# Review of policies on managing and controlling pests and diseases of honey bees

## Evidence profile on *Nosema*

This is the profile on *Nosema* which was developed during the policy review. **Part 1** sets out an overview of *Nosema* including biology, incidence and geographical distribution, and current policy. **Part 2** summarises the main points from discussions on *Nosema* by the Review Group including insights on beekeeping practices and behaviours provided by Bee Inspectors and beekeeping representatives (note: Part 2 seeks to capture the main points from discussions and are not attributed).

## Readers' guide

## Part 1 – Overview of *Nosema*

### Biology, symptoms, impacts, spread and management, and treatment

1. **Background**
There are two species of *Nosema* known to infect *Apis mellifera*, *Nosema apis* and *N. ceranae*. *N. apis* is a well established pathogen of *A. mellifera. N. ceranae* was originally reported as a pathogen of *Apis cerana*, but in 2005 was reported in *Apis mellifera* in both Europe and Asia. Both *N. apis* and *N. ceranae* are now thought to be widespread across the world. Honey bees can be co-infected with both species.

2. **Biology**
Both *Nosema* species are microsporidial gut parasites of adult bees. Adult bees ingest spores which germinate and multiply in the gut. *N. apis* only invades the gut, but *N. ceranae* can penetrate the gut wall and invade other tissues. The spores can be detected microscopically and only experienced clinicians can tell the difference between the species based on spore morphology. The morphology of *N. apis* spores is consistent, whereas *N. ceranae* spores can show some variation morphology. *N. apis* spores are fatter and more rounded at the ends (similar to rice grains) than spores of *N. ceranae*, which tend to be more tapered (similar to a rugby ball) and appear to have a slight kink.

3. **Disease symptoms**
*Nosema* infections are predominantly covert in honey bees, meaning that infected bees do not exhibit obvious symptoms. Infection may lead to reduced lifespan of the bees, increased winter mortality, increase in winter food requirements, poor spring build up, and reduced honey yields. Infection by *N. apis* causes classic symptoms of Nosemosis which can include dysentery (spotting) inside and outside the hives and spring dwindling. *N. ceranae* causes 'Nosemosis C', which has been described as causing an Autumn dwindle after several years of infection. Symptoms may be more obvious when bees have spent long periods in the hive, for example during periods of inclement weather.

4. **Impacts**
*N. apis* has been known for at least 100 years and is generally considered to have a low impact. Opinion is divided about *N. ceranae* with Portugal, Spain, Vietnam and Greece reporting it as a significant pathogen while Canada, Italy, France and Germany consider it to be a low grade pathogen. In Spain and Portugal *N. ceranae* has been linked to 40% colony losses, slow depopulation, low honey production and higher autumn/winter losses. The differences could be caused by associations with other pests and pathogens, local weather, local beekeeping practices or regional differences in the ability of the local honey bee races to tolerate infection.

5. **Spread and management**
Spores can be spread through the use of contaminated combs, equipment and bees and can remain viable for long periods of time. Therefore not transferring contaminated combs between colonies or apiaries and adopting good husbandry practices are essential for

managing the disease i.e. standard barrier management advice. Once present in an apiary *Nosema* spores can also be spread by bee to bee contact (faecal/ oral).

*Nosema* has been regularly found in bees imported from third countries. In particular, imports from Hawaii have showed a high percentage of infected bees. However, following the arrival of the small hive beetle in 2010, bees are no longer permitted to be imported into the EU from Hawaii. *Nosema* has not been found in any imported consignments from other EU member states in the last 5 years. Details of imports from third countries for 2007 to 2010 can be seen in Annex A. This shows that *Nosema* has been detected by the NBU in post-import checks.

6. **Treatment**

Previously UK beekeepers had been using Fumidil B which was the only medicine authorised in the UK for the treatment of *Nosema*. However this product has now been withdrawn from the market. Directive 2001/82/EC (the "Veterinary Medicines Directive"), only permits food producing animals to be treated with medicines whose pharmacologically active substances are listed in the Table of Allowed Substances in Commission Regulation EU No 37/2010. Fumagillin, the active ingredient in Fumidil-B, does not have a Maximum Residues Limit (MRL) status and is not included in the Table of Allowed Substances. Therefore the UK had no alternative but to act on CEVA's (the manufacturer) request to expire the marketing authorisation for Fumidil B on 30 December 2011 as continuing to allow this medicine to be on the market would have been contrary to EU law.

Other EU countries where this product used to be authorised took action some years earlier to remove it from their markets because of the absence of an MRL and hence concerns regarding consumer safety.

The VMD, the BBKA, the Food and Environment Research Agency (FERA) and other organisations with an interest in promoting honey bee health have been researching alternatives to fumagillin with no success. However, VMD is working to try to improve the availability of medicines for bees at the European level, through the work on the revision of the Veterinary Medicines Directive. In addition, the VMD chairs an electronic working group on honey (part of the Codex Committee on Residues of Veterinary Drugs in foods) which aims to find alternatives to the current approach to setting MRLs for vet medicines in honey (ftp://ftp.fao.org/codex/ccrvdf20/rv20_14e.pdf). However, it is very unlikely that any changes will be implemented before 2015 and hence it will be important that in the meantime husbandry measures are used effectively to manage Nosemosis.

**Incidence and geographic distribution of *Nosema* across England and Wales (E&W)**

1. **History of *Nosema* introduction to the UK**

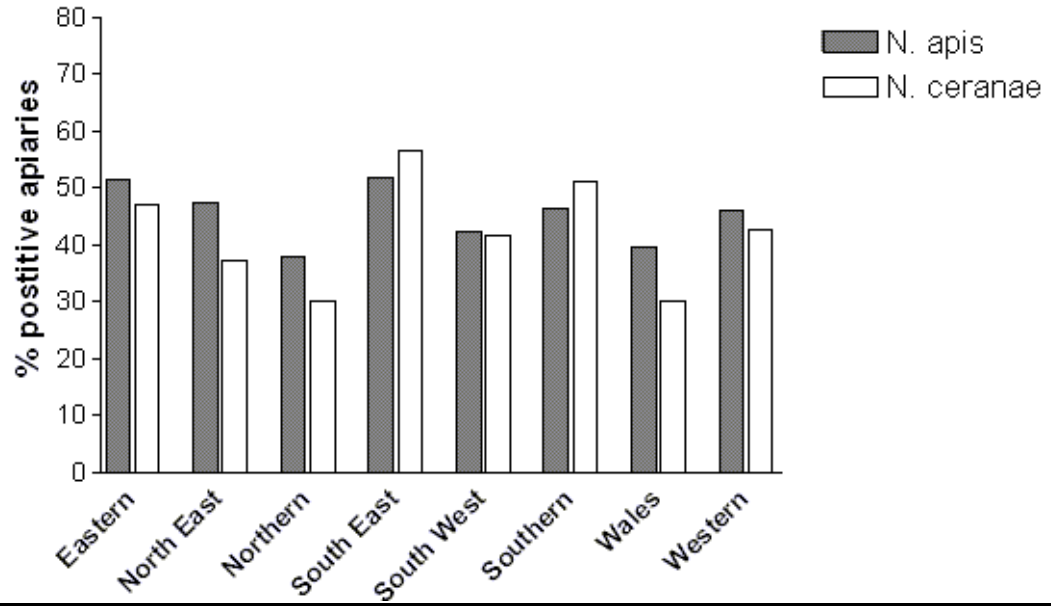
*N. apis* is endemic in the UK and is thought to have been present since the early 1900's. *N. ceranae* arrived more recently and has been detected by the National Bee Unit in samples of bees from 2004.

2. **Prevalence of Varroa from the Random Apiary Survey (RAS) results**

In 2009, Defra and the Welsh Government commissioned the National Bee Unit to undertake an assessment of the national picture of honey bee pests and diseases (with the intention of using this assessment to inform the future honey bee pest and disease control programme). The NBU undertook this assessment from 2009 to 2011 by a survey of 4600 random apiaries (RAS) including apiaries with single and multiple colonies. A total of 13,000 colonies were sampled.

The results from this survey demonstrate that both species are well established across England and Wales, with some variation in regional prevalence (Figure 1).

**Figure 1. Regional prevalence of *Nosema apis* and *Nosema ceranae* observed during the RAS inspections (source NBU)**




Both species are often found together, co-infecting apiaries. *N. apis* was more likely to be found in spring and winter months but *N. ceranae* was less seasonal. *N. apis* has been reported to be associated with some viruses, such as black queen cell virus. The RAS data suggested similar associations for both *Nosema* species. Interestingly within the RAS there were no associations between the presence of either *Nosema* species and poor apiary health.

3. **Results from other NBU research**

In 2007/8, the NBU undertook a Defra funded project to investigate honey bee colony losses in England and Wales since 2007. Bulk bee and larvae samples were collected from dead or failing colonies across England and Wales. These were tested for a range of pests and pathogens using “state of the art” molecular methodology. Pathogen screening in respect of *Nosema* sp. showed:

- *N. ceranae* was confirmed for the first time in the UK in 2007, but *N. apis* was more common;
- Both *Nosema* spp were found to be widely distributed across England and Wales but

were not associated with unhealthy colonies.

An apiary was set up by the NBU in 2008 to monitor the effect of coinfection of *Nosema* to an apiary site without treatment. After monitoring the colonies for 4 years, both species of *Nosema* persisted in the apiary, and only one colony of 21 was lost to classic Nosemosis. This colony tested positive for both *Nosema* species.
Taken together, these data suggest that good husbandry practices can prevent the loss of colonies to *Nosema*, and no current evidence suggests that *N. ceranae* will cause large-scale losses in England and Wales.

**Current policy on *Nosema***

The current policy for *Nosema* is to improve effective management by all beekeepers to minimise impacts on colonies. To help beekeepers achieve this, the NBU currently provides best practice advice on managing *Nosema* which highlights the importance of monitoring, comb changing and sterilisation; completing autumn feeding by September/early October; and to avoid factors that promote dysentery (e.g. fermented stores, late syrup feeding, damp etc.)

## Part 2 - Main points made on *Nosema* policy by the Review Group

**1. Beekeepers' perspective on managing *Nosema*.**

- *Nosema* was not considered to be a significant problem for beekeepers to manage. Comb changing was an important way of reducing impacts and good nutrition could help overcome susceptibility to this disease.

- Many associations have purchased microscopes to facilitate detection – early detection was important for management of this disease. However, the cost was an issue and many have used funds from sponsorship or grants to help with purchase.

- BeeBase provides advice on recognising the disease and best practice. However, further advice was needed following withdrawal of Fumidil B. Withdrawal of this medicine could be beneficial in the longer term as its use could be perpetuating poor quality stock. There is also a lack of independent scientific evidence on the reliability of other treatments following the removal of Fumidil B.

- Better livestock was the key to managing *Nosema*, e.g. by sourcing queens that were not susceptible to the disease or had a level of resistance, or breeding programmes.

**2. Improving beekeepers' management of *Nosema***

- Good husbandry and Integrated Pest Management were the key to effective management.

- Training on the recognition and identification of *Nosema* should be continued.

- Long term priority was the development of *Nosema*-resistant stock – it was currently possible to source queens from Denmark which were fully resistant to *Nosema* or more able to tolerate infections, although some beekeepers were reluctant to change to resistant strains (due to costs) and some were not convinced about the benefits of certain strain/races of bees.

- In the short term, updated/refreshed advice was needed from the NBU on best practice following withdrawal of Fumidil B.

## Annex A - Imports of honey bees into the UK from third countries (2007 to 2010):

| Year | Country of origin | Queens | Consignments | *Nosema* found |
|---|---|---|---|---|
| **2007** | Hawaii | 2118 | 40 | 15 (37.5%) |
| | New Zealand | 690 | 9 | 3 (33.3%) |
| | Total | 2808 | 49 | 18 (36.7%) |
| | | | | |
| **2008** | Argentina | 150 | 1 | 1 (100%) |
| | Hawaii | 3201 | 54 | 14 (25.9%) |
| | New Zealand | 615 | 8 | 8 (100%) |
| | | 3966 | 63 | 23 (36.5%) |
| | | | | |
| **2009** | Australia | 300 | 1 | 0 (0%) |
| | Hawaii | 4182 | 57 | 33 (57.9%) |
| | New Zealand | 740 | 5 | 5 (100%) |
| | | 5222 | 63 | 38 (60.3%) |
| | | | | |
| **2010** | Australia | 650 | 2 | 2 (100%) |
| | Hawaii | 730 | 12 | 9 (75%) |
| | New Zealand | 1050 | 9 | 5 (55.5%) |
| | | 2430 | 23 | 16 (69.6%) |