

# Surveillance report on honeybee (*Apis mellifera*) diseases and disorders in 2014

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## Abstract

The surveillance of notifiable bee diseases includes diseases found in France such as American foulbrood, varroasis, nosemosis caused by *Nosema apis*, the Asian hornet, and two exotic pathogens, *Tropilaelaps* spp. and *Aethina tumida*. Several surveillance systems described in this article contribute to the surveillance of honeybee diseases and colony losses. The European Epilobee/Resabeille programme has studied some of these diseases, and is closely linked to the surveillance scheme for bee disorders set up in 2002 to handle cases of acute bee mortality where intoxication by plant protection products was suspected. This scheme was renewed in October 2014. Results confirmed previous trends regarding the enzootic circulation of the first two diseases and showed that *Tropilaelaps* spp. and *Aethina tumida*, recently discovered in southern Italy, were not found in France. Massive acute mortality cases are also described.

## Keywords

American foulbrood, Nosemosis, *Tropilaelaps*, Asian hornet, *Aethina*, Mortality, Depopulation, Bees, Surveillance, Intoxication

## Résumé

### **Bilan de la surveillance des maladies réglementées et troubles des abeilles domestiques *Apis mellifera* pour l'année 2014**

La surveillance des maladies réglementées des abeilles concerne des maladies présentes en France telles que la loque américaine, la varroose, la nosérose à *Nosema apis*, le frelon asiatique ainsi que les deux agents pathogènes exotiques que sont *Tropilaelaps* spp. et *Aethina tumida*. Plusieurs dispositifs décrits dans cet article contribuent à la surveillance des maladies et des mortalités d'abeilles. Le programme européen Epilobee/Resabeille s'est notamment intéressé à certaines de ces maladies. Le dispositif de surveillance des troubles des abeilles mis en place en 2002 traite les cas de mortalités aiguës d'abeilles avec suspicion d'intoxication par des produits phytosanitaires ; ce dernier a été rénové en octobre 2014. Les résultats confortent ceux des années précédentes concernant la circulation sous forme enzootique des deux premières maladies, et confirment l'absence de *Tropilaelaps* spp. et d'*Aethina tumida* sur le territoire dans un contexte d'introduction d'*A. tumida* dans le Sud de l'Italie. Les mortalités massives aiguës sont également décrites.

## Mots-clés

Loque américaine, nosérose, *Tropilaelaps*, frelon asiatique, *Aethina*, mortalité, dépopulation, abeilles, surveillance, intoxication

## Surveillance scheme for bee diseases and mortality

Surveillance of diseases and mortality of honeybees, *Apis mellifera*, is unusual in that it covers both biological and chemical risks.

Some of the biological risks are subject to regulations and are monitored particularly closely. Four health hazards have been classified as Category 1 in France: *Paenibacillus larvae* (American foulbrood), *Nosema apis* (nosemosis), *Aethina tumida* (small hive beetle) and the *Tropilaelaps clareae* mite; two others have been classified in Category 2: *Varroa destructor* (varroasis) and *Vespa velutina* (Asian hornet) (Decree 2012-845 of 30 June 2012 and Ministerial Order of 29 July 2013). *Paenibacillus larvae*, *Varroa destructor* and the two exotic pathogens (*A. tumida* and *Tropilaelaps* spp.) are also regulated at European level by Regulation (EU) no. 206/2010 and the Directives 92/65/EEC and 82/894/EEC, and at international level by the Terrestrial Animal Health Code of the World Organisation for Animal Health (OIE) (Table 1).

Each monitoring scheme for bee diseases and mortality funded or subsidised by the State in 2014 has a specific range of actions, described in Box 1.

A key event for 2014 was the arrival of the small hive beetle, *Aethina tumida*, in Italy. A total of 61 outbreaks were discovered during the last four months of 2014 in Sicily and Calabria. The reinforced surveillance schemes implemented are described in Box 2.

## Health inspections

Health inspections are carried out jointly, and depending on the nature of the missions, by staff of the departmental directorates for protection of the population (DDecPPs) or of the regional food authorities (SRALs), by specialist veterinarians and bee health inspectors (ASAs). On 15 October 2014, the organisation of the ASAs was dissolved and a new player was defined, the bee health technician (TSA) (Article L. 243-3 of the French Rural Code).

DDecPP staff carried out 437 visits in 2014: 101 random inspections, 126 as the result of an alert by a beekeeper and 159 targeted visits, mainly concerning the systematic inspections needed for imports (ten for the establishment of a health certificate).

In total, 1,131 active ASAs are listed in those *départements* that responded, an average of ten per *département*, with significant disparity between *départements* (from 0 to 80 ASAs). An important mission for these ASAs is to visit apiaries. In 2014, 2,781 visits were made, with an average of 28 visits per *département*: 2,223 (80%) of these visits were conducted by ASAs at the request of the DDecPPs.

Lastly, we are witnessing a growing interest on the part of veterinary practitioners, who are becoming more specialised in bee diseases (acquiring the inter-institution diploma in "Beekeeping and bee diseases"). Forty one visits were carried out by veterinarians in the framework of the monitoring of regulated diseases.

**Table 1.** List of regulated health hazards to bees in France

Hazard	Common name	Nature of the hazard	Regulations	Health status in mainland France
<i>Paenibacillus larvae</i>	American foulbrood	Bacterium	- Category 1 health hazard - Directive 92/65/EEC (Annex A) - Regulation (EC) no. 206/2010 - OIE	Present
<i>Nosema apis</i>	Nosemosis	Fungus	- Category 1 health hazard	Present
<i>Aethina tumida</i>	Infestation by the small hive beetle	Insect	- Category 1 health hazard - Directive 92/65/EEC (Annex A) - EU Directive 82/894/EEC - Regulation (EC) no. 206/2010 - OIE	Absent
<i>Tropilaelaps spp.</i>	Infestation by the <i>Tropilaelaps</i> mite	Mite	- Category 1 health hazard (for <i>Tropilaelaps clareae</i> ) - Directive 92/65/EEC (Annex A) - EU Directive 82/894/EEC - Regulation (EC) no. 206/2010 - OIE	Absent
<i>Varroa destructor</i>	Varroosis	Mite	- Category 2 health hazard - Directive 92/65/EEC (Annex B) - OIE	Present
<i>Vespa velutina</i>	Asian hornet	Insect	- Category 2 health hazard	Present

## Results

### Results from surveillance of *Paenibacillus larvae*, the agent of American foulbrood

The DDecPPs recorded 241 clinical suspicions of American foulbrood in SIGAL, the official database maintained by DDecPP staff. Eleven APMS orders were issued for the apiaries concerned (5 % of the cases). Among these suspect cases, 208 new outbreaks of American foulbrood (or 86 %) were confirmed (Table 2). Seventy-nine outbreaks were the subject of an APDI.

**Table 2.** Annual number of suspected cases and confirmed outbreaks of American foulbrood between 2010 and 2014

	2010	2011	2012	2013	2014
Clinical suspicions	348	290	232	354	241
Confirmed Outbreaks	95	121	97	209	208

### Results from surveillance of *Nosema apis*

The DDecPPs recorded 20 clinical suspicions of nosemosis (caused by *N. apis*). No APMS or APDI were recorded for 2014 (Table 3).

**Table 3.** Annual number of suspected cases and confirmed outbreaks of nosemosis between 2010 and 2014

	2010	2011	2012	2013	2014
Clinical suspicions	64	43	25	98	20
Confirmed Outbreaks	7	5	2	5	0

### Results from surveillance of *Aethina tumida*

Four suspected cases recorded by the DDecPPs led to the issuing of an APMS. The identifications conducted by the NRL for bee diseases helped to rule out these suspicions. No suspicions were reported as a result of the monitoring scheme implemented for queen bee imports.

### Results from surveillance of *Tropilaelaps clareae*

One suspicion, which did not lead to the issuing of an APMS, was recorded in 2014. Identification by the NRL helped to eliminate the suspicion. No suspicions were reported as a result of the monitoring scheme implemented for queen bee imports.

### Results from surveillance of *Varroa destructor*

*Varroa destructor* is endemic in France (apart from a few island territories such as the Île d'Ouessant).

The visits carried out in the framework of the Résabeilles surveillance network showed that 4.70% and 12.35% of the apiaries presented clinical signs suggestive of varroosis, in spring and summer respectively (Hendrikx *et al.*, 2015).

### Results from surveillance of *Vespa velutina*

Between April 2014 and April 2015, three new *départements* were colonised by the Asian hornet: the Aube, the Seine et Marne and the Val de Marne (Figure 1).

### Results from surveillance of bee colony mortality

One hundred and fifteen alerts of disorders from 42 different *départements* were reported to the DDecPPs in 2014. The investigations carried out by the State services (DDecPP and SRAL) indicated a pathological origin in 20% of the cases, and a toxicological origin in 3.5% of the cases; it was not possible to reach any conclusion in the other cases.

Toxicological analyses were positive (above the limit of detection) in 32 cases. In total, 32 different chemical compounds were identified, including four whose use is not authorised in France: coumaphos, endosulfan, carbaryl and chlorfenvinphos. In four of these cases (3.5% of all the alerts declared), seven chemicals were identified in sufficient concentration (> LD<sub>50</sub>) to confirm a toxic origin for the mortality observed. They were the following substances: Chlorpyrifos-ethyl, fluazifop, tebuconazole, prothioconazole, permethrin, tetramethrin and carbaryl (Table 4).

In addition, at least six analyses carried out in 2014 also revealed associations of chemicals likely to be responsible for mortality: tau-fluvalinate, coumaphos, chlorpyrifos-ethyl, endosulfan and spirotetramat (Table 4).

**Table 4.** List of substances involved / potentially involved in mortality in 2014

Residues	Use	Plant health	Veterinary	Biocides
Carbaryl	I	■	■	■
Chlorpyrifos-ethyl	I	■	■	■
Fluazifop	H	■	■	■
Tebuconazole	F	■	■	■
Prothioconazole	F	■	■	■
Permethrin	I	■	■	■
Tetramethrin	I	■	■	■
Coumaphos	I	■	■	■
Tau-fluvalinate	I	■	■	■
Endosulfan	I	■	■	■
Spirotetramat	I	■	■	■
Chlorpyrifos-ethyl	I	■	■	■

■ Authorised product - ■ Prohibited product - ■ Substance detected in association likely to be responsible for mortality  
F: Fungicide, I: Insecticide, H: Herbicide

### Objectives of the surveillance programme

- To ensure early detection:
  - > of any introduction of the exotic pathogens, *Aethina tumida* and *Tropilaelaps* spp., in France and guarantee the country's pest-free status for trade and export purposes.
  - > of outbreaks of American foulbrood and *Nosema apis* noserosis to prevent the spread of these two pathogens in France.
- To determine the status of zones (parasite-free or not).
- To determine the prevalence of bee health hazards and disorders (e.g. mortality) and detect any possible resurgence.
- To collect alerts concerning the mortality observed in bee colonies in order to implement investigations taking the toxic risk into account.

### The population monitored

Every beekeeper is required to complete an annual declaration of the location of apiaries and the number of hives (Act No. 229-967 and the Ministerial Order of 11 August 1980) (Table 1). In 2014, 38,748 beekeepers made a declaration, for a total of 1,043,444 hives. Because of the under-reporting, the real French bee population is estimated to be 1,600,000 hives.

**Table 1. Annual number of declarations by beekeepers between 2011 and 2014**

	2011	2012	2013	2014
Beekeepers	30,416	30,542	32,352	38,748
Hives	814,750	899,886	949,660	1,043,444

### Surveillance procedures

#### Outbreak surveillance

- Network for annual surveillance of bee disorders (Memorandum DGAL/SDSPA/SDQPV/N2012-8113), which was replaced on 14 November 2014 by the surveillance scheme for mass acute mortality and diseases, classified as Category 1 health hazards in bees (Memorandum DGAL/SDQPV/2014-899), which enabled investigations to be extended to mass acute winter mortality and the exploration of toxic causes.
- Mandatory declaration of all suspicions of Category 1 and 2 health hazards affecting the bee *Apis mellifera* (Article L201-9).
- Updating of a map of the distribution of *Vespa velutina* by the National Museum of Natural History (MNHN) (Memorandum DGAL/SDSPA/N2013-8082).

#### Programmed surveillance

- Epilobee epidemiological surveillance network, with its French components Résabeilles and Ecotox. This network was established in six French *départements* (Cantal, Drôme, Haut-Rhin, Bouches du Rhône, Indre et Loire and Finistère) in 2012 and the programme came to an end on 31 December 2014. Sixty-six apiaries per *département*, chosen at random, were visited three times (in autumn, spring and summer) over two successive annual campaigns during which an in-depth clinical examination of the colonies took place, aimed particularly at estimating mortality. Samples were also taken in cases of suspicion of disease and systematically on some visits in order to determine the prevalence of *Varroa destructor*, and of *N. ceranae* and *N. apis* in the spring. Bee bread and honey were also screened for plant protection substances. The results of this study will be the subject of a specific publication.
- Random surveillance. It is based on the implementation of random inspections planned at departmental level by each DDecPP without a coordinated national framework. The number and frequency of these "random" visits therefore vary from *département* to *département*.

- For queens, bees and drones imported from non-EU countries, targeted surveillance involves systematic laboratory examination of transport cages and the bees they contain to detect the *A. tumida* hive beetle and *Tropilaelaps* spp. mites in accordance with Regulation (EU) No 206/2010.

### Laboratories

- National Reference Laboratory: ANSES Sophia-Antipolis Laboratory.
- A network of eight departmental laboratories accredited to diagnose American foulbrood and noserosis (Memorandum DGAL/SDPRAT/N2012-8199 of 10 October 2012).
- A network of laboratories accredited for detecting the risk of introducing the small hive beetle and *Tropilaelaps* mites *via* imported queen bees or drones from non-EU countries (Memorandum DGAL/SDPRAT/N2011-8128 of 8 June 2011).
- Six laboratories specifically accredited for analysis in the framework of the Résabeilles scheme.

### Health control measures

The Ministerial Order of 23 December 2009 lays down the animal health measures applicable to Category 1 health hazards.

- In the event of suspicion of a Category 1 health hazard, the apiary is placed under APMS, which leads to investigations and possibly the establishment of precautionary measures.
- In the event of laboratory confirmation, the apiary is placed under APDI surveillance in compliance with the Ministerial Order of 11 August 1980 on combating contagious bee diseases amended by the Order of 23 December 2009 with, according to the case, implementation of containment measures, destruction of infected colonies, destruction or disinfection of equipment, and an epidemiological investigation to identify cases linked to the first outbreak, along with compensation for affected beekeepers.
- Epidemiological investigation. The various field visits to apiaries as part of the surveillance programme or in compliance with health control measures are carried out by DDecPP staff or bee health inspectors appointed by the Prefect and authorised to carry out specific surveillance missions on behalf of the State. In the future, veterinarians mandated in beekeeping will be directly involved in the framework of health control measures.

### Regulatory References

Commission Regulation (EU) No 206/2010 of 12 March 2010 laying down lists of third countries, territories or parts thereof authorised for the introduction into the European Union of certain animals and fresh meat and the veterinary certification requirements

Council Directive 92/65/EEC of 13 July 1992 laying down animal health requirements governing trade in and imports into the Community of animals, semen, ova and embryos not subject to animal health requirements laid down in specific Community rules referred to in Annex A(I) to Directive 90/425/EEC

Council Directive 82/894/EEC of 21 December 1982 on the notification of animal diseases in the Community.

Ministerial Order of 11 August 1980 regarding the control of contagious bee diseases amended by Ministerial Order of 23 December 2009

Ministerial Order of 29 July 2013 defining Category one and two animal health hazards.

Commission Implementing Decision of 4 July 2012 concerning a financial contribution by the Union to certain Member States to support voluntary surveillance studies on honeybee colony losses.

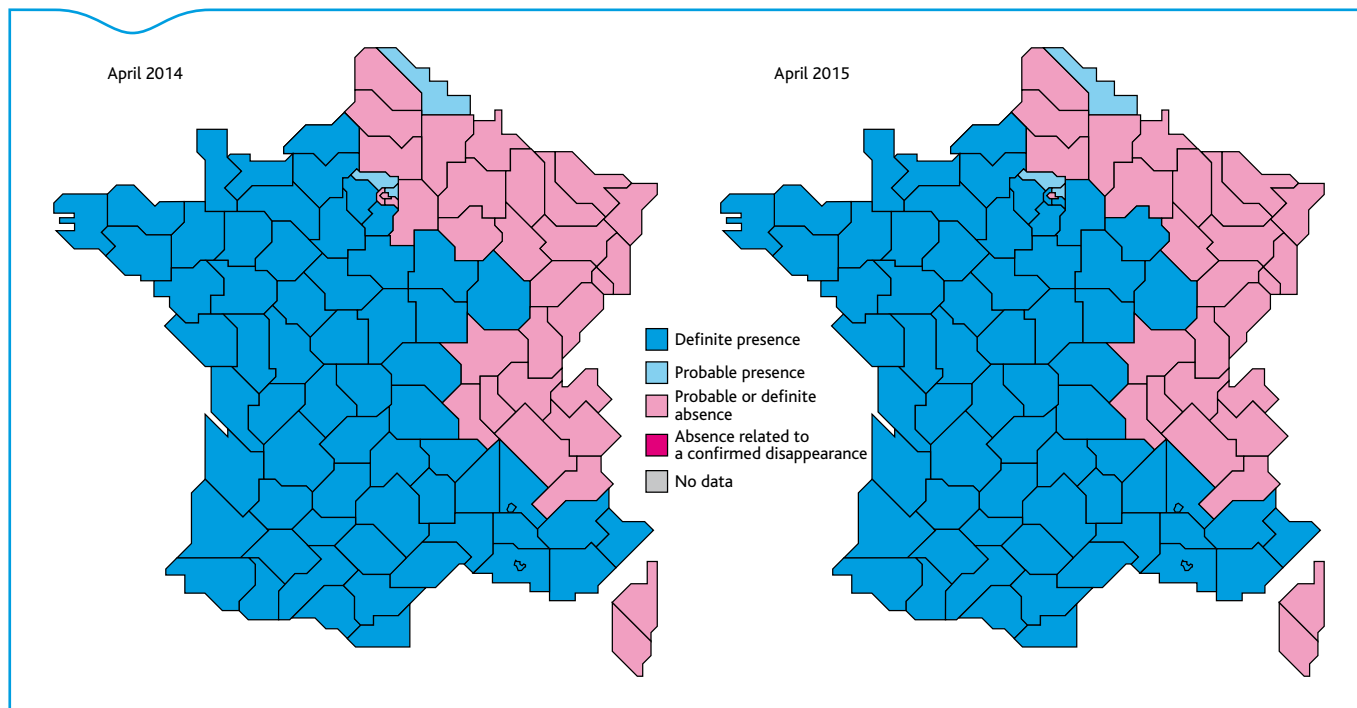


Figure 1. Change in the range of *Vespa velutina* between April 2014 and April 2015 (source: French Natural History Museum)

The Résabeilles surveillance network helped estimate the bee colony mortality rate at 13.7% during winter 2013/2014 and 11.1% during the 2014 beekeeping season (Chauzat *et al.*, 2015; Hendriks *et al.*, 2015).

No funds were available for monitoring the colony mortality rate in France for the winter of 2014/2015.

## Costs

The review of costs incurred by the various State services for implementing the bee surveillance schemes is not exhaustive, so the results presented below are only indicative (amounts are in euros excluding tax):

- random or targeted health visits were estimated by the DDecPPs at €45,383 in 39 départements,
- visits for issuing health certificates were estimated to cost €515 by the ten départements responding,
- visits carried out following suspicions of a disease by beekeepers amounted to €11,647 in 27 départements,
- thirty-four départements incurred costs for laboratory analyses for pathogen screening estimated at €8,337.

In addition, analyses for toxicological screening cost €38,258.

Total expenditure in 2014 (visits, health control measures, analyses, etc.) for the départements that provided information amounted to about €104,140.

It should be noted that the Résabeilles surveillance scheme cost €767,948 over the duration of the project (two years), with European funding covering 70% of the total cost of the programme.

## Discussion

It should be remembered that each surveillance scheme has its own limitations and peculiarities (Lee *et al.*, 2015), which are not specifically detailed in this article.

No surveillance scheme is currently able to make a thorough assessment of the health situation of the French bee population, for various reasons, including:

- a partial knowledge of the bee population because of under-reporting,

- subclinical carriage of certain health hazards that has not been precisely evaluated (e.g. *Paenibacillus larvae*, the agent of American foulbrood),
- the probable limited sensitivity of outbreak surveillance, based on reporting by beekeepers or beekeeping stakeholders,
- poor knowledge of the clinical signs suggestive of the diseases that should be subject to mandatory declaration,
- programmed surveillance schemes that are not suitably representative of the French bee population,
- no harmonised definition of bee diseases and disorders,
- technical limitations in the screening of chemical residues.

### *Paenibacillus larvae*, the agent of American foulbrood

For American foulbrood, France only practices clinical surveillance, unlike other European countries, which screen for the presence of *P. larvae* spores in honey or debris collected from hive bottom boards. In France, the management of outbreaks is not very precise and it is impossible to determine the situation (prevalence, incidence, geographic distribution) of this health hazard from the number of APDIs issued for *P. larvae*, mainly because of under-reporting. The Résabeilles study showed that during the first visit that took place in autumn 2012, more than 10% of apiaries visited were clinically affected by American foulbrood (Chauzat *et al.*, 2015).

This observation prompted an analysis of the likely causes of these under-declarations:

- poor knowledge among beekeepers of the regulatory control measures, and fear of the consequences of their implementation (e.g. restriction measures),
- the difficulties encountered by some DDecPPs in mobilising and sustaining the resources,
- the low levels of compensation awarded to beekeepers for outbreaks,
- poor knowledge by some beekeepers of the clinical signs suggestive of American foulbrood,
- the low level of health monitoring by some beekeepers and unauthorised control practices (use of antibiotics).

These findings raise questions about the efficacy and relevance of the management measures in force for American foulbrood.



## Box 2.

The discovery of *Aethina tumida* in the south of Italy in September 2014 led the DGAL to strengthen vigilance with regard to this Category 1 health hazard (Ministerial Order of 29 July 2013):

- a first instruction dated 23 September 2014 (DGAL/SDSPA/2014-770) informed the State services of this discovery. They were asked to raise awareness among the stakeholders of the beekeeping sector as quickly as possible of the risk posed by this health hazard and the beekeepers' obligation to declare any suspicion to the DDecPP,
- a second instruction dated 20 November 2014 (DGAL/SDSPA/2014-842) called on the State services to strengthen vigilance, particularly with regard to the trade and import of bees governed by Directive 92/65/EEC and Regulation (EC) No 206/2010, specified the measures to be taken to raise awareness among the stakeholders of the beekeeping sector, and planned inspections to be carried out at wholesalers, distributors and beekeepers,
- a third instruction dated 6 February 2015 (DGAL/SDSPA/2015-113) asked the State services for a summary of the actions carried out and information collected,
- a fourth instruction dated 28 April 2015 (DGAL/SDSPA/2015-406), drawn up in the light of the information gathered by means of these summaries, with the support of the Epidemiological Surveillance Platform for Animal Health (ESA Platform) and the recommendations of the NRL for bee diseases, specified the enhanced surveillance procedures to address this health hazard. The aim is the early detection of any emergence of *Aethina tumida* in France in order to ensure its eradication. The enhanced surveillance scheme includes:
  - > outbreak surveillance *via* declarations by beekeepers of all suspect cases,
  - > programmed surveillance based on the risk. This consists of systematic visits to apiaries identified as presenting a particular risk of being infested, following the investigation by the National division for veterinary and plant health investigations. The risk factors targeted are the bees' zone of origin, the date of introduction in France, the presence of a health certificate, the type of biological material (swarms on frames, swarms alone, packages of bees, queens). Two hundred and ninety-one beekeepers have been identified. These visits are still in progress and no outbreak has so far been identified by this scheme.

### **Nosema apis, agent of nosemosis**

Until 1996, *Nosema apis* was the only known species of microsporidia in the honeybee, *A. mellifera*. The clinical expression of the nosemosis caused by *N. apis* includes digestive disorders (mainly diarrhoea), nervous disorders (bees unable to fly, crawling bees, paralysed bees) and population losses, with a predominance of cases in the spring and their virtual disappearance during the summer. This form of nosemosis is called type A nosemosis.

For the last few years, the clinical prevalence of *N. apis* nosemosis seems to have been falling from year to year. The official notifications leading to APDIs have followed this same trend: 46 APDIs were issued in 2007 (Memorandum DGAL/SDSPA/N20009-8061), seven in 2010, two in 2012 (Bendali *et al.*, 2013) and none in 2014.

This phenomenon is probably the result of the crossing of the species barrier of another microsporidia, *N. ceranae*, a parasite of the bee *A. cerana* which now infests the honeybee, *A. mellifera*, and currently predominates in France. Because the two species of microsporidia occupy the same ecological niche - the epithelial cells of the bee ventricle - competition has been introduced. *N. ceranae* seems to have adaptive advantages over *N. apis* (lower infective dose, spores more resistant to high temperatures, more spores produced, greater number of epithelial cells infected at D4 and D7).

The nosemosis caused by *N. ceranae* is qualified as type C or "dry nosemosis" due to an attenuated clinical picture (population loss, mortality, colony weakening, with an absence of diarrhoea and crawling bees) and silent carriage, despite the sometimes high infection rates.

Recent studies carried out in different European countries, including France, show that the *N. ceranae* species is ubiquitous and largely predominates (Chauzat *et al.*, 2015), which explains the low number

of clinical suspicions of *N. apis* nosemosis in France, and the absence of APDIs issued for 2014.

The current surveillance scheme appears able to detect any clinical resurgence of *N. apis* nosemosis. Nevertheless, the procedures for monitoring *N. ceranae* should be examined, even though this agent is not currently regulated. Unlike *N. apis*, clinical surveillance is not possible because of the attenuated clinical signs associated with its presence. However, it was recently demonstrated, in the framework of co-exposure, that interactions with chemical agents or other pathogens may cause disorders in bee colonies (Vidau *et al.*, 2011). In the event that bee colony disorders are reported in the framework of Memorandum DGAL/SDQPV/2014-899 or as part of a future surveillance scheme, screening and quantification of *N. ceranae* spores could be carried out systematically in order to better assess these phenomena.

### **Aethina tumida, small hive beetle**

Despite the increased risk of introduction of the small hive beetle in France since it was discovered in Italy, the number of suspicions recorded by the State services remained low in 2014.

In view of the massive campaign to raise awareness among beekeepers and their representatives, the low number of suspicions may suggest that *Aethina tumida* is not established in France. This low number may also be indicative of under-reporting by beekeepers, especially since *Galleria mellonella* (greater wax moth) and *Achroia grisella* (lesser wax moth), which are frequently observed, develop larvae similar to those of *A. tumida*, and other beetles may be identified in the hives.

In order to enhance the sensitivity of the surveillance schemes currently in place (outbreak surveillance and surveillance by systematic examination of cages of queens imported from non-EU countries), other programmed surveillance schemes have been set up and are presented in Box 2. A first review of these schemes will take place at the end of the 2015 beekeeping season.

### **Tropilaelaps clareae**

Only *Tropilaelaps clareae* is regulated in France (Ministerial Order of 29 July 2013) whereas since 2007 and the advances made in molecular biology tools, this species has been separated into two distinct species, the first, which has kept the name of *Tropilaelaps clareae*, and a second, which was named *Tropilaelaps mercedesae*. Both are likely to cause severe damage to colonies of *Apis mellifera* bees and warrant monitoring.

Just like *Aethina tumida*, the low number of suspicions recorded by the State services should be examined.

Awareness campaigns among beekeepers and beekeeping managers, as well as programmed surveillance schemes to complement the current schemes (outbreak surveillance and surveillance by systematic examination of cages of queens imported from non-EU countries) are possible ways to improve the sensitivity of surveillance.

### **Varroa destructor, agent of varroasis**

The current regulations making it mandatory to report infestation of colonies by *V. destructor* (Ministerial Order of 29 July 2013) do not seem to be suited to the epidemiological situation of the parasite in France. Moreover, no notifications were registered by the State services in 2014. In contrast, French island territories such as the *Île d'Ouessant* remain free of the parasite. The plan to have the parasite-free status of this territory recognised by the European Union could enable trade to be regulated to prevent introduction of the parasite. Obtaining and maintaining this recognition is dependent on the establishment of a surveillance scheme to guarantee the parasite-free status (Article 15 of the European Directive 92/65/EEC).

The classification of *V. destructor* as a Category 2 health hazard means that its management is the responsibility of the professionals. This was the context that led to the implementation of regional programmes to combat *Varroa*, managed by recognised regional animal health

organisations (OVS-A). The DGAL provides financial support, half of which is supplemented by European funds managed by France Agrimer, to pay the salaries of the people responsible for implementing the control plan. The OVS-As of the Bretagne and Centre regions were eligible for the 2013/2014 season, and for the 2014/2015 season eligibility was granted to the OVS-As of Aquitaine, Bretagne, Centre, Corse, Provence-Alpes-Côte d'Azur and Rhône-Alpes. One of the objectives of these plans, which are intended to be introduced throughout the country, is the monitoring of *Varroa destructor*. Indeed, the implementation of rational management of *Varroa destructor* infestation requires in particular monitoring of the parasite population within the bee colony, with the beekeeper being required to intervene before this parasite population exceeds a threshold threatening the survival of the colony. An initial assessment of these plans will be carried out in the last quarter of 2015.

In the event of health disorders being observed in bee colonies in the framework of Memorandum DGAL/SDQPV/2014-899 or as part of a future surveillance scheme, the level of parasitism by *Varroa destructor* should be estimated systematically even in the absence of clinical signs characteristic of varroosis. This estimate can be performed *post-mortem* if possible and/or by studying colonies from unaffected apiaries. Indeed, *Varroa destructor* is a factor weakening bee immunity and can increase the colony's sensitivity to other stress factors.

### **Vespa velutina, Asian hornet**

The scheme provided for by Memorandum DGAL/SDSPA/N2013-8082 (Box 1) is helping to measure the inexorable spread of this predator. The expansion front is estimated to advance by 60 km a year (Rome *et al.*, 2015). Beekeeping stakeholders indicate that the impact of the Asian hornet seems to vary, depending on the areas that have been colonised and from one year to the next. It might be wise to develop an indicator for determining the pressure of predation depending on the geographical areas and periods of the year in order to assess this phenomenon. Implementation of the Ministerial Order of 29 July 2013 making it mandatory to report the discovery of any *Vespa velutina* specimen or nest to the prefect could help monitor the density of hornet nests and changes over time.

### **Monitoring of mass mortality of bee colonies**

The results from this scheme should be analysed with caution, given that reporting is not mandatory. Moreover, the number of notifications recorded by the State services is low compared to the health difficulties regularly reported by beekeeping stakeholders. In addition, the investigations, especially toxicological ones, are impeded by late notifications, which make it impossible to conduct a full investigation into the toxic risk. This is part of the reason why many cases remain unexplained following the investigations.

In order to increase this scheme's effectiveness, information campaigns have been conducted among representatives of the beekeeping profession at the national level. Others could be targeted at beekeepers, to make them more aware of the scheme.

A large number of the investigations carried out showed the concomitant presence of chemical contaminants and pathogens, although it is not possible to conclude, in the current state of knowledge, as to a cause-and-effect relationship between these various stress factors. In the light of the results obtained in the field, only experimental studies could investigate the mechanisms involved, in order to identify the relative share of each of the risk factors identified.

In Europe, a normal winter mortality rate of bee colonies has been estimated empirically at less than 10%. The average winter mortality rate in France during the 2013/2014 winter was estimated at about 14%. France is situated in a middle range between countries with a very low mortality rate (< 5%) and countries where the rates are very high (> 20%). The mortality rate observed in France in the beekeeping

season is particularly high compared to other European countries. This trend had already been observed during the 2013 season. Efforts should now be made to explain this French specificity.

## **Outlook**

In order to improve the efficiency of the health initiatives, including the surveillance actions in the beekeeping sector, the DGAL is continuing to implement the new bee health organisation launched in 2013:

- at the national level: a committee of beekeeping experts reporting to the national advisory council for animal and plant health policy (CNOPSAP) is currently being set up,
- at the regional level, in terms of health governance, the creation of a beekeeping section within each regional animal health organisation (OVS) is planned. The animal OVS is a member of the regional health association (ASR) and participates in the regional advisory council for animal and plant health policy (CROPSAV),
- regarding players in the field, the Minister of Agriculture has decided to call on mandated veterinarians with competence in beekeeping for the health control missions. In addition, the bee health inspectors (ASAs) have become bee health technicians (TSA) and work under the responsibility of a veterinarian.

Moreover, the surveillance schemes are set to improve through a revision of the methodological, technical and regulatory aspects, with the support of the French Epidemiological Surveillance Platform for Animal Health (ESA Platform) and by involving, as far as possible, all those contributing to health in the beekeeping sector.

With the end of the European surveillance programme, Epilobee, the current surveillance system will be supplemented by a new scheme called the Observatory of mortality and beekeeping alerts (OMAA), which will collect and exploit data on mortality and disorders affecting honeybee colonies. This scheme is in preparation.

Lastly, the national surveillance and control strategy will be adapted with regard to the health hazards. Two ANSES reports will shortly be made public, one on the prioritisation of biological pathogens in bees, and the other on ANSES's expert appraisal of co-exposure of bees to stress factors. These reports will provide a basis for a working group led by the DGAL and made up of members of the beekeeping expert committee. The aim will be to define a new categorisation of bee health hazards and ultimately to prioritise health actions in the beekeeping sector.

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