A European Study on Honey Bee Losses

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In October 2012 *BBKA News* we explained how the European Commission had appointed the first European Union Reference Laboratory (EURL) for honey bee health (Sophia-Antipolis Laboratory of ANSES), tasked with the implementation of a European Union Pilot Surveillance Programme. The focus of this unique international project (now renamed 'EPILOBEE') would be the collection of standard baseline data for over-winter and within-season colony losses, and identification of any associated risk factors, i.e. particular pests or diseases, across the European Union (EU). The project began in 2012 and the first results have now been published in an important report, presented in April 2014 at the Conference for Better Bee Health in Brussels http://ec.europa.eu/dgs/health_consumer/information_sources/ahw_events_en.htm). The full report is available at: http://europa.eu/rapid/press-release_MEMO-14-260_en.htm and with permission from the primary authors (Marie-Pierre Chauzat and her colleagues at ANSES), the following article from the NBU (who led the UK's contribution on behalf of England and Wales) is based on the content of this document.

Table 1. Number of randomly selected apiaries and colonies in the 17 MS in EPILOBEE 2012–2013

	No. of apiaries visited autumn 2012	Size of the apiaries visited during autumn 2012 (%)			No. of colonies visited autumn 2012
		<50 colonies	50–100 colonies	>150 colonies	
Belgium	149	100	0	0	627
Denmark	202	100	0	0	1,394
Germany	223	97.8	2.2	0	1,988
Estonia	197	95.4	4.1	0.5	2,337
Finland	161	100	0	0	787
France	344	95.3	4.7	0	2,477
Greece	161	39.8	43.5	16.8	1,386
Hungary	197	50.8	37.6	11.7	3,934
Italy	184	77.2	19.6	3.3	1,682
Latvia	194	84	14.9	1	1,930
Lithuania	191	39.8	50.8	9.4	2,484
Poland	190	71.6	27.4	1.1	3,207
Portugal	146	96.6	3.4	0	437
Slovakia	190	82.1	15.8	2.1	3,199
Spain	204	40.7	56.4	2.9	2,321
Sweden	151	100	0	0	725
UK (England & Wales)	200	100	0	0	917
TOTAL	3,284	–	–	–	31,832
MEAN	–	80.6	16.5	2.9	–

EPILOBEE

Honey bee populations face multiple health threats. Colony loss studies from various parts of the world have reported several biological and environmental factors which, acting alone or in combination, have the potential to cause premature colony mortality. Alarming losses of honey bee colonies were recently reported in the USA and Canada; in Europe, decreases in honey bee colonies have been estimated at ~16 %, and the reduction of beekeepers at 31%. Although such accounts paint a picture of significant declines, standardised data that accurately quantify colony losses within or between nations has been absent, so it has not been possible to draw reliable conclusions about the true status of global populations of managed honey bees.

EPILOBEE's primary objective was to quantify the mortality of honey bee colonies in each participating Member State (MS) on a 'harmonised basis', i.e. in a strictly standardised way, so that data would be reliable and comparable. It also sought to estimate the health of the bee population by assessing disease prevalence and other information related to beekeeping practices. Here we present the results produced during EPILOBEE's first year, from September 2012 to September 2013.

Field visits

During the winter and during the beekeeping season, three visits were performed by bee inspectors: before winter 2012 (autumn 2012), after winter 2012 (spring 2013) and during the beekeeping season (summer 2013). The process for these visits was described in October 2012 *BBKA News*.

Data collection and management

During each visit, bee inspectors completed a detailed questionnaire recording husbandry practices and clinical observations. In addition, laboratory analyses were performed on samples collected during the visit. All these data were collected and stored in a standardised way at European level using an online database via a website developed by the EURL and the French epidemiological surveillance platform for Animal Health. Given the scale of EPILOBEE (first year encompassing >8,500 apiary visits and >100,000 laboratory samples), the task of data analysis is complex. Full data for Denmark and Portugal is not yet available.

Results

Population sampled During this first year 31,832 colonies located in 3,284 randomly selected apiaries were visited in the autumn of 2012 (Table 1). Overall, since the start of the project, more than 95,000 colony visits have been conducted by 1,354 bee inspectors in the 17 participating MS. In the majority of MS (x14) small apiaries (<50 colonies) were the most abundant, representing 100% of those randomly selected in Belgium, Denmark, Finland, Sweden and the UK. In Greece, Lithuania and Spain, apiaries comprised of between 50 and 100 colonies were the most common. Large apiaries (>150 colonies) were sampled in just nine MS, being comparatively abundant in Greece and, to a lesser extent, Hungary and Lithuania.

Overwintering mortality (winter 2012–2013) Rates of colony mortality during winter ranged from 3.5% to 33.6% between the MS (Table 2, Figure 1). In 11 MS, this rate exceeded 10%. Most of the Northern European MS had over-wintering mortality rates higher than 10% with the highest rate in Belgium (33.6%). The lowest rate of colony mortalities (3.5%) was recorded in Lithuania.

Seasonal mortality (spring – summer 2013) Rates of colony mortality during the beekeeping season ranged from 0.3% to 13.6% (Table 2, Figure 2). The seasonal mortality rate was higher than 10% in France only. In 12 out of the 17 MS, the seasonal mortality rates were lower than 5%.

Detection of the exotic arthropods Small hive beetle and Tropilaelaps mites To date these two arthropods have never been observed in Europe. This was an opportunity to increase the surveillance and the probability of detection of any signs of their presence in European apiaries. Fifteen suspect arthropods were collected in seven MS and the analyses of samples all tested negative.

American foul brood Overall prevalence of AFB was low in the 15 MS for whom complete data is currently available (Figure 3; Danish and Portuguese data to be included in later analyses). In Belgium, Germany and the UK no positive cases were observed during the three visits.

European foul brood Prevalence of EFB was extremely low. Only five MS observed positive cases of EFB and clinical prevalence exceeded 2% only in France. Only in France and the UK were clinical signs of EFB observed during all three visits.

Varroosis Varroosis was observed in all the MS except Finland. In six MS, prevalence did not exceed 5% at any visit. It should be noted that the assessment of varroosis (the

Table 2. Overwinter and within season mortality rates recorded in EPILOBEE 2012–2013

Country	Overwinter (%)	Within season (%)
Belgium	33.6	8.9
Denmark	20.2	2.9
Germany	13.6	3.8
Estonia	23.4	4.0
Finland	23.3	6.5
France	14.1	13.6
Greece	6.6	2.5
Hungary	8.8	1.9
Italy	5.3	2.3
Latvia	15.3	0.4
Lithuania	3.5	0.3
Poland	14.8	1.2
Portugal	14.8	3.5
Slovakia	6.1	0.7
Spain	9.5	6.8
Sweden	28.7	2.4
UK (England & Wales)	28.8	9.7

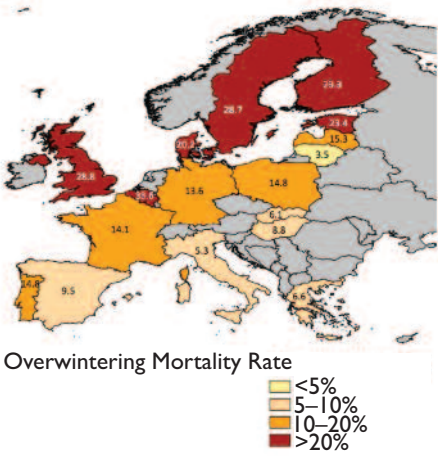

Figure 1. Winter mortality rates recorded in EPILOBEE 2012–2013.
For both figures 1 and 2 the map is reprinted from the EURL report — it erroneously depicts losses across UK including N. Ireland & Scotland; UK results obtained from England & Wales only.

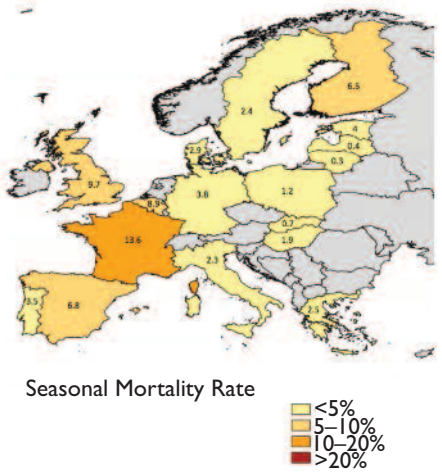

Figure 2. Within season mortality rates recorded in EPILOBEE 2012–2013.

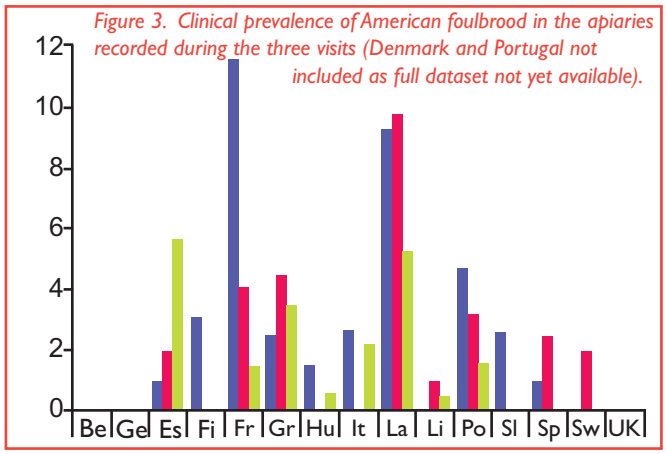

Figure 3. Clinical prevalence of American foulbrood in the apiaries recorded during the three visits (Denmark and Portugal not included as full dataset not yet available).

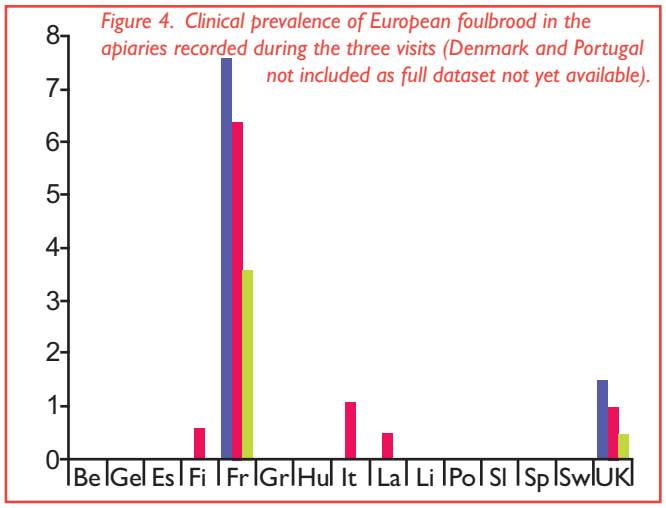

Figure 4. Clinical prevalence of European foulbrood in the apiaries recorded during the three visits (Denmark and Portugal not included as full dataset not yet available).

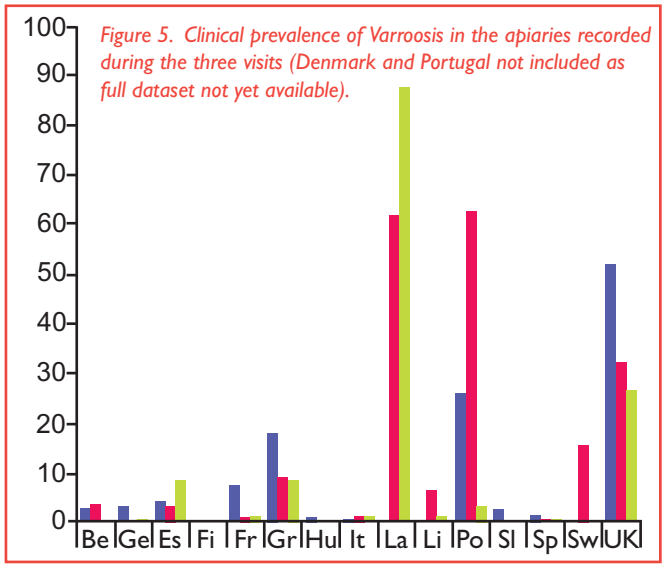

Figure 5. Clinical prevalence of Varroosis in the apiaries recorded during the three visits (Denmark and Portugal not included as full dataset not yet available).

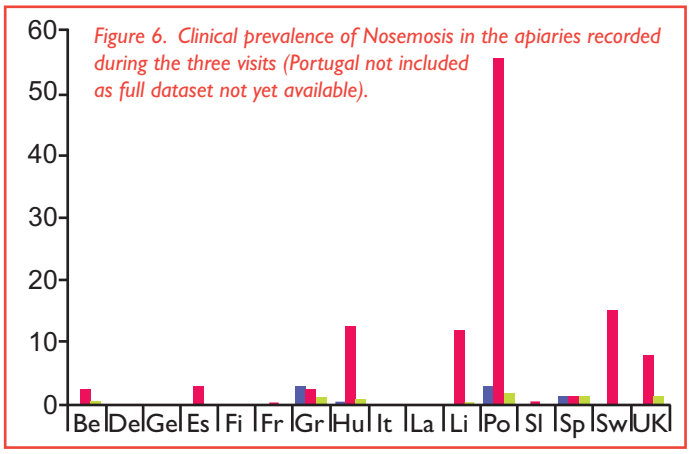

Figure 6. Clinical prevalence of Nosemosis in the apiaries recorded during the three visits (Portugal not included as full dataset not yet available).

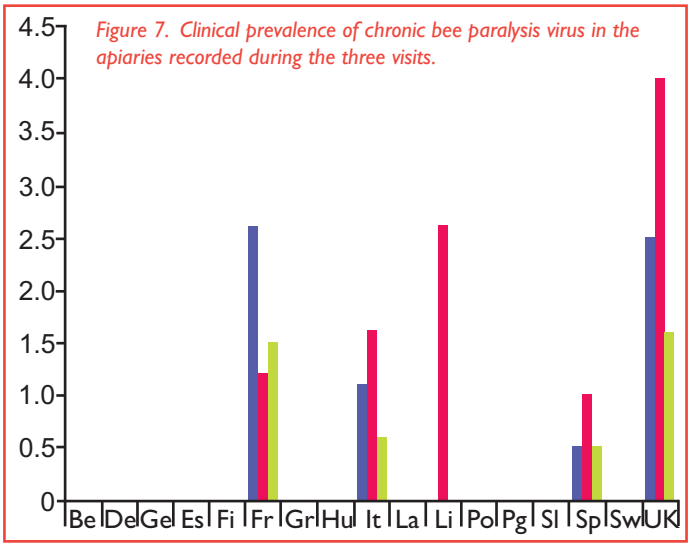

Figure 7. Clinical prevalence of chronic bee paralysis virus in the apiaries recorded during the three visits.

Country abbreviations used:

Be = Belgium
De = Denmark
Ge = Germany
Es = Estonia
Fi = Finland
Fr = France
Gr = Greece
Hu = Hungary
It = Italy
La = Latvia
Li = Lithuania
Po = Poland
Pg = Portugal
Sl = Slovakia
Sp = Spain
Sw = Sweden
UK = England and Wales

Sampling period:

autumn 2012
spring 2013
summer 2013

disease) is not the same as the amount of parasitic *V. destructor* mites present in a colony. The numbers of mites per hundred bees was systematically recorded in each colony at the autumn 2012 visit by sampling living bees. Statistical analysis on this particular epidemiological risk factor is on-going and yet to be reported.

Nosemosis The prevalence of nosemosis, the disease caused by *Nosema spp*. exceeded 10% in four MS. No positive case of nosemosis were reported in Denmark, Germany, Finland, Italy and Latvia. In nine MS, prevalence increased at the second visit in spring 2013 reaching 55.8% in Poland.

Paralysis Some clinical cases of paralysis were observed in five out of the 17 MS (Figure 7), but the prevalence of chronic bee paralysis virus (CBPV) did not exceed 4% at any visit in these countries. In France, Italy and the UK prevalence decreased between the first in autumn 2012 and the third visit in summer 2013.

Discussion

This is the first time that an EU-wide programme on honey bee health has been implemented with standardised epidemiological methods; mortality rates, and pest and disease prevalence were calculated according to a standardised method. As seen in other studies, the colony losses recorded, varied across a wide range being 3.5% to 33.6%, with significant regional differences.

Prior to the introduction of varroa mites into the USA, beekeepers reported 5–10% winter losses. These losses rose to 15–25% with the introduction of varroa and tracheal mites in the mid 1980s. In publications in the 1960s, it was stated that normal reported winter mortality should be less than 10%. In the 2000s, average colony mortality of 10% was still considered acceptable for winter in Germany and Switzerland. The Bee Informed Partnership in the USA has explicitly explored this question for several years, collecting the view of beekeepers. Acceptable rates of winter colony mortality varied with years from 2007 to 2013 with a tendency to reduction; the acceptable rate in 2007 was 21.7% and 13.7% in 2012.

For the EPILOBEE report, the acceptable level of colony mortality is less than 10%. The term 'acceptable' is the level

of mortality usually admitted in scientific papers as reasonable (or expected) by European beekeepers under usual beekeeping conditions. However experienced and competent a beekeeper may be, s/he may not be immune to some level of colony losses. It is interesting that in Northern America, beekeepers and scientists accept higher levels of colony mortality at 15%. Therefore, according to the EU references, EPILOBEE winter mortality rates were below the acceptable threshold of 10% in one third of the MS (Greece, Hungary, Italy, Lithuania, Slovakia and Spain). In Germany, France, Latvia, Poland and Portugal, mortality rates were between 10 and 15%. In the last third of the member states, which included the UK, mortality rates were above 20%.

When looking at the map, high rates of winter mortality were located in the northern MS of the EU, suggesting a strong geographical influence probably due to the climate. It should be remembered that the 2012–2013 winter was particularly long and cold in Europe and this effect of long and cold winters on colony survival is well known in cold countries, although it has not been previously documented at this scale. Specific statistical analysis will be performed in the future to better study the spatial distribution of the colony losses.

The COLOSS network recently published results on colony mortalities recorded through a questionnaire filled in by beekeepers during the winter 2012–2013 in 13 MS, which is at most ~30% of the total number of colonies in Europe. Average losses per country were not provided, making the comparison with EPILOBEE data difficult. However, in both studies, similar trends were observed in some MS with high losses in Denmark, Estonia, Finland and Sweden and lower losses in Lithuania and Slovakia.

Varroa mites are present in all honey bee colonies in the EU and worldwide, with few rare exceptions. The wide variation in prevalence between MS (minimum 0%; maximum 87.4%) may come from national differences in interpretation of the case definition of varroosis i.e. descriptors of signs and symptoms of this condition, provided by the EURL. In autumn 2012 when the first apiary visits took place, the levels of mite infestation were systematically recorded in each colony. Future statistical analysis on this particular epidemiological risk factor will link the amount of mites present in the colonies in autumn to their subsequent survival over the winter.

Cases of nosemosis were reported in 11 MS, all located in Northern Europe. Data on nosemosis will be further statistically explored in the future in order to better know the risk posed to honey bee colonies by these pathogens.

The full report from which this article is derived cites plenty of literature to provide context for interpretation of colony losses. It also presents data with 95% confidence intervals to illustrate variability and statistical significance between different values.

Acknowledgements

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