
Small hive beetles (*Aethina tumida*) have recently become a substantial problem in both the United States and in Australia, but are a limited problem in their native Africa. In Africa, small hive beetle problems are largely restricted to the honey house and to beekeepers using traditional hives. Such problems are readily overcome with the use of moveable hives, the proper maintenance of such hives, and with hygienic and rapid honey extraction.

Various species of large hive beetles are a substantial problem in the warmer areas of Africa, but can be readily controlled by preventing access of the beetles into the colonies.



Left : Large hive beetles can be a real problem if allowed access to colonies *Picture © ARC*

Right : Small hive beetle larvae can be a major problem in honey houses *Picture © ARC*

PREDATORS OF BEES IN SOUTHERN AFRICA

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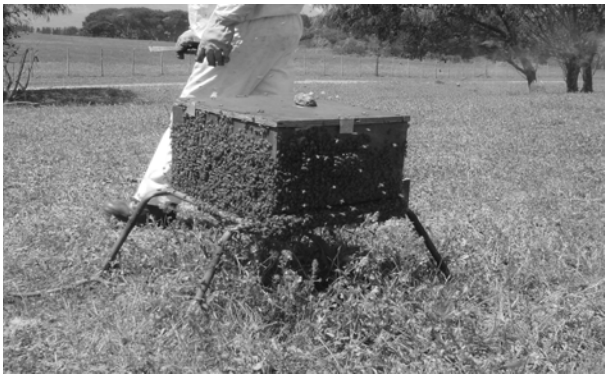
Honeybees throughout Africa are troubled by predators that include honey badgers, baboons, indigenous and exotic wasps, ants, birds and people. Such predators often cause substantial losses to beekeepers. The best methods to protect honeybee colonies from the various predators, and the importance of using non-lethal control measures, are discussed.

Fences to keep out people, often the most serious pest to beekeepers.

Raising colonies on stands protects them from honey badgers.

Some birds, like the drongo, can be a serious pest.



Placing hives on stands allows a beekeeper to control for ants.

All pictures © ARC

VARROA : INTRODUCTION TO THE PARASITIC MITE

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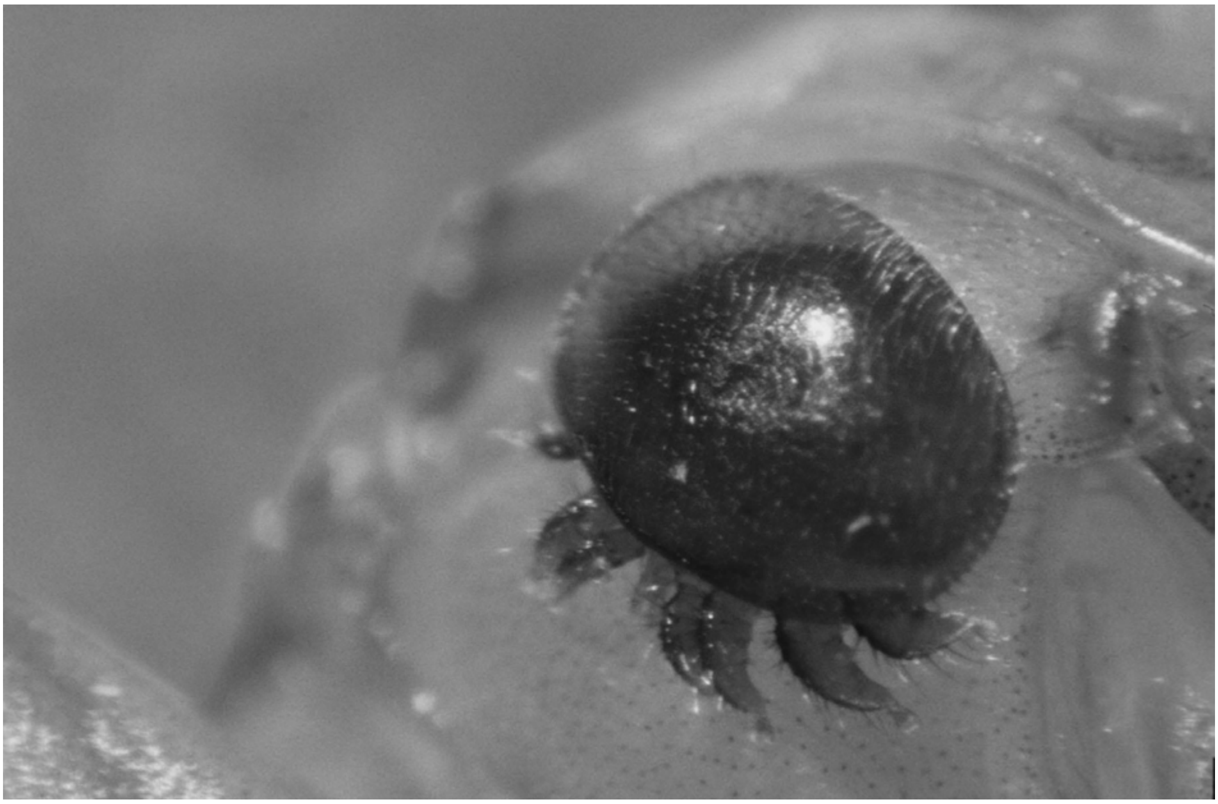
Varroa is a parasitic mite of the honeybee which feeds on haemolymph from immature and adult bees. It reproduces in the brood with a clear preference for the male brood. There are several species of varroa. The one in question is called *Varroa destructor* and it parasitises the honeybee *Apis*, and in particular *Apis mellifera*, the honeybee of Europe and Africa. Its original host, *Apis cerana*, is a bee from South-East Asia with which it lives in parasitic equilibrium without endangering colony survival. The importation of *Apis mellifera* into South-East Asia has favoured the transmission of varroa to this species. Subsequently the parasite spread gradually to nearly all parts of the world. There are several *Varroa destructor* haplotypes, two of which have colonised the planet, the Korean and Japanese haplotypes. The other haplotypes from South-East Asia are a potential threat for the honeybee.

Detection of varroa in bee colonies can be done with the use of grid boards placed at the bottom of hives which enable the collection of varroa falling from the bee colony, or with simple techniques for Varroa mite counts on adult bees or in the brood.



The *Varroa* mite *Picture © Yves Le Conte*

There is a marked sexual dimorphism between the male and female varroa. Only the female can parasitise adult bees. For reproduction, the female varroa enters a brood cell containing a bee larva, just before capping. It lays several eggs from which the first will be a male and the following ones females. The male will fertilize its sisters in the cell, which leads to significant inbreeding for this species. When it emerges, the young bee uncaps its cell and frees the founding female and one to three daughters. They will start a phoretic phase lasting a few days on the adult bees before re-infesting the brood for reproduction. This parasitism has very harmful effects on bees, on the one hand because varroa extracts a significant quantity of haemolymph to feed itself, but also because it is the vector of several viruses. European honeybee colonies not treated against this pest die within two or three years.

Since its arrival in Europe in the 1970's, considerable research efforts have been carried out. More than 3400 scientific papers have been published on this mite, which corresponds to about 115 per year. Nonetheless, the mite is still one of the most serious problems for the honeybee.

Comparative studies carried out between *Apis cerana* and *Apis mellifera* have shed very useful light on several factors involved in varroa bee resistance and varroa population control in bee colonies. Among these factors, one can mention grooming behaviour, varroa hygienic behaviour with respect to the capping-time of cells (pupal development), brood thermoregulation, swarming, and varroa fecundity reduction by immature bees. Bee hygienic behaviour towards varroa has been described as the ability of bees (1) to detect cells parasitised by reproductive varroa females and (2) to destroy the contents of those cells. This characteristic with the reduction of fertility are the most promising for selective breeding of varroa resistance.

Natural selection of varroa resistant bees is a very promising field of research given the occurrence of colonies which survive the parasite with no treatment at all. The presence of the pest in South Africa and in Central Africa presents a major challenge in terms of natural resistance of bee populations. Do these bees develop hygienic behaviour towards this pest? What is the importance of viruses in parasitosis? What will be the reaction of bees when submitted to varroa in the presence of other stress?

Recent progress in bee research, with the sequencing of the bee and varroa genome might enable rapid progress towards a sustainable solution of equilibrium between host and parasite.

VARROA IN MADAGASCAR

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Infections by *Varroa* species or varroosis are caused by the parasitic agent, the *Varroa destructor* mite. The usual route of introduction of the pest is the importation of used beehive materials. In Madagascar, estimates are that the introduction took place in December 2009, based on the first report of the mite in an apiary of the district of Antananarivo, called Avaradrano. The first confirmation was made in February 2010, following the diagnostic results by the reference laboratory of Sophia Antipolis. The impact of varroosis, as observed in Madagascar, included: (a) reduction in the size of the colony; (b) certain bees flew with difficulty; (c) sparse brood with dead or dying larvae; (d) deformation of certain bees with atrophy or deformation of the wing, missing legs, and shortened abdomen.

A rapid diagnostic screening in the field was done according to the following protocol:

- Sampling of live bees in the suspected hives
- Fixing with 70% alcohol in a sampling container
- Stirring the mixture, allowing the *Varroa* to fall to the bottom of the container if present
- Collecting of the mites and transferring them to a microscope slide and examining under the microscope

The varroosis outbreaks were detected in 3 districts of Analamanga Region, near the Capital, these being Ambohidratrimo, Antananarivo Renivohitra and Antananarivo Avaradrano, and in a district of Toamasina Region, Toamasina II, on the east coast of the country. The outbreaks were notified to the OIE on February 11, 2010.

Measures taken included : (a) identification of the infected zones and surveillance; (b) devising an emergency intervention and control plan against bee - diseases; (c) devising a surveillance plan for bee - diseases; (d) approval of a ministerial decree defining the control measures against varroosis; (e) approval of decrees declaring the infestation in each of the contaminated districts; (f) information and public awareness campaigns targeting all stakeholders (veterinary services, bee-keepers, exporters) ; (g) translation into the Malagasy language of the recommended preventive and control measures; (h) strengthening the awareness of beekeepers and other stakeholders; (i) strengthening the surveillance of the disease in un-affected export zones; (j) production and broad dissemination of communications tools; and (k) support to research on the use of the biological products in the fight against varroosis.

As a result of these measures, the outbreaks were declared resolved (to the OIE) on March 26, 2010.

Localization of *Varroa* cases detected in the course of December 2009 and January 2010

VARROA IN SOUTH AFRICA

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The varroa mite (*Varroa destructor*) has become an near-global pest of Western honeybee (*Apis mellifera*) colonies, both natural and managed, and in many parts of the world a continuous flow of novel pesticides and other control strategies has been required to prevent collapse of the honeybee population. The strategy chosen in South Africa, however, following the detection of the mite in 1997 was to do nothing and to allow susceptible honeybee colonies to die. Both managed commercial colonies and 'wild' colonies (unmanaged colonies in conservation areas where no beekeeping is allowed) were monitored for up to ten years, to assess the impact on the mite on local honeybee populations. This live-and-let die approach has resulted in the South African honeybee population becoming essentially tolerant to the *Varroa* mite within ten years, and without a collapse in the honeybee population.

Monitoring 'wild' colonies in nature reserves for the impact of the varroa mite *Picture © ARC*

It is suggested that the possible sub-optimal vitality of unmanaged African honeybee colonies, in which the *Varroa* mite is now just one of a battery of pests and diseases in natural equilibrium with their host, is preferable to lengthy and likely futile efforts on the pesticide or biocontrol treadmill. Doing nothing was clearly the correct response to the arrival of *Varroa* mites in South Africa, and the same is probably true for the rest of Africa. It is further suggested that efforts at control might frequently frustrate the development of natural tolerance and are often of questionable long-term value.

Bees that recovered from varroa infestation rapidly recovered their defensive behaviour *Picture © ARC*

VARROA : TREATMENT & CONTROL

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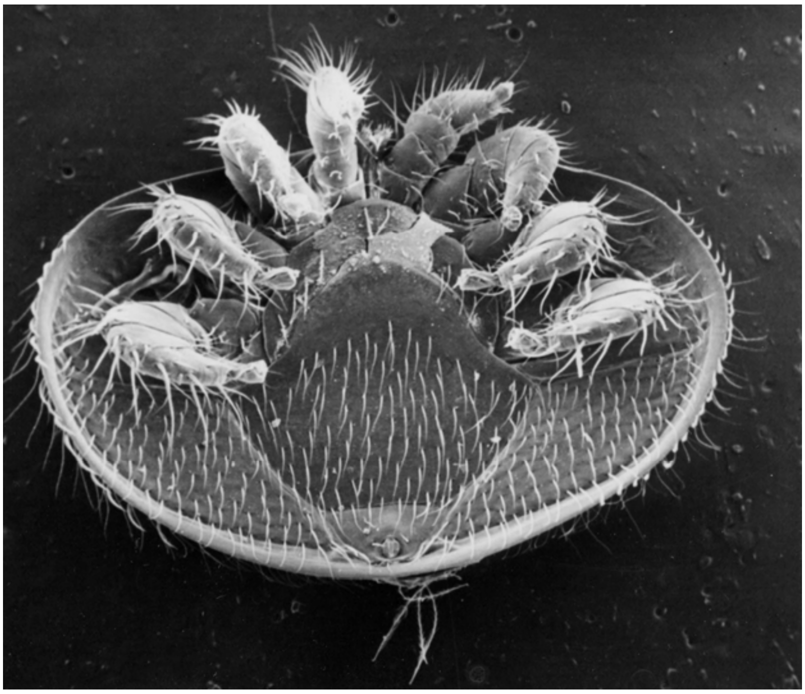
One of the major problems in the treatment of bee colonies against varroa is the fact that it reproduces inside capped cells and that this wax envelope limits the dissemination of acaricides. Application must therefore reach the phoretic varroa, on adult bees, and inside the brood cells. Methods that release acaricides over time enable the treatment of varroa as they emerge from the brood cells when the young bees are born.

When varroa occurred in Europe in the 1970's, various acaricides were used to combat the parasite, in particular folbex (not very effective), amitraz, fluvalinate and coumaphos. PERIZIN (coumaphos) and APISTAN (fluvalinate) have been registered with marketing authorization and were very effective, in particular APISTAN. In 1995, the first varroa resistant to fluvalinate were detected in Italy, and then resistance occurred for other acaricides. At the same time Amitraz-based APIVAR and Thymol-based APIGUARD products were put on the market. To date we have not yet detected any resistance in Europe for these two products. The advantages for products with marketing authorization are their effectiveness, protecting both consumer and beekeeper. Their drawbacks are cost, leading to anarchic use of generic chemicals, residue risks in hive products, and the occurrence of resistance.



The varroa mite
Picture © Yves Le Conte

Other methods of control are biotechnical methods such as the elimination of the male brood, the installation of grid floors, the production of heat, or even methods based on the use of essential oils or acids. Biological control from pathogenic fungi for varroa is envisaged but is not yet on the market.

Finally, the use of varroa resistant bees is a solution for the future as it will limit and even eliminate the use of acaricides in hives. Such bees have been bred in the USA on the basis, for example, of honeybee hygiene behaviour against varroa. Moreover, bees naturally tolerant to varroa have been described in France and Sweden, which brings hope for the integrated control of varroa in beekeeping.

ACARAPIS PARASITIC MITES

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Avignon, France

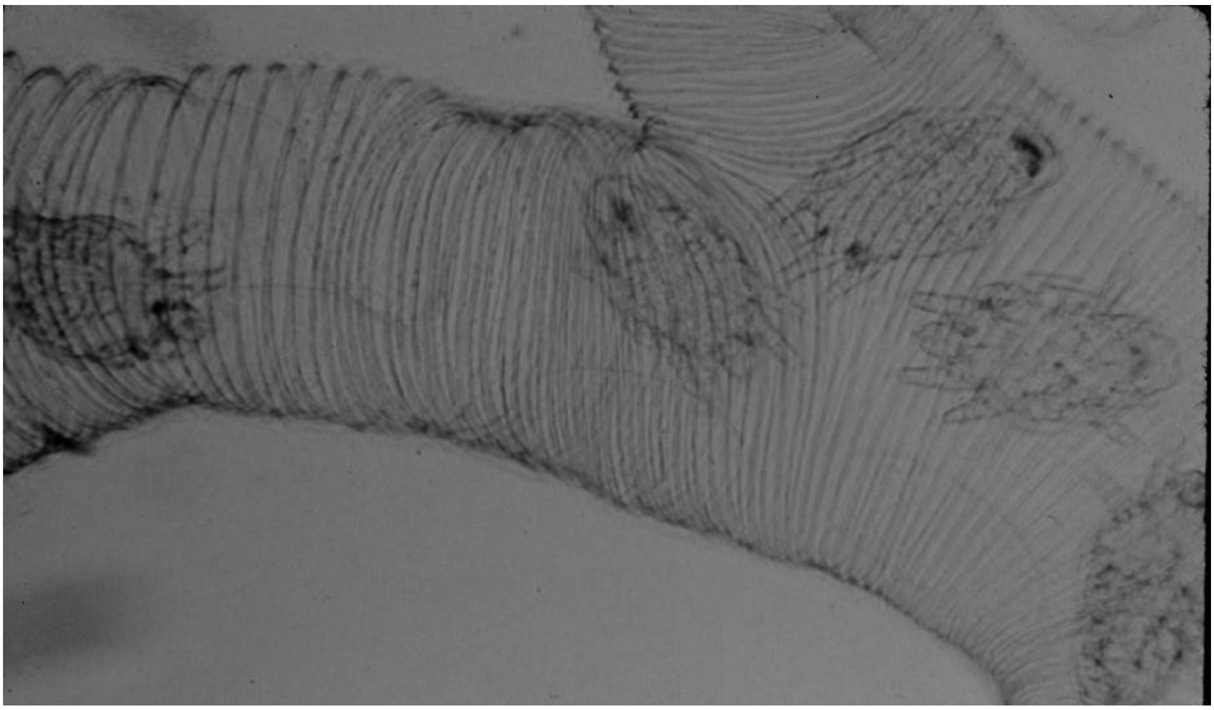
Acariosis is a parasitosis whose agent is the mite *Acarapis*. There are four species of *Acarapis*, and the one which parasitises the honeybee *Apis mellifera* is *Acarapis woodi* (Rennie). The pest lives inside the trachea of adult bees and feeds on bee haemolymph. The male size is 125 to 136 microns and the female 143 to 174 microns. It was first described in Great Britain in 1921 and then spread in Europe where it destroyed a great part of the bee stock.

The infection occurs in bees aged 10 days, and then lasts 19 to 21 days. The female can lay 5 to 20 eggs in the parasitized trachea. Depending on the number of parasites present in the trachea, the visible effects are lesions on the wall of the trachea, physiological disorders due to their obstruction (choking) and a change in haemolymph. The increase of mite populations in the trachea is visible thanks to the opaque colour of the trachea which also has black spots. The identification of the agent can be by microscopic examination of the bee trachea. Staining with methylene blue solution facilitates the observation. One can also use ELISA or PCR techniques to detect and quantify the mite.

There are no sure clinical signs of this acariosis. The presence of bees wandering around the base of the hive and/or perched at the top of a blade of grass, unable to fly with disjointed wings and a distended abdomen can indicate parasitosis.

Acariosis can be treated with acaricides such as Acarol, Menthol, Folbex Forte, Folbex VA (bromopropylate) or formic acid (Apicure).

At present, acariosis is no longer a problem in Europe, probably because bees have become resistant and/or because beekeepers treat their hives with anti-varroa acaricides, thereby killing the acariosis agent.



The Tracheal Mite *Acarapis woodi*   *Picture © ARC*

TROPILAELAPS PARASITIC MITES

Yves Le Conte

Directeur de Recherche
INRA, UMR 406 Abeilles & Environnement
Avignon, France

Tropilaelaps clareae and *Tropilaelaps koenigerum* are two mites which parasitise honeybees in the tropical and subtropical regions of South-East Asia. They spread from Asiatic bees to European bees when the latter were introduced into this region. Their potential transfer to European bees from other parts of the world is a serious threat for world beekeeping. These mites are brown red and 0.7 to 1 mm in length and 0.6 mm in width. The males are nearly as large as the females, but less sclerotized. *Tropilaelaps koenigerum* is slightly smaller than *Tropilaelaps clareae.* The mites move freely and quickly on and in the brood frames and feed on the immature bees. Their mouth parts do not enable them to pierce the membranes of the adult bee. That is why they cannot survive without the brood.

These pests reproduce in the honeybee brood, preferably in the male brood. The female lays 3 to 4 eggs which become protonymphs then deutonymphs, before reaching the adult stage 6 days after the egg is laid. When the bee emerges, the male and the female emerge from the cell to parasitise a new host, an adult bee, for 1 to 2 days. The pregnant females then must lay their eggs within two days, otherwise they die. Therefore *Tropilaelaps* cannot survive in bee colonies without brood, which limits its spread in cold countries which have a period without brood.

It appears that there is competition with the *Varroa* mite for reproduction in brood cells.

The *Tropilaelaps* mite *Picture © Yves Le Conte*

Epidemio-surveillance, treatment and control

POSSIBILITIES AND RISKS OF USE OF DRUGS IN BEE HIVES

Wolfgang Ritter

Head of Bee branch
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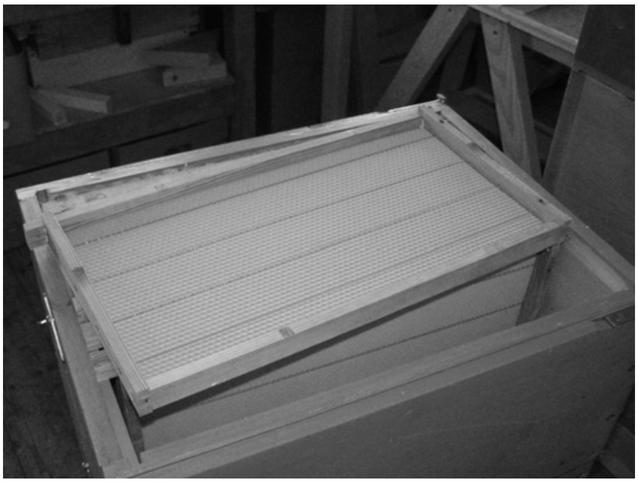
Today beekeepers are more often confronted with the use of medicines. The current perception of many beekeepers would be that any treatment that helps to fight diseases is allowed. However, the safety profile of the medicines, ensuring safety of the user, consumer safety, effectiveness and low side effects to the bees should be the choice.

www.beehealth.info
www.bienengesundheit.info

Treatment might result in residues of hydrophilic substances in honey, while lipophilic substances would accumulate in the wax, which due to the process of wax recycling and comb foundation could eventually lead to contamination of the honey. There exist different application routes (feeding, trickling, strips, vaporization and evaporation, spraying and dusting) and they have pros and cons in respect to their risk for the applicant, their risk for food contamination and their extent of efficacy or tolerance in the bee or their brood.

The specific situations regarding certain bee diseases are different. Nosemosis presents a problem, in particular in southern Europe. No authorised medicines were available and other control measures were applied as well as anti-coccidial medicines under off-label use. These anti-coccidia seem to be effective, but may lead to residue problems too. In contrast to many American countries no authorised medicines are available in Europe for the treatment of either European or American Foulbrood. Some antibiotics show efficacy against the bacteria in the larvae, however not against the spores, and these can only be destroyed by eradication programs (e.g. burning). The danger of a new infection after treatment is very high. This is the case when antibiotics are used in intervals and spores accumulate in the bees nest i.e. in the bees' food.



Lipophilic substances can accumulate in wax
Picture © Wolfgang Ritter

Varroa mite infestation remains the currently most important disease in bees, not only with regard to causing parasitism but also by introducing viral diseases. While several veterinary medicines were authorised, there is concern for the future due to observed resistance against synthetic anti-infectious medicines, and the uncertainty of effectiveness of some natural anti-infectious substances. This should be tested under local condition and different bee races. The authorisation of bee medicines should be made easier and better harmonised.

STRATEGIES AND POSSIBILITIES TO DIAGNOSE AND CONTROL BEE DISEASES IN TRADITIONAL AND LOCAL BEE HIVES

Wolfgang Ritter

Head of Bee branch
Chemisches und Veterinäruntersuchungsamt
Institute for Animal Health
Freiburg, Germany

It is common in Africa to keep honeybees in colonies with non-movable frames. Hence, in these colonies frames cannot be removed to examine for bee diseases, a standard practise where movable-frame hives are used. Nonetheless, there are strategies to examine and diagnose diseases in these traditional and local bee hives.

The brood disease American Foulbrood provides a problem as the brood cannot be removed to be examined. Nonetheless the disease can be diagnosed in colonies by examining in the laboratory worker bees collected from the hive entrance, or debris from the hive bottom, or hive products such as honey or pollen. The level of spores present will indicate the extent of the bacterial infection. The presence of the *Varroa* mite can be determined by examining bees collected at the hive entrance, or by examining hive debris, or boards placed beneath the colony. Similarly for other mites such as *Acarapis* and *Tropilaelaps*. The microsporidian *Nosema* can also be detected from bees collected at the hive entrance.

As well as diagnosing the presence of pests and diseases in colonies without movable frames, it is possible to treat for these pests and diseases in these hives. All forms of treatment except for the spraying of combs are possible, with allows for the treatment of all pests and diseases. It is therefore not necessary for the change to be made to movable frame hives for the diagnosis and treatment of pests and diseases.

Frames cannot be removed to be examined for disease and pests in traditional hives *Picture © Nicola Bradbear*

IMPORTANCE OF EPIDEMIO-SURVEILLANCE: THE EXAMPLE OF BOTSWANA

*David C. Munthali & Queen Turner**

Associate Professor
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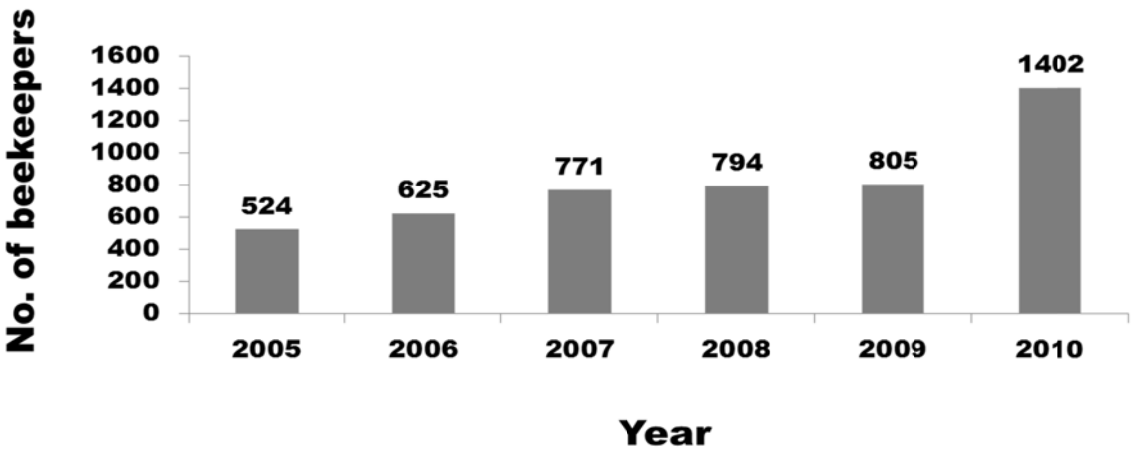
Gaborone, Botswana

*Ministry of Agriculture
Gaborone, Botswana

A pilot survey was conducted from May to November 2009, in nine sites located in different parts of Botswana. The aim of the survey was to assess the incidence and status of *Varroa* mites and bee diseases in the country. Forty seven samples of brood combs (about 15 cm long x 12 cm wide each) were collected from hives from different parts of the country. Each sample was examined under a dissecting microscope at 20x magnification. The data recorded were: total number of cells on each side of the comb; the number of cells with brood; the number of cells with *Varroa* mites; the total number of *Varroa* mites per sample and the number of cells with diseased larvae. One of the samples collected was from an irrevocably queenless colony. In order to determine the pattern of egg laying by workers when such a condition occurs, the eggs in each individual cell were counted from each side of the comb.

Results showed that varroa mites occurred in 9 of the 47 colonies. The pest was widely distributed (from Selibe-Phikwe in the North-East to Tsabong in the South-West). Abundance of *Varroa* mites in the infested combs ranged from 204 in pieces collected from Ranaka to 23 per piece in samples collected from Tshwaane, The levels of infestation varied depending on geographic location. Comparisons of the number of *Varroa* mites per 100 comb cells showed that comb samples obtained from Ranaka had the greatest intensity of infestation per colony, while colonies from Bobonong and Tshwaane had relatively lower infestation levels. The overall abundance of *Varroa* mite infestation during the survey period was greatest in samples collected in September and October and least in June. Each of the 47 pieces of brood comb had black larvae, showing that they were diseased. The incidence of diseased larvae per comb ranged from 10.8 to 100%. Monthly averages showed that the highest incidence occurred in September while the lowest was in June. Results of percent diseased larvae per comb per location show that Tsabong and Ngwaketse (with 70.3 and 70.6% infested larvae respectively) had the highest incidence while combs from Bobonong had the lowest incidence.



The number of beekeepers in Botswana

The total number of eggs found in the irrevocably queenless colony ranged from zero to 15 on one side of the comb and zero to 13 on the other. A queen always lays only one egg in a brood cell. The large numbers of eggs confirm that the irrevocably queenless condition had occurred in this colony and that the colony would eventually perish. Results also showed that on one side of the comb, the largest proportion of cells (36.4%) had 2 – 5 eggs/cell while only a small proportion (5.1%) had one egg/cell. A similar pattern was found on the other side of the comb. When cells in which no eggs were oviposited were excluded, those with 2 – 5 eggs represented 51.2% while those with 6 – 10 eggs/cell represented 36.9% of the total number of brood cells/sample/comb. A similar pattern was also found on the other side of the comb.

Apart from confirming that *Varroa* mites infestations are widespread in Botswana, the survey also showed that bee colonies suffer high levels of disease infection. The disease pathogen needs to be identified as soon as possible. A more detailed and systematic monitoring of the abundance and distribution of pests and diseases of honey bees needs to be conducted in Botswana.

ARE THE OIE BEE DISEASES RECOMMENDATIONS, THE MANUAL AND THE CODE APPROPRIATE FOR THE HONEYBEE SITUATION IN SOUTHERN AFRICA?

Mike H. Allsopp

Senior Researcher
Plant Protection Research Institute
Agricultural Research Council (ARC)
Stellenbosch, South Africa

The OIE *Terrestrial Animal Health Code* (TAHC) and the *Manual for Diagnostic Tests and Vaccines* provide guidelines for the management and control of honeybee pests and diseases. These measures include the notification of pests and diseases; appropriate diagnostic tests; and surveillance, inspection and eradication procedures. The management of the system requires inspection services, laboratory and diagnostic services, and adequate border controls. The primary purpose of the TAHC is to minimize the risk of disease spread in the trade of honeybee-derived commodities, with imports restricted to being from historically disease-free zones. That is, to minimize the risk to the importing country, but not necessarily the best management of the honeybee population in the exporting country.

The health and diversity of wild bees is crucial in Africa. Imported bees and alien bee species are a major threat. *Pictures © ARC*

In contrast, Africa has little or no history in this type of management of honeybee pests and diseases. Rather, the honeybee populations have simply been left to manage on their own against all pests and diseases. Furthermore, Africa in general does not have the infrastructure necessary for intensive honeybee pests and disease management, and the non-movable frame beekeeping practised in much of the continent does not allow for such management. This lack of management notwithstanding, the honeybee populations of Africa are largely unaffected by pests and diseases.

It is suggested that Africa should be careful not to sacrifice the natural tolerance of their honeybee populations, or the 'organic' status of their honeybee products, by the application of chemical control measures against pests and diseases, even if these are necessary to obtain 'pest-free' status. Rather, Africa should concentrate on maintaining the vitality of its honeybee population by maintaining honeybee genetic diversity, preventing the introduction of foreign honeybees, limiting the exposure to new pests and diseases, and better regional co-operation.

Testimony

« …, we very much appreciated this seminar which was very enriching.

Thank you also for the link to access all information regarding this seminar.

As much as this seminar was enriching, it was also an opportunity to raise a certain number of challenges, such as the establishment of a communication platform on bees, honey and bee diseases.

Thank you

Yours sincerely,

Dr Prosper KABAMBI NGABU, DVM

Head of Division Animal Health and Hygiene

Department of Animal production and Health

Ministry of Agriculture

OIE Focal point / notification of animal diseases
Kinshasa, Dem. Rep. of Congo… »

[translated from French]

Annexes

Day 1: June 14th, 2011		
Time	Theme	Speaker
08:30-09:00	Registration of participants	Mpho Mantsho Thabisile Magagula
09:00-10:00	Inauguration and Opening Group photograph	Roland Dlamini Bonaventure Mtei Yacouba Samaké Mahamadou Saley Robert Thwala Clement Dlamini
10:00-10:30	*Morning break – Coffee/Tea*	
10:30-11:00	Structure and Operation of the OIE 20 minutes general video presentation of the OIE (+ Questions)	Neo Mapitse
11:00-11:20	Beekeeping and bee products Beekeeping worldwide with a special focus on beekeeping in Africa (including domestic and traditional beekeeping)	Nicola Bradbear
11:20-11:40	Beekeeping in Swaziland	Thembinkosi Ndlangamandla
11:40-12:00	Questions and answers	
12:00-12:20	Bee populations in Southern Africa General introduction to reproduction and life stages	Christian Pirk
12:20-12:30	Swaziland: Beekeeping with *Apis mellifera scutellata*	Daniel Nkambule
12:30-12:40	Western Cape: *Apis mellifera capensis*	John Moodie
12:40-13:00	Questions and answers	
13:00-14:00	*Lunch*	

Time	Theme	Speaker
14:00-14:20	A history of importing bees into Southern Africa and the *Capensis* problem	Mike Allsopp
14:20-14:30	Questions and answers	
14:30-14:50	Bees and the environment & bees and human development Pollination and biodiversity	Christian Pirk
14:50-15:10	Pesticides and insecticides: General overview	Marie-Pierre Chauzat
15:10-15:30	Pesticides and insecticides in Southern Africa	David Munthali
15:30-15:50	Beekeeping as a way out of poverty	Nicola Bradbear
15:50-16:10	Questions and answers	
16:10-16:40	*Afternoon Break - Coffee/Tea*	
16:40-17:20	Global Bee Health General overview of bee diseases in the world, predators, resistance, self-healing, pathogenesis, epidemiology, world distribution.	Wolfgang Ritter
17:20-17:40	Colony Collapse Disorder (CCD)	Marie-Pierre Chauzat
17:40-18:00	Questions and answers	
19:00-21:00	*Welcome reception*	

Day 2: June 15th, 2011		
Time	Theme	Speaker
08:30-09:30	OIE standards and tools with regard to diseases of honey bees *Terrestrial Animal Health Code* (TAHC) and *Manual of Diagnostic Tests and Vaccines for Terrestrial Animals* (MDTV) OIE List of notifiable diseases and criteria for inclusion General Presentations Specific chapters on bee diseases	 François Diaz François Diaz François Diaz
09:30-10:30	Reference Laboratories and Collaborating Centres General introduction Reference Laboratory for bee diseases (Sophia Antipolis) Reference Laboratory for bee diseases (Freiburg) Reference Laboratory for AFB (La Plata) Twinning	 Neo Mapitse Marie-Pierre Chauzat Wolfgang Ritter Adriana M. Alippi Neo Mapitse
10:30-11:00	*Morning break – Coffee/Tea*	
11:00-12:00	World Animal Health Information System (WAHIS) Types of notifications, frequency and scope WAHIS WAHID Current status of reporting of bee diseases to OIE	Simona Forcella
12:00-12:30	Questions and answers	
12:30-13:00	Standards at work: reality check (notification of a disease of bees) Immediate notification Six-monthly report	 Simona Forcella Simona Forcella
13:00-14:00	*Lunch*	
14:00-18:00	Standards at work: reality check Field visit	Roland Dlamini (coordinating)
18:00-20:00	*Social event (Mbabane)*	

Day 3: June 16th, 2011		
Time	Theme	Speaker
08:30-08:50	Diseases of honeybees Viral diseases of bees	Marie-Pierre Chauzat
08:50-09:10	Bacterial brood diseases: European Foulbrood (EFB)	Adriana M. Alippi
09:10-09:30	Breeding efforts on resistant honey bees	Robin Moritz
09:30-09:50	Bacterial brood diseases: American Foulbrood (AFB)	Adriana M. Alippi
09:50-10:10	AFB in Southern Africa: current diagnostic capacity	Teresa Goszczynska
10:10-10:40	*Morning break – Coffee/Tea*	
10:40-11:00	AFB in Southern Africa: how far has it spread?	Teresa Goszczynska & Mike Allsopp
11:00-11:20	AFB in South Africa - how to make sense of it?	Mike Allsopp
11:20-11:40	Control and eradication of AFB	Adriana M. Alippi
12:20-12:40	Protozoan diseases of bees : *Nosema*	Marie-Pierre Chauzat
11:40-12:00	Questions and answers	
12:00-12:20	Pests and predators of honeybees Small hive beetle (*Aethina tumida*)	Mike Allsopp
12:20-12:40	Predators of honeybees in Southern Africa	Mike Allsopp
12:40-13:00	Questions and answers	
13:00-14:00	*Lunch*	

Time	Theme	Speaker
14:00-14:20	*Varroa*: General introduction to the parasitic mite	Yves Le Conte
14:20-14:40	*Varroa* in Madagascar	Annie Francia Rakotondramanana
14:40-15:00	*Varroa* in South Africa	Mike Allsopp
15:00-15:20	*Varroa*: Treatment and control	Yves Le Conte
15:20-15:30	Questions and answers	
15:30-15:45	*Acarapis* parasitic mites	Yves Le Conte
15:45-16:00	*Tropilaelaps* parasitic mites	Yves Le Conte
16:00-16:10	Questions and answers	
16:10-16:40	*Afternoon break – Coffee/Tea*	
16:40-17:00	Epidemio-surveillance, treatment and control: Possibilities and risks of use of drugs in bee hives	Wolfgang Ritter
17:00-17:20	Strategies and possibilities to diagnose and control bee diseases in traditional and local bee hives	Wolfgang Ritter
17:20-17:40	Importance of epidemio-surveillance: the example of Botswana	David Munthali
17:40-18:00	Questions and answers	

Day 4: June 17th, 2011		
Time	Theme	Speaker
08:30-08:50	Can foreign bee breeds help to solve the problem of bee diseases?	Robin Moritz
08:50-09:10	Beekeeping and conservation of wild honeybees	Robin Moritz
09:10-10:30	Are the OIE bee diseases recommendations, the MDTV and the TAHC appropriate for the honeybee situation in Southern Africa? Followed by panel discussion	Mike Allsopp
10:30-11:00	*Morning Break - Coffee/Tea*	
11:00-11:40	**Website resources:** OIE main website – OIE Vademecum Report of the last meeting of the OIE *ad hoc* Group on Diseases of Honey Bees and press release from the OIE Director General OIE Africa website Others: Bees for Development Others: ANSES	 François Diaz François Diaz Neo Mapitse Nicola Bradbear Marie-Pierre Chauzat
11:40-12:00	Evaluation	
12:00-13:00	Conclusions and closing ceremony	
13:00-14:00	*Lunch*	

GLOSSARY OF TERMS[7]

Terms defined in the Terrestrial Code that are used in this publication are reprinted here for ease of reference. As these may change from time to time, please refer to the Terrestrial Code for the latest definitions :

Animal

means a mammal, bird or bee.

Animal for breeding or rearing

means a domesticated or confined animal which is not intended for slaughter within a short time.

Animal health status

means the status of a country or a zone with respect to an animal disease, according to the criteria listed in the relevant chapter of the Terrestrial Code dealing with the disease.

Animal traceability

means the ability to follow an animal or group of animals during all stages of its life.

Animal welfare

means how an animal is coping with the conditions in which it lives. An animal is in a good state of welfare if (as indicated by scientific evidence) it is healthy, comfortable, well nourished, safe, able to express innate behaviour, and if it is not suffering from unpleasant states such as pain, fear and distress. Good animal welfare requires disease prevention and veterinary treatment, appropriate shelter, management, nutrition, humane handling and humane slaughter/killing. Animal welfare refers to the state of the animal; the treatment that an animal receives is covered by other terms such as animal care, animal husbandry, and humane treatment.

Apiary

means a beehive or group of beehives whose management allows them to be considered as a single epidemiological unit.

Appropriate level of protection

means the level of protection deemed appropriate by the country establishing a sanitary measure to protect human or animal life or health within its territory.

Approved

means officially approved, accredited or registered by the Veterinary Authority.

[7] Based on the 2011 version of the OIE Terrestrial Code

Beehive

means 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.

Biosecurity plan

means a plan that identifies potential pathways for the introduction and spread of disease in a zone or compartment, and describes the measures which are being or will be applied to mitigate the disease risks, if applicable, in accordance with the recommendations in the Terrestrial Code.

Border post

means any airport, or any port, railway station or road check-point open to international trade of commodities, where import veterinary inspections can be performed.

Case

means an individual animal infected by a pathogenic agent, with or without clinical signs.

Commodity

means live animals, products of animal origin, animal genetic material, biological products and pathological material.

Compartment

means an animal subpopulation contained in one or more establishments under a common biosecurity management system with a distinct health status with respect to a specific disease or specific diseases for which required surveillance, control and biosecurity measures have been applied for the purpose of international trade.

Competent Authority

means the Veterinary Authority or other Governmental Authority of a Member having the responsibility and competence for ensuring or supervising the implementation of animal health and welfare measures, international veterinary certification and other standards and recommendations in the Terrestrial Code and in the OIE Aquatic Animal Health Code in the whole territory.

Container

means a non-self-propelled receptacle or other rigid structure for holding animals during a journey by one or several means of transport.

Containment zone

means a defined zone around and including suspected or infected establishments, taking into account the epidemiological factors and results of investigations, where control measures to prevent the spread of the infection are applied.

Death

means the irreversible loss of brain activity demonstrable by the loss of brain stem reflexes.

Disease

means the clinical and/or pathological manifestation of infection.

Disinfection

means the application, after thorough cleansing, of procedures intended to destroy the infectious or parasitic agents of animal diseases, including zoonoses; this applies to premises, vehicles and different objects which may have been directly or indirectly contaminated.

Disinfestation

means the application of procedures intended to eliminate arthropods which may cause diseases or are potential vectors of infectious agents of animal diseases, including zoonoses.

Emerging disease

means a new infection resulting from the evolution or change of an existing pathogenic agent, a known infection spreading to a new geographic area or population, or a previously unrecognized pathogenic agent or disease diagnosed for the first time and which has a significant impact on animal or public health.

Epidemiological unit

means a group of animals with a defined epidemiological relationship that share approximately the same likelihood of exposure to a pathogen. This may be because they share a common environment (e.g. animals in a pen), or because of common management practices. Usually, this is a herd or a flock. However, an epidemiological unit may also refer to groups such as animals belonging to residents of a village, or animals sharing a communal animal handling facility. The epidemiological relationship may differ from disease to disease, or even strain to strain of the pathogen.

Equivalence of sanitary measures

means the state wherein the sanitary measure(s) proposed by the exporting country as an alternative to those of the importing country, achieve(s) the same level of protection.

Eradication

means the elimination of a pathogenic agent from a country or zone.

Establishment

means the premises in which animals are kept.

Exporting country

means a country from which commodities are sent to another country.

Free compartment

means a compartment in which the absence of the animal pathogen causing the disease under consideration has been demonstrated by all requirements specified in the Terrestrial Code for free status being met.

Free zone

means a zone in which the absence of the disease under consideration has been demonstrated by the requirements specified in the Terrestrial Code for free status being met. Within the zone and at its borders, appropriate official veterinary control is effectively applied for animals and animal products, and their transportation.

Hazard

means a biological, chemical or physical agent in, or a condition of, an animal or animal product with the potential to cause an adverse health effect.

Hazard identification

means the process of identifying the pathogenic agents which could potentially be introduced in the commodity considered for importation.

Headquarters

means the Permanent Secretariat of the World Organisation for Animal Health located at:

12, rue de Prony, 75017 Paris, FRANCE

Telephone: 33-(0)1 44 15 18 88 Fax: 33-(0)1 42 67 09 87

Electronic mail: oie@oie.int http://www.oie.int

Importing country

means a country that is the final destination to which commodities are sent.

Incidence

means the number of new cases or outbreaks of a disease that occur in a population at risk in a particular geographical area within a defined time interval.

Incubation period

means the longest period which elapses between the introduction of the pathogen into the animal and the occurrence of the first clinical signs of the disease.

Infected zone

means a zone in which a disease has been diagnosed.

Infection

means the entry and development or multiplication of an infectious agent in the body of humans or animals.

Infective period

means the longest period during which an affected animal can be a source of infection.

International trade

means importation, exportation and transit of commodities.

International veterinary certificate

means a certificate, issued in conformity with the provisions of Chapter 5.2., describing the animal health and/or public health requirements which are fulfilled by the exported commodities.

Laboratory

means a properly equipped institution staffed by technically competent personnel under the control of a specialist in veterinary diagnostic methods, who is responsible for the validity of the results. The Veterinary Authority approves and monitors such laboratories with regard to the diagnostic tests required for international trade.

Listed diseases

means the list of transmissible disease agreed by the World Assembly of OIE Delegates and set out in Chapter 1.2. of the Terrestrial Code.

Market

means a place where animals are assembled for the purpose of trade or sale.

Monitoring

means the intermittent performance and analysis of routine measurements and observations, aimed at detecting changes in the environment or health status of a population.

Notifiable disease

means a disease listed by the Veterinary Authority, and that, as soon as detected or suspected, should be brought to the attention of this Authority, in accordance with national regulations.

Notification

means the procedure by which:

a. the Veterinary Authority informs the Headquarters,

b. the Headquarters inform the Veterinary Authority,

of the occurrence of an outbreak of disease or infection, according to the provisions of Chapter 1.1. of the Terrestrial Code.

Official control programme

means a programme which is approved, and managed or supervised by the Veterinary Authority of a country for the purpose of controlling a vector, pathogen or disease by specific measures applied throughout that country, or within a zone or compartment of that country.

Official Veterinarian

means a veterinarian authorised by the Veterinary Authority of the country to perform certain designated official tasks associated with animal health and/or public health and inspections of commodities and, when appropriate, to certify in conformity with the provisions of Chapters 5.1. and 5.2. of the Terrestrial Code.

Official veterinary control

means the operations whereby the Veterinary Services, knowing the location of the animals and after taking appropriate actions to identify their owner or responsible keeper, are able to apply appropriate animal health measures, as required. This does not exclude other responsibilities of the Veterinary Services e.g. food safety.

Outbreak

means the occurrence of one or more cases in an epidemiological unit.

Pathological material

means samples obtained from live or dead animals, containing or suspected of containing infectious or parasitic agents, to be sent to a laboratory.

Population

means a group of units sharing a common defined characteristic.

Prevalence

means the total number of cases or outbreak of a disease that are present in a population at risk, in a particular geographical area, at one specified time or during a given period.

Protection zone

means a zone established to protect the health status of animals in a free country or free zone, from those in a country or zone of a different animal health status, using measures based on the epidemiology of the disease under consideration to prevent spread of the causative pathogenic agent into a free country or free zone. These measures may include, but are not limited to, vaccination, movement control and an intensified degree of surveillance.

Quality

is defined by International Standard ISO 8402 as 'the totality of characteristics of an entity that bear on its ability to satisfy stated and implied needs'.

Quarantine station

means an establishment under the control of the Veterinary Authority where animals are maintained in isolation with no direct or indirect contact with other animals, to ensure that there is no transmission of specified pathogen(s) outside the establishment while the animals are undergoing observation for a specified length of time and, if appropriate, testing and treatment.

Registration

is the action by which information on animals (such as identification, animal health, movement, certification, epidemiology, establishments) is collected, recorded, securely stored and made appropriately accessible and able to be utilised by the Competent Authority.

Risk

means the likelihood of the occurrence and the likely magnitude of the biological and economic consequences of an adverse event or effect to animal or human health.

Sanitary measure

means a measure, such as those described in various chapters of the Terrestrial Code, destined to protect animal or human health or life within the territory of the OIE Member from risks arising from the entry, establishment and/or spread of a hazard.

Specific surveillance

means the surveillance targeted to a specific disease or infection.

Subpopulation

means a distinct part of a population identifiable according to specific common animal health characteristics.

Surveillance

means the systematic ongoing collection, collation, and analysis of information related to animal health and the timely dissemination of information to those who need to know so that action can be taken.

Terrestrial Code

means the OIE Terrestrial Animal Health Code.

Terrestrial Manual

means the OIE Manual of Diagnostic Tests and Vaccines for Terrestrial Animals.

Transparency

means the comprehensive documentation of all data, information, assumptions, methods, results, discussion and conclusions used in the risk analysis. Conclusions should be supported by an objective and logical discussion and the document should be fully referenced.

Unit

means an individually identifiable element used to describe, for example, the members of a population or the elements selected when sampling; examples of units include individual animals, herds, flocks and apiaries.

Vector

means an insect or any living carrier that transports an infectious agent from an infected individual to a susceptible individual or its food or immediate surroundings. The organism may or may not pass through a development cycle within the vector.

Veterinarian

means a person registered or licensed by the relevant veterinary statutory body of a country to practice veterinary medicine/science in that country.

Veterinary Authority

means the Governmental Authority of an OIE Member, comprising veterinarians, other professionals and para-professionals, having the responsibility and competence for ensuring or supervising the implementation of animal health and welfare measures, international veterinary certification and other standards and recommendations in the Terrestrial Code in the whole territory.

Veterinary legislation

means laws, regulations and all associated legal instruments that pertain to the veterinary domain.

Veterinary para-professional

means a person who, for the purposes of the Terrestrial Code, is authorised by the veterinary statutory body to carry out certain designated tasks (dependent upon the category of veterinary para-professional) in a territory, and delegated to them under the responsibility and direction of a veterinarian. The tasks for each category of veterinary para-professional should be defined by the veterinary statutory body depending on qualifications and training, and according to need.

Veterinary Services

means the governmental and non-governmental organisations that implement animal health and welfare measures and other standards and recommendations in the Terrestrial Code and the OIE Aquatic Animal Health Code in the territory. The Veterinary Services are under the overall control and direction of the Veterinary Authority. Private sector organisations, veterinarians, veterinary paraprofessionals or aquatic animal health professionals are normally accredited or approved by the Veterinary Authority to deliver the delegated functions.

Veterinary statutory body

means an autonomous authority regulating veterinarians and veterinary para-professionals.

Zone/region

means a clearly defined part of a territory containing an animal subpopulation with a distinct health status with respect to a specific disease for which required surveillance, control and biosecurity measures have been applied for the purpose of international trade.

Zoonosis

means any disease or infection which is naturally transmissible from animals to humans.

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Group photo of participants and trainers in the courtyard of the Happy Valley Hotel
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BETTER TRAINING FOR SAFER FOOD (BTSF)

The *Health and Consumer Directorate General* of the European Commission (DG SANCO) organises training for developing country participants under the *Better Training for Safer Food* programme (BTSF). The training covers food and feed law, animal health and welfare rules and plant health rules.

The general aims of the third country part of BTSF are to ensure fair trade with third and particularly developing countries, to help third countries to better understand and meet EU standards, which in turn will reduce rejections at the EU borders. Furthermore, better food safety controls give third country consumers better food safety and EU consumers access to a more diverse product range.

Under the BTSF a training programme of EUR 10 million for the period 2008/2012 is dedicated to Africa. Half of these training activities are organised by the OIE. In 2010 alone, approximately 60 events were planned with around 3000 participants.

The BTSF Africa programme is aimed at strengthening the capacity of public and private sectors in the veterinary and plant health field, to support food security through technical and policy advice on animal health, food safety and quality, to contribute to reducing food-borne diseases and to support the competitiveness of the agro-food sector and contribute to rural development and employment in Africa.

Specific topics in relation to animal health organised together with OIE are:

- Evaluation of performance of Veterinary Services
- Improvement of national / regional legal framework on animal health
- Laboratory capacity (twinning)
- Training of CVOs and national focal points.

USEFUL WEBSITES

www.beesfordevelopment.org

www.apimondia.org

www.oie.int

www.rr-africa.oie.int

www.anses.fr

SEMINAR BACKGROUND AND OBJECTIVES

On April 3rd, 2009, the Republic of South Africa reported to the OIE that American Foulbrood (AFB) has been diagnosed in certain beehives in the Western Cape province. The Plant Protection Research Institute (PPRI) of the Agricultural Research Council (ARC) had been surveying honeybee colonies and retail honey in South Africa for the presence of American Foulbrood, as a project for the national Department of Agriculture (DoA), meanwhile renamed national Department of Agriculture, Forestry and Fisheries (DAFF). This disease, caused by the spore-forming bacterium *Paenibacillus larvae*, had reviously never been reported in sub-Saharan Africa. In other parts of the world AFB has caused large scale colony losses and as it is extremely contagious and very difficult to eradicate, and has been the subject of extensive eradication and control programmes. This is the major reason why honey and other honeybee products entering South Africa are required by law to be irradiated, in an effort to prevent the disease from entering the local honeybee population. Unfortunately, this did not prevent AFB to be found in some colonies and apiaries in the Western Cape. As a result of intensified inspections, it was later revealed that the bee disease had surfaced beyond the so called "capensis line", raising fears it could have spread from Cape honeybees to the African honey bee. The "capensis line" is a management barrier intended to keep the Cape honey bee *Apis mellifera capensis* separate from the African variety, *Apis mellifera scutellata*. The bacteria were found in 4 out of 24 tested bulk honey samples north of the line. Whether or not the disease had breached the line in bee colonies themselves would only be revealed in test samples. According to the NGO Bees-for-Development, a charity based in the UK, analysis of honey from Burundi, collected in 1990 and 1991 and from The Gambia in 1999 did not find contamination with *Paenibacillus larvae larvae* spores. Fries and Raina (2003) made a survey of honey samples from Kenya, Senegal, South Africa, Tanzania, Uganda, Zambia, and Zimbabwe. Neither contamination with foulbrood spores in the honey nor clinical symptoms of AFB in the bee colonies was found. The only report of the disease in South Africa is by Davison *et al* (1999) who mentioned that Wolfgang Ritter identified one sample from South African bee colonies as AFB - following this, honeys were examined for *Paenibacillus larvae larvae*. No *Paenibacillus larvae larvae* were found in this survey and it was concluded that AFB was not present in South Africa at that time. However, in 2001, analyses of South African honey and in 2002, from the Gambia and Guinea Bissau found contamination with *Paenibacillus larvae larvae* in South Africa and Guinea Bissau (Hansen *et al.,* 2003). Several studies report that colonies without clinical symptoms of AFB may contain honey contaminated with its spores. Field experiments with inoculation of *Paenibacillus larvae larvae* spores have also shown that infected colonies may eliminate the infections and that no simple correlation exists between the number of spores in the honey and the first visible signs of AFB in capped brood cells. A study by Hansen *et al* (2003) only indicates the presence of *Paenibacillus* spores in African bee colonies, and not that colonies with clinical symptoms of AFB are present. Since the South African outbreak of 2009, no other country has reported AFB on its territory, while Zambia and Swaziland claim disease freedom (but not officially to the OIE), based on surveys carried out, again under auspices of Bees-for-Development. The current spread of the disease in southern Africa is therefore largely unknown, not in the least because the sector is not regularly investigated for this disease, and least of all by the veterinary authority, as the detection of AFB in South Africa illustrates. The Republic of South Africa declared to the OIE that the disease had become endemic on April 30th, 2010. Paradoxically, no further cases have been encountered since (M. Allsopp, personal comm., 2011).

Varroosis of honey bees in Madagascar (exotic to the island) was reported on the 11th of February 2010 in the vicinity of the capital Antananarivo and declared resolved on March 26th, 2010. Varroosis is one of the most destructive diseases of honey bees, inflicting damage and higher economic costs than all other known apicultural diseases. Brood and adults bees are impaired. The mite injures the bee through repeated intake of hemolymph from the host while in all the stages i.e. larval, pupal and adult. Loss of hemolymph effects development cycle of the bee. Colonies infested by *V. destructor* develop what is commonly known as the parasitic mite syndrome and ultimately collapse if left untreated. Varroosis is known to exist in Swaziland and Libya (WAHID, 2010) and has not or never been reported from Tunisia, Egypt, Sudan, Ethiopia, Somalia, Kenya and Lesotho. Other African countries do not report on the disease. The disease is reported from Western Europe, Central Europe and the Balkan, the Middle East, Russia, Iran, Mongolia and the Far East, as well as New Zealand, Canada, Chile and Argentina, along several Central American countries. To date, only Australia seems to be free of the disease.

Since 2006, a new threat is constituted by Colony Collapse Disorder or CCD, a term coined for a syndrome or disorder for which the precise etiology is not entirely known to date. CCD has been reported in the US and Europe and is spreading rapidly across the planet. In the United States, 25 percent of honeybees vanished in 2006 and 2007, and in several European countries the situation is possibly even worse. A European Union research project called Bee-Doc has been looking into the problem since March 2010. Together, 11 universities from nine different countries are working under Professor Robin Moritz, one of the world's top experts in this field and a guest speaker at our seminar.

The idea behind Bee-Doc is to seek three different research pillars, one aiming at diagnosis of diseases – developing new easy tools for bee disease diagnostics. The other is for developing strategies of disease prevention and the third one is trying to develop novel treatments that may rely less on the tedious chemical therapy that we have now.

In Brussels, last December, in order get a better understanding of the reasons behind the high bee mortality worldwide, the European Commission announced a string of measures to tackle the problem for which, so far, scientific studies have determined neither the exact causes nor the precise extent of the problem, although US researchers recently proposed the association of a virus (Iridoviridae) and a microsporidian fungus (*Nosema ceranae*) as a possible cause of the disorder (Bromenshenk *et al.*, 2010). Whether this association between a virus and a fungus is the cause of the disorder or merely a symptomatic consequence of a larger disorder (e.g. a drop in immunity) remains open to discussion. Indeed, a loss of biodiversity is one of the main suspected reasons for the fall in the bee population, along with excessive use of pesticides and pollution. Beekeeping is a widely-developed activity in the EU. There are about 700,000 beekeepers in the Union, most of who enjoy beekeeping as a hobby. The Commission launched, completed or planned the following specific actions that will permit a better understanding of bee mortality, and consequently of the various remedial actions that may be required:

- Designation of an EU Reference Laboratory for bee health (ANSES - France)
- A pilot surveillance programme to estimate the extent of bee mortalities
- Review of the EU animal health rules for bees, in particular for essential elements such as general definitions, principles for disease control measures and movements
- Increased use of guidance documents to address issues for which legislation at EU level would not be appropriate
- Bee health training for Member States' officials under the Better Training for Safer Food initiative
- Take into account the limited availability of veterinary medicinal products for bees during the review of the EU veterinary medicinal products legislation
- Approve pesticides at EU level only if they are safe for honeybees
- Protect bees by addressing biodiversity loss
- Increase the EU contribution to the financing of the national apiculture programmes by almost 25 percent for the period 2011-2013
- Research projects to deal with honeybee health and the decline of both wild and domesticated pollinators, including honeybee colonies in Europe
- Increased cooperation with international organisations (e.g. OIE)

Given these developments within and outside the region, and as awareness about the tremendous direct and indirect benefits of beekeeping within the 'traditional' veterinary services increases, there is a need to build capacity on all aspects of the beekeeping sector. The OIE's scope within this context is limited to raising awareness on the developments (in animal health terms) in the sector worldwide, and within the region, and ensure timely and accurate reporting to the international community, as much of these disease impact not only on household revenues and agricultural production, but can also be trade sensitive.

Given the importance of bee populations in the way honey is harvested in major parts of this region, and given the very low reporting rate on bee-diseases in general, the subject matter focal points for animal disease notification to the OIE will be invited to attend this training :

TERMS OF REFERENCE OF OIE FOCAL POINTS FOR ANIMAL DISEASE NOTIFICATION

To ensure the optimal collection and submission of information on animal diseases, Members were requested to nominate one or more national focal points to assist the OIE Delegate and act as a direct contact point with the OIE Animal Health Information Department on matters related to information on animal diseases.

The focal points for disease notification to the OIE are the Veterinary Services officers in charge, under the authority of the Delegate to the OIE, of animal disease notification to the OIE. They should be preferably be the responsibility of the National Epidemiological Unit, with experience in epidemiology, computers and software use.

Focal points of each country are key players in the World Animal Health Information System through the optimal use of the online notification system, WAHIS, and in its output. They actually are the information providers to the OIE and through the OIE to the rest of the world and they play a major role at the national level to gather good quality information needed to be processed into WAHIS.

Each Delegate is requested to nominate his/her Focal points, using the WAHIS secure web application (https://www.oie.int/wahis/), using his/her user access and password. There are three possible kinds of access-privileges that can be given by the Delegate to the Focal points : (a) to notify on terrestrial and aquatic animal diseases or (b) to notify on terrestrial animal diseases only or (c) to notify on aquatic animal diseases only.

OBJECTIVES OF THE SEMINAR

The main purpose of the training seminar is to increase understanding of non-traditional stakeholders, such as the veterinarians working within the veterinary services, of the economics, social and environmental importance of the beekeeping sector and to improve the attention given to disease surveillance and bio-security of diseases of honeybees in southern Africa, especially in the context of the recent introduction of American Foulbrood on the African continent (2009). Inversely, it will aim to familiarise those who work in the beekeeping sector with the OIE and its mandates.

The training is expected to improve reporting (both immediate and scheduled) on honeybee diseases to the OIE, based on information provided by specialist biologists and the beekeeping / honey producing industry. The seminar will cover important issues covered by the OIE Terrestrial Animal Health Code (Terrestrial Code) and the OIE Manual of Diagnostic Tests and Vaccines for Terrestrial Animals (Terrestrial Manual), where they pertain to diseases of honeybees, i.e. chapter 4.14 and chapters 9.1 – 9.6 of the section 9 of the Terrestrial Code and chapters 2.2.1 – 2.2.7 of the section 2.2. of the Terrestrial Manual.

In addition it will briefly cover on-going developments and challenges of beekeeping within the region (American Foulbrood and varroosis primarily) as well as bee diseases outside the region (e.g. Colony Collapse Disorder). To demonstrate the application of OIE standards in this field of animal health, a field visit will be organised to a production facility while representatives from the private sector, regional and international stakeholders, as well as participants themselves will have an opportunity to air their views on instances of compliance and non-compliance with international standards.

Chapter 9.1.

Acarapisosis of honey bees

Article 9.1.1.

General provisions

For the purposes of this chapter, acarapisosis, acarine disease or tracheal mite infestation is a disease of the adult honey bee *Apis mellifera* L., and possibly of other *Apis* species (such as *Apis cerana*). It is caused by the Tarsonemid mite *Acarapis woodi* (Rennie). The mite is an internal obligate parasite of the respiratory system, living and reproducing mainly in the large prothoracic trachea of the bee. Early signs of infection normally go unnoticed, and only when infection is heavy does it become apparent; this is generally in the early spring. The infection spreads by direct contact from adult bee to adult bee, with newly emerged bees under ten days old being the most susceptible. The mortality rate may range from moderate to high.

Standards for diagnostic tests are described in the Terrestrial Manual.

Article 9.1.2.

Trade in commodities

When authorising import or transit of the following commodities, Veterinary Authorities should not require any acarapisosis related conditions, regardless of the acarapisosis status of the honey bee population of the exporting country or zone:

1. honey bee semen and honey bee venom;
2. used equipment associated with beekeeping;
3. honey, beeswax, honey bee-collected pollen, propolis and royal jelly.

When authorising import or transit of other commodities listed in the chapter, Veterinary Authorities should require the conditions prescribed in this chapter relevant to the acarapisosis status of the honey bee population of the exporting country or zone.

Article 9.1.3.

Determination of the acarapisosis status of a country or zone/compartment

The acarapisosis 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 acarapisosis occurrence and their historic perspective;

2. acarapisosis should be notifiable in the whole country or zone/compartment (under study) and all clinical signs suggestive of acarapisosis 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 acarapisosis;
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 whole country.

Article 9.1.4.

Country or zone/compartment (under study) free from acarapisosis

1. Historically free status

   A country or zone /compartment (under study) may be considered free from acarapisosis after conducting a risk assessment as referred to in Article 9.1.3. 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 acarapisosis after conducting a risk assessment as referred to in Article 9.1.3. and 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/compartment (under study);
   b. acarapisosis is notifiable in the whole country or zone/compartment (under study), and any clinical cases suggestive of acarapisosis are subjected to field and laboratory investigations;
   c. for the three years following the last reported case of acarapisosis, annual surveys 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 percent of detecting acarapisosis if at least 1 percent of the apiaries were infected at a within-apiary prevalence rate of at least 5 percent of the hives; such surveys may be targeted towards apiaries, areas and seasons with a higher likelihood of disease;
   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* or other possible host species in the country or zone/compartment (under study);
   f. the importation of the commodities listed in the chapter into the country or zone/compartment (under study) is carried out in conformity with the recommendations of this chapter.

Article 9.1.5.

Recommendations for the importation of live queen honey bees, worker bees and drones with or without associated brood combs

Veterinary Authorities of importing countries should require the presentation of an international veterinary certificate attesting that the bees come from a country or zone/compartment (under study) free from acarapisosis.

Article 9.1.6.

Recommendations for the importation of eggs, larvae and pupae of honey bees

Veterinary Authorities of importing countries should require the presentation of an international veterinary certificate attesting that the products:

1. were sourced from an officially free country or zone/compartment (under study); or
2. were examined by an official laboratory and declared free of all life stages of *A. woodi;* or
3. have originated from queens in a quarantine station and were examined microscopically and found free of all life stages of *A. woodi.*

Chapter 9.2.

American foulbrood of honey bees

Article 9.2.1.

General provisions

For the purposes of this chapter, American foulbrood is a disease of the larval and pupal stages of the honey bee *Apis mellifera* and other *Apis* spp., and occurs in most countries where such bees are kept. *Paenibacillus larvae,* the causative organism, is a bacterium that can produce over one billion spores in each infected larva. The spores are very long-living and extremely resistant to heat and chemical agents, and only the spores are capable of inducing the disease.

Combs of infected apiaries may show distinctive clinical signs which can allow the disease to be diagnosed in the field. However, subclinical infections are common and require laboratory diagnosis.

For the purposes of the Terrestrial Code, the incubation period for American foulbrood shall be 15 days (not including the wintering period which may vary according to country).

Standards for diagnostic tests are described in the Terrestrial Manual.

Article 9.2.2.

Trade in commodities

When authorising import or transit of the following commodities, Veterinary Authorities should not require any American foulbrood related conditions, regardless of the American foulbrood status of the honey bee population of the exporting country or zone:

1. honey bee semen;
2. honey bee venom.

When authorising import or transit of other commodities listed in the chapter, Veterinary Authorities should require the conditions prescribed in this chapter relevant to the American foulbrood status of the honey bee population of the exporting country or zone.

Article 9.2.3.

Determination of the American foulbrood status of a country or zone/compartment

The American foulbrood 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 American foulbrood occurrence and their historic perspective;
2. American foulbrood should be notifiable in the whole country or zone/compartment (under study) and all clinical signs suggestive of American foulbrood should be subjected to field and/or laboratory investigations;
3. an on-going awareness programme should be in place to encourage reporting of all cases suggestive of American foulbrood;
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.

Article 9.2.4.

Country or zone/compartment (under study) free from American foulbrood

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 9.2.3. 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 American foulbrood after conducting a risk assessment as referred to in Article 9.2.3. and 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/compartment (under study);
   b. American foulbrood is notifiable in the whole country or zone /compartment (under study), and any clinical cases suggestive of American foulbrood are subjected to field and/or laboratory investigations;
   c. for the five years following the last reported isolation of the American foulbrood agent, annual surveys 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 percent of detecting American foulbrood if at least 1 percent of the apiaries were infected at a within-apiary prevalence rate of at least 5 percent of the hives; such surveys may be targeted towards areas with the last reported isolation of the American foulbrood agent;
   d. to maintain free status, an annual survey supervised by the Veterinary Authority, with negative results, is carried out on a representative sample of hives in the country or zone/compartment (under study) to indicate that there has been no new isolations; such surveys may be targeted towards areas with a higher likelihood of isolation;
   e. (under study) there is no self-sustaining feral population of *A. mellifera* or other possible host species in the country or zone/compartment (under study);
   f. all equipment associated with previously infected apiaries has been sterilised or destroyed;
   g. the importation of the commodities listed in the chapter into the country or zone/compartment (under study) is carried out in conformity with the recommendations of this chapter.

Article 9.2.5.

Recommendations for the importation of live queen honey bees, worker bees and drones with or without associated brood combs

Veterinary Authorities of importing countries should require the presentation of an international veterinary certificate attesting that the bees come from a country or zone/compartment (under study) officially free from American foulbrood.

Article 9.2.6.

Recommendations for the importation of eggs, larvae and pupae of honey bees

Veterinary Authorities of importing countries should require the presentation of an international veterinary certificate attesting that the products:

1. were sourced from a free country or zone/compartment (under study); or
2. have been isolated from queens in a quarantine station, and all workers which accompanied the queen or a representative sample of eggs or larvae were examined for the presence of P. larvae by bacterial culture or PCR in accordance with the Terrestrial Manual.

Article 9.2.7.

Recommendations for the importation of used equipment associated with beekeeping

Veterinary Authorities of importing countries should require the presentation of an international veterinary certificate attesting that the equipment was sterilised under the supervision of the Veterinary Authority by either immersion in 1 percent sodium hypochlorite for at least 30 minutes (suitable only for non-porous materials such as plastic and metal), gamma irradiation using a cobalt-60 source at a dose rate of 10 kiloGray, or processing to ensure the destruction of both bacillary and spore forms of P. larvae, in conformity with one of the procedures referred to in Chapter X.X. (under study).

Article 9.2.8.

Recommendations for the importation of honey, honey bee-collected pollen, beeswax, propolis and royal jelly

Veterinary Authorities of importing countries officially free from American foulbrood should require the presentation of an international veterinary certificate attesting that the products:

1. were collected in a country or zone/compartment (under study) free from American foulbrood; or
2. have been processed to ensure the destruction of both bacillary and spore forms of *P. larvae,* in conformity with one of the procedures referred to in Chapter X.X. (under study).

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Chapter 9.3.

European foulbrood of honey bees

Article 9.3.1.

General provisions

For the purposes of this chapter, European foulbrood is a disease of the larval and pupal stages of the honey bee *Apis mellifera* and other *Apis* spp., and occurs in most countries where such bees are kept. The causative agent is the non-sporulating bacterium *Melissococcus plutonius.* Subclinical infections are common and require laboratory diagnosis. Infection remains enzootic because of mechanical contamination of the honeycombs. Recurrences of disease can therefore be expected in subsequent years.

For the purposes of the Terrestrial Code, the incubation period for European foulbrood shall be 15 days (not including the wintering period which may vary according to country).

Standards for diagnostic tests are described in the Terrestrial Manual.

Article 9.3.2.

Trade in commodities

When authorising import or transit of the following commodities, Veterinary Authorities should not require any European foulbrood related conditions, regardless of the European foulbrood status of the honey bee population of the exporting country or zone:

1. honey bee semen;
2. honey bee venom.

When authorising import or transit of other commodities listed in the chapter, Veterinary Authorities should require the conditions prescribed in this chapter relevant to the European foulbrood status of the honey bee population of the exporting country or zone.

Article 9.3.3.

Determination of the European foulbrood status of a country or zone/compartment

The European foulbrood 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 European foulbrood occurrence and their historic perspective;
2. European foulbrood should be notifiable in the whole country or zone/compartment (under study) and all clinical signs suggestive of European foulbrood 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 European foulbrood;
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 apiaries in the whole country.

Article 9.3.4.

Country or zone/compartment (under study) free from European foulbrood

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 9.3.3. 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 European foulbrood after conducting a risk assessment as referred to in Article 9.3.3. and 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/compartment (under study);
   b. European foulbrood is notifiable in the whole country or zone/compartment (under study), and any clinical cases suggestive of European foulbrood are subjected to field and laboratory investigations;
   c. for the three years following the last reported isolation of the European foulbrood agent, 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 percent of detecting European foulbrood if at least 1 percent of the apiaries were infected at a within-apiary prevalence rate of at least 5 percent of the hives; such surveys may be targeted towards areas with the last reported isolation of the European foulbrood agent;
   d. to maintain free status, an annual survey supervised by the Veterinary Authority, with negative results, is carried out on a representative sample of hives in the country or zone/compartment (under study) to indicate that there has been no new isolations; such surveys may be targeted towards areas with a higher likelihood of isolation;
   e. (under study) there is no self-sustaining feral population of *A. mellifera* or other possible host species in the country or zone/compartment (under study);
   f. the importation of the commodities listed in the chapter into the country or zone/compartment (under study) is carried out in conformity with the recommendations of this chapter.

Article 9.3.5.

Recommendations for the importation of live queen honey bees, worker bees and drones with or without associated brood combs

Veterinary Authorities of importing countries should require the presentation of an international veterinary certificate attesting that the bees come from a country or zone/compartment (under study) free from European foulbrood.

Article 9.3.6.

Recommendations for the importation of eggs, larvae and pupae of honey bees

Veterinary Authorities of importing countries should require the presentation of an international veterinary certificate attesting that the products:

1. were sourced from a free country or zone/compartment (under study); or
2. have been isolated from queens in a quarantine station, and all workers which accompanied the queen or a representative sample of eggs or larvae were examined for the presence of *M. plutonius* by bacterial culture or PCR in accordance with the Terrestrial Manual.

Article 9.3.7.

Recommendations for the importation of used equipment associated with beekeeping

Veterinary Authorities of importing countries should require the presentation of an international veterinary certificate attesting that the equipment was sterilised under the supervision of the Veterinary Authority by either immersion in 0.5 percent sodium hypochlorite for at least 20 minutes (suitable only for non-porous materials such as plastic and metal), gamma irradiation using a cobalt-60 source at a dose rate of 10 kiloGray, or processing to ensure the destruction of *M. plutonius,* in conformity with one of the procedures referred to in Chapter X.X. (under study).

Article 9.3.8.

Recommendations for the importation of honey, honey bee-collected pollen, beeswax, propolis and royal jelly

Veterinary Authorities of importing countries should require the presentation of an international veterinary certificate attesting that the products:

1. were collected in a country or zone/compartment (under study) free from European foulbrood; or
2. have been processed to ensure the destruction of *M. plutonius,* in conformity with one of the procedures referred to in Chapter X.X. (under study).

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Chapter 9.4.

Small hive beetle infestation *(Aethina tumida)*

Article 9.4.1.

General provisions

For the purposes of this chapter, *small hive beetle* (SHB) is an infestation of bee colonies by the beetle *Aethina tumida,* which is a free-living predator and scavenger affecting populations of the honey bee *Apis mellifera* L. It can also parasitise bumble bee *Bombus terrestris* colonies under experimental conditions, and although infestation has not been demonstrated in wild populations, *Bombus* spp. should also be considered to be susceptible to infestation.

The adult beetle is attracted to bee colonies to reproduce, although it can survive and reproduce independently in other natural environments, using other food sources, including certain types of fruit. Hence once it is established within a localised environment, it is extremely difficult to eradicate.

The life cycle of *A. tumida* begins with the adult beetle laying eggs within infested hives. These are usually laid in irregular masses in crevices or brood combs. After two to six days, the eggs hatch and the emerging larvae begin to feed voraciously on brood comb, bee eggs, pollen and honey within the hive. The SHB has a high reproductive potential. Each female can produce about 1,000 eggs in its four to six months of life. At maturation (approximately 10–29 days after hatching), the larvae exit the hive and burrow into soil around the hive entrance. Adult beetles emerge after an average of three–four weeks, although pupation can take between 8 and 60 days depending on temperature and moisture levels.

The life span of an adult beetle depends on environmental conditions such as temperature and humidity but, in practice, adult beetles can live for at least six months and, in favourable reproductive conditions, the female is capable of laying new egg batches every 5–12 weeks. The beetle is able to survive at least two weeks without food and 50 days on brood combs.

Early signs of infestation may go unnoticed, but the growth of the beetle population is rapid, leading to high bee mortality in the hive. Because *A. tumida* can be found and can thrive within the natural environment, and can fly up to 6–13 km from its nest site, it is capable of dispersing rapidly and directly colonising hives. Dispersal includes following or accompanying swarms. Spread of infestation does not require contact between adult bees. However, the movement of adult bees, honeycomb and other apiculture products and used equipment associated with bee-keeping may all cause infestations to spread to previously unaffected colonies.

Standards for diagnostic tests are described in the Terrestrial Manual.

Article 9.4.2.

Trade in commodities

When authorising import or transit of the following commodities, Veterinary Authorities should not require any small hive beetle 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 the 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.

Article 9.4.3.

Determination of the *A. tumida* status of a country or zone

The *A. tumida* status of a country or zone can only be determined after considering the following criteria:

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.

Article 9.4.4.

Country or zone free from *A. tumida*

1. Historically free status

   A country or zone may be considered free from the pest after conducting a risk assessment as referred to in Article 9.4.3. but without formally applying a specific surveillance programme if the country or zone complies with the provisions of 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 *A. tumida* infestation after conducting a risk assessment as referred to in Article 9.4.3. and 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 *A. tumida* 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 *A. tumida* 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 percent of detecting *A. tumida* infestation if at least 1 percent of the apiaries were infested at a within-apiary prevalence rate of at least 5 percent 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., in conformity with one of the procedures referred to in Chapter X.X. (under study);
   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 *A. tumida* larvae and pupae;
   g. the importation of the commodities listed in the chapter into the country or zone is carried out, in conformity with the recommendations of this chapter.

Article 9.4.5.

Recommendations for the importation of individual consignments containing a single live queen honey bee or queen bumble bee, accompanied by a small number of associated attendants (a maximum of 20 attendants per queen)

Veterinary Authorities of importing countries should require the presentation of an international veterinary certificate attesting that the bees come from a country or zone officially free from *A. tumida* infestation.

OR

Veterinary Authorities of importing countries should require the presentation of an international veterinary certificate including an attestation from the Veterinary Authority of the exporting third country stating that:

1. the bees come from hives or colonies which were inspected immediately prior to dispatch and show no sign or suspicion of the presence of *A. tumida* or its eggs, larvae or pupae; and
2. the bees come from an area of at least 100 km radius where no apiary has been subject to any restrictions associated with the occurrence of *A. tumida* for the previous six months; and
3. the bees and accompanying packaging presented for export have been thoroughly and individually inspected and do not contain *A. tumida* or its eggs, larvae or pupae; and
4. the consignment of bees is covered with fine mesh through which a live beetle cannot enter.

Article 9.4.6.

Recommendations for the importation of live worker bees, drone bees or bee colonies with or without associated brood combs or for live bumble bees

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.

Article 9.4.7.

Recommendations for the importation of eggs, larvae and pupae of honey bees or bumble bees

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 sign 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.

Article 9.4.8.

Recommendations for the importation of used equipment associated with beekeeping

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

a. contains no live honey bees or bee brood; and
b. has been thoroughly cleaned, and treated to ensure the destruction of *A. tumida* spp., in conformity with one of the procedures referred to in Chapter X.X. (under study);

AND

2. all precautions have been taken to prevent infestation/contamination.

Article 9.4.9.

Recommendations for the importation of honey-bee collected pollen and beeswax (in the form of honeycomb)

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

a. contains no live honey bees or bee brood; and
b. has been thoroughly cleaned, and treated to ensure the destruction of *A. tumida* spp., in conformity with one of the procedures referred to in Chapter X.X. (under study);

AND

2. all precautions have been taken to prevent infestation/contamination.

Article 9.4.10.

Recommendations for the importation of comb honey

Veterinary Authorities of importing countries should require the presentation of an international veterinary certificate attesting that the products:

1. comes from a country or zone free from *A. tumida* infestation; and
2. contains 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 during at least 24 hours.

Chapter 9.5.

Tropilaelaps infestation of honey bees

Article 9.5.1.

General provisions

For the purposes of this chapter, *Tropilaelaps* infestation of the honey bee *Apis mellifera* L. is caused by the mites *Tropilaelaps clareae, T. koenigerum, T. thaii* and *T. mercedesae.* The mite is an ectoparasite of brood of *Apis mellifera* L., *Apis laboriosa* and *Apis dorsata*, and cannot survive for periods of more than seven days away from bee brood.

Early signs of infection normally go unnoticed, but the growth in the mite population is rapid leading to high hive mortality. The infection spreads by direct contact from adult bee to adult bee, and by the movement of infested bees and bee brood. The mite can also act as a vector for viruses of the honey bee.

Standards for diagnostic tests are described in the Terrestrial Manual.

Article 9.5.2.

Trade in commodities

When authorising import or transit of the following commodities, Veterinary Authorities should not require any *Tropilaelaps* infestation related conditions, regardless of the *Tropilaelaps* status of the honey bee population of the exporting country or zone:

1. honey bee semen, honey bee eggs and honey bee venom;
2. extracted honey and beeswax (not in the form of honeycomb).

When authorising import or transit of other commodities listed in the chapter, Veterinary Authorities should require the conditions prescribed in this chapter relevant to the *Tropilaelaps* status of the honey bee population of the exporting country or zone.

Article 9.5.3.

Determination of the *Tropilaelaps* status of a country or zone/compartment

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.

Article 9.5.4.

Country or zone/compartment (under study) free from *Tropilaelaps* spp

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:

   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 percent of detecting *Tropilaelaps* infestation if at least 1 percent of the apiaries were infected at a within-apiary prevalence rate of at least 5 percent 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 the chapter into the country or zone/compartment (under study) is carried out, in conformity with the recommendations of this chapter.

Article 9.5.5.

Recommendations for the importation of live queen honey bees, worker bees and drones with associated brood combs

Veterinary Authorities of importing countries should require the presentation of an international veterinary certificate attesting that the bees come from a country or zone/compartment (under study) officially free from *Tropilaelaps* infestation.

Article 9.5.6.

Recommendations for the importation of live queen honey bees, worker bees and drones without associated brood combs

Veterinary Authorities of importing countries 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.

Article 9.5.7.

Recommendations for the importation of used equipment associated with beekeeping

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 seven days prior to shipment; or
3. has been treated to ensure the destruction of *Tropilaelaps* spp., in conformity with one of the procedures referred to in Chapter X.X. (under study).

Article 9.5.8.

Recommendations for the importation of honey-bee collected pollen, beeswax (in the form of honeycomb), comb honey and propolis

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., in conformity with one of the procedures referred to in Chapter X.X. (under study).

Chapter 9.6.

Varroosis of honey bees

Article 9.6.1.

General provisions

For the purposes of this chapter, varroosis is a disease of the honey bee *Apis mellifera* L. It is caused by the Korea and Japan haplotypes of the mite *Varroa destructor*, the original hosts of which are the Korea and Japan haplotypes of *Apis cerana* (under study). The mite is an ectoparasite of adults and brood of *Apis mellifera* L. During its life cycle, sexual reproduction occurs inside the honey bee brood cells. Early signs of infection normally go unnoticed, and only when infection is heavy does it become apparent. The infection spreads by direct contact from adult bee to adult bee, and by the movement of infested bees and bee brood. The mite can also act as a vector for viruses of the honey bee.

The number of parasites steadily increases with increasing brood activity and the growth of the bee population, especially late in the season when clinical signs of infestation can first be recognised. The life span of an individual mite depends on temperature and humidity but, in practice, it can be said to last from some days to a few months.

Standards for diagnostic tests are described in the Terrestrial Manual.

Article 9.6.2.

Trade in commodities

When authorising import or transit of the following commodities, Veterinary Authorities should not require any varroosis related conditions, regardless of the varroosis status of the honey bee population of the exporting country or zone:

1. honey bee semen, honey bee eggs and honey bee venom;
2. extracted honey and beeswax (not in the form of honeycomb).

When authorising import or transit of other commodities listed in the chapter, Veterinary Authorities should require the conditions prescribed in this chapter relevant to the varroosis status of the honey bee population of the exporting country or zone.

Article 9.6.3.

Determination of the varroosis status of a country or zone/compartment

The varroosis 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 varroosis occurrence and their historic perspective;
2. varroosis should be notifiable in the whole country or zone/compartment (under study) and all clinical signs suggestive of varroosis 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 varroosis;
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.

Article 9.6.4.

Country or zone/compartment (under study) free from varroosis

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 9.6.3. but without formally applying a specific surveillance programme (historical freedom) 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 varroosis after conducting a risk assessment as referred to in Article 9.6.3. and 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/compartment (under study);
   b. varroosis is notifiable in the whole country or zone/compartment (under study), and any clinical cases suggestive of varroosis are subjected to field and laboratory investigations;
   c. for the three years following the last reported case of varroosis, 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 percent of detecting varroosis if at least 1 percent of the apiaries were infected at a within-apiary prevalence rate of at least 5 percent of the hives; such surveys may be targeted towards areas with a higher likelihood of disease;
   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,* the Korea and Japan haplotypes of *Apis cerana* or other possible host species in the country or zone/compartment (under study);
   f. the importation of the commodities listed in the chapter into the country or zone/compartment (under study) is carried out in conformity with the recommendations of this chapter.

Article 9.6.5.

Recommendations for the importation of live queen honey bees, worker bees and drones with or without associated brood combs

Veterinary Authorities of importing countries should require the presentation of an international veterinary certificate attesting that the bees come from a country or zone/compartment (under study) officially free from varroosis.

Article 9.6.6.

Recommendations for the importation of larvae and pupae of honey bees

Veterinary Authorities of importing countries should require the presentation of an international veterinary certificate attesting that the products:

1. were sourced from a free country or zone/compartment (under study); or
2. have originated from queens in a quarantine station and were inspected and found free of *Varroa destructor.*

Article 9.6.7.

Recommendations for the importation of used equipment associated with beekeeping

Veterinary Authorities of importing countries should require the presentation of an international veterinary certificate attesting that the equipment:

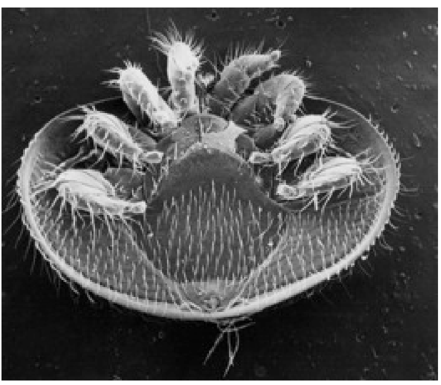
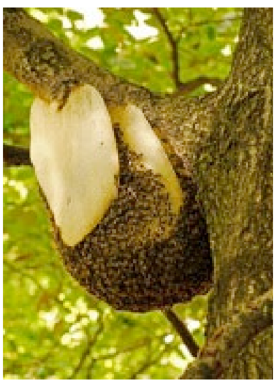
1. comes from a country or zone/compartment (under study) free from varroosis; or
2. contains no live honey bees or bee brood and has been held away from contact with live honey bees for at least seven days prior to shipment; or
3. has been treated to ensure the destruction of *Varroa destructor*, in conformity with one of the procedures referred to in Chapter X.X. (under study).

Article 9.6.8.

Recommendations for the importation of honey-bee collected pollen, beeswax (in the form of honeycomb), comb honey and propolis

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 varroosis; 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 *Varroa destructor*, in conformity with one of the procedures referred to in Chapter X.X. (under study).

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