National Assembly for Wales
Research paper

Bee Health

May 2013

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Bee Health

May 2013

Caitlin Pearson

This research paper provides an overview of recent trends in bee numbers and bee health in the UK. The benefits of bees to the economy are outlined. The factors affecting bee populations are described as well as measures being taken to combat observed declines. A synopsis of the current legislation and policies related to bee health is also included with particular focus on current debates regarding the impact of neonicotinoid pesticides on bees.

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Cynulliad Cenedlaethol Cymru
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Summary

Bees provide pollination services for commercial crop plants, wild flowers and garden plants. Together, the crop pollination services and apiculture products provided by bees contribute £200 million per year to the UK economy. Bees also contribute to a wide range of ecosystem services with indirect economic value, such as promotion of biodiversity. Maintaining healthy bee populations is important to the success of a number of Welsh policies including Food from Wales, Food for Wales, the Farming Food and Countryside Strategy and the Natural Environment Framework.

There are estimated to be around 270 bee species in the UK in three distinct groups; honeybees, solitary bees and bumblebees. Honey bees are widely domesticated and managed but diverse populations of wild bees are also important for provision of effective and stable pollination services. A number of the species of bee originally present in the UK are now locally extinct and others are endangered. The number of managed honeybee and wild bee colonies has decreased dramatically in recent decades. However, there is some indication of improvements in bee health since 2008.

A number of factors can have negative impacts on bee populations. Since the 1990s, several parasites and viral diseases affecting bee colonies have been introduced to the UK and their populations have increased dramatically over the past 5 to 10 years. Declines in wildflowers, reduced extent of foraging habitat and changing climatic conditions are also believed to be driving declines in bee numbers.

There is currently debate on the impacts of neonicotinoids, a widely used type of pesticide, on bee populations. Recent scientific studies have not shown a consensus and data gaps remain. In February 2013, the European Food Safety Authority reported that neonicotinoids posed a ‘high acute risk’ to bees. This led to the European Commission adopting a two year restriction on use of these pesticides despite votes on the ban by Member States not achieving a qualified majority. The UK voted against the proposed ban.

A number of governmental and non-governmental organisations are working to prevent further decline of bee populations. A national apiculture programme is governed by European Council Regulation 797/204 and applied through the *Healthy Bees Plan* in England and Wales. The plan is implemented by the National Bee Unit. The Welsh Government published a draft *Action Plan for Pollinators* on 9 April, 2013, which aims to reverse the decline in pollinator populations.

Bee Health

1. Introduction

Around 80 per cent of plant species in Europe, including 84 per cent of crop plants, are pollinated by insects.[1] Without insects moving pollen between their flowers these plants would fail to reproduce or would produce yields lower in quality and quantity.[2] Although thousands of insect species perform pollination; including butterflies, moths and hoverflies, bees are generally considered to be the most important pollinators.[3] The European honeybee is responsible for 80 per cent of insect mediated crop pollination globally[4] and in the UK 70 different crop plants are pollinated by bees.[5] Their relatively large size, hairy bodies and active foraging behaviour result in bees having very high pollinating efficiency.[6] Further, bees contribute to other ecosystem services and produce honey, wax and propolis.[7] Overall, bees are estimated to be worth millions of pounds to the UK economy each year.[8]

Recent evidence suggests bee populations have declined globally.[9] A number of factors have been cited as contributing to this decline including: diseases, pests, poor spring and summer weather, pesticide use and habitat loss. The current understanding of the causes of bee decline will be examined in this paper.

Legislation and best practice guidelines are in place to manage bee populations. Several organisations, including the Welsh Government, are working to better understand the threats to bee populations and to implement actions to combat declines. The National Bee Unit (NBU), a part of the Food and Environment Research Agency (FERA, an executive agency of the UK Government's Department for Environment, Food and Rural Affairs), plays a major role in the conservation of bee populations across the UK.[10] This paper gives an overview of current legislation and initiatives on bee health.

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[1] Williams I.H. (1994) *The dependence of crop production within the European Union on pollination by honeybees*, Agricultural Science Reviews 6, *229-257*

[2] United Nations Food and Agriculture Organisation ***Bees are diligent pollinators of fruit and seed crops*** (website) [accessed 3 April 2013]

[3] Breeze T.D., Bailey A.P., Balcombe K.G., Potts S.G. (2011) ***Pollination services in the UK: how important are honeybees?*** Agriculture, ecosystems and environment. 142, 137-143

[4] Carreck N. and Williams I. (1998) *The Economic Value of Bees in the UK*. Bee World. 79 , 115-123

[5] The British Beekeepers Association. ***Importance of bees*** (website) [accessed 28 March 2013]

[6] Breeze T.D., Roberts P.M. and Potts S.G. (2012) ***The decline of England's bees*** [accessed 28 March 2013]

[7] Propolis is a resin-like substance that bees collect from plant sources. It is used as a structural material in the hive but can be harvested for commercial use in health care products and manufacturing.

[8] The British Beekeepers Association. ***Importance of bees*** (website) [accessed 28 March 2013]

[9] Department for Environment, Food and Rural Affairs (2009) ***Healthy Bees – Protecting and improving the health of honey bees in England and Wales***. [accessed 28 March 2013]

[10] National Bee Unit (**website)** [accessed 28 March 2013]

2. Status and trends in UK bee colonies

2.1. Types of bee in the UK

There are approximately 267 species of bee present in the UK.[11] Bees can be categorised into three distinct groups: the honeybee, of which there is a single species in the UK (*Apis mellifera*); bumblebees (*Bombus* spp.) of which there are 23 species in the UK; and solitary bees (*Osmia* spp.) of which there are around 220 species in the UK.[12]

The European honeybee is widely cultivated by beekeepers to provide pollination services for crop growers. There are very few wild colonies of honeybee left in the UK.[13] Increasingly, bumblebee and solitary bee colonies are being imported for cultivation.[14]

2.2. Pollination services provided by different bee groups

Honeybee cultivation is a practicable method of increasing pollinator numbers as they can be reliably managed.[15] Honeybees are, however, unable to pollinate certain crops and less effective than wild pollinators in many circumstances.[16] For example, solitary bees are 300 times more effective than honeybees at pollinating apple plants.[17] Beans, tomatoes, peppers and blueberries are examples of crops which require 'buzz' pollination by bumblebees; bumblebees can vibrate their wings to ensure pollination in a way that honeybees cannot.[18] Further, mason bees and bumblebees are able to forage in weather conditions that prevent honeybees from flying.[19] A 54 per cent increase in insect pollinated crops in the UK between 1984 and 2010 despite a decline in honeybee numbers suggests honeybees do not provide the majority of pollination services.[20]

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[11] Breeze T.D., Roberts P.M. and Potts S.G. (2012) ***The decline of England's bees*** [accessed 28 March 2013]
[12] *ibid*
[13] International Bee Research Association, ***Honey bees leaflet*** [accessed 28 March 2013]
[14] European Commission. Health and consumers. ***Beekeeping, honey production and wild bees*** (website) [accessed 28 March 2013]
[15] Parliamentary Office of Science and Technology (2010) POST Note No.348 ***Insect Pollination*** [accessed 28 March 2013]
[16] Garibaldi L.A. *et al.* (2013) ***Wild pollinators enhance fruit set of crops regardless of honeybee abundance***, Science [accessed 28 March 2013]
[17] Thomson J.D.and Goodall K. (2001) *Pollen removal and deposition by honeybee and bumblebee visitors to apple and almond flowers*, Journal of Applied Ecology. 38, 1032-1044
[18] Delaplane K.S. and Mayer D.E. (2000) *Crop pollination by Bees.* Centre for Agricultural Bioscience International publishing; Wallingford.
[19] Staus and Trends of European pollinators (STEP) Project factsheet: ***Pollinators support farm productivity*** [accessed 28 March 2013]
[20] Breeze T.D., Bailey A.P., Balcombe K.G. and Potts S.G. (2011) ***Pollination services in the UK: how important are honeybees?*** Agriculture, ecosystems and environment. 142, 137-143

Studies have demonstrated that diverse communities of pollinators provide more effective and stable pollination services than less diverse communities.[21,22,23] Further, more diverse communities are less likely to undergo catastrophic declines as different species differ in their susceptibility to external factors such as weather conditions and disease.[24] The House of Commons Environmental Audit Committee recently criticised the Department of Environment, Food and Rural Affairs (DEFRA) for over focussing on honeybees in their research and monitoring.[25]

2.3. Trends in bee and beekeeper numbers

2.3.1. Estimates of honeybee colony numbers

Estimates of the number of managed bee colonies in the UK are variable. An independent study in 2001 estimated there to be 274,000 managed honeybee colonies in the UK, kept by 44,000 beekeepers.[26] This figure is published on the Welsh Government's website, with a breakdown figure of 20,000 colonies kept by 4,000 bee keepers in Wales in 2001.[27] The Welsh Government's and DEFRA's '*Healthy Bees policy 2009*' document cites a figure of 230,000 colonies in the UK kept by 33,000 beekeepers in 2001.[28] Current data from the National Bee Unit database leads to estimates of 3,400 beekeepers with 18,300 colonies in Wales.[29]

2.3.2. Trends in honeybee colonies through time

A recent scientific study used published estimates from the then Ministry for Agriculture Forestry and Fisheries beekeeping statistics and the National Bee Unit database to calculate changes in bee colony numbers over time. The number of honeybee colonies decreased by 54 per cent in England and 23 per cent in Wales between 1985 and 2005.[30] No data were presented for 2005 onwards.

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[21] Garibaldi L.A., Aizen M.A., Klein A.M., Cunnigham S.A. and Harder L.D. (2011) *Global growth and stability of agricultural yield decrease with pollinator dependence*, Proceedings of the National Academy of Science of the United States.108, 1581-1584

[22] Winfree R. and Kremen C. (2009) *Are ecosystem services stabilized by differences among species? A test using crop pollination*, Proceedings of the Royal Society B – Biological Sciences, 276, 229-237

[23] Albrecht, M., Schmid, B., Hautier, Y. et al. (2012) *Diverse pollinator communities enhance plant reproductive success*, Proceedings of the Royal Society B. 279: 4845-4852

[24] Brittain C., Kremen C. and Klein A-M. (2013) *Biodiversity buffers pollination from changes in environmental conditions*, Global Change Biology, 19, 540-547

[25] House of Commons Environmental Audit Committee, ***Pollinators and Pesticides*** Seventh Report of Session 2012–13 [accessed 9 April 2013]

[26] Department for Environment, Food and Rural Affairs ***Bee Health*** (website) [accessed 28 March 2013]

[27] Welsh Government ***Bees*** (website) [accessed 28 March 2013]

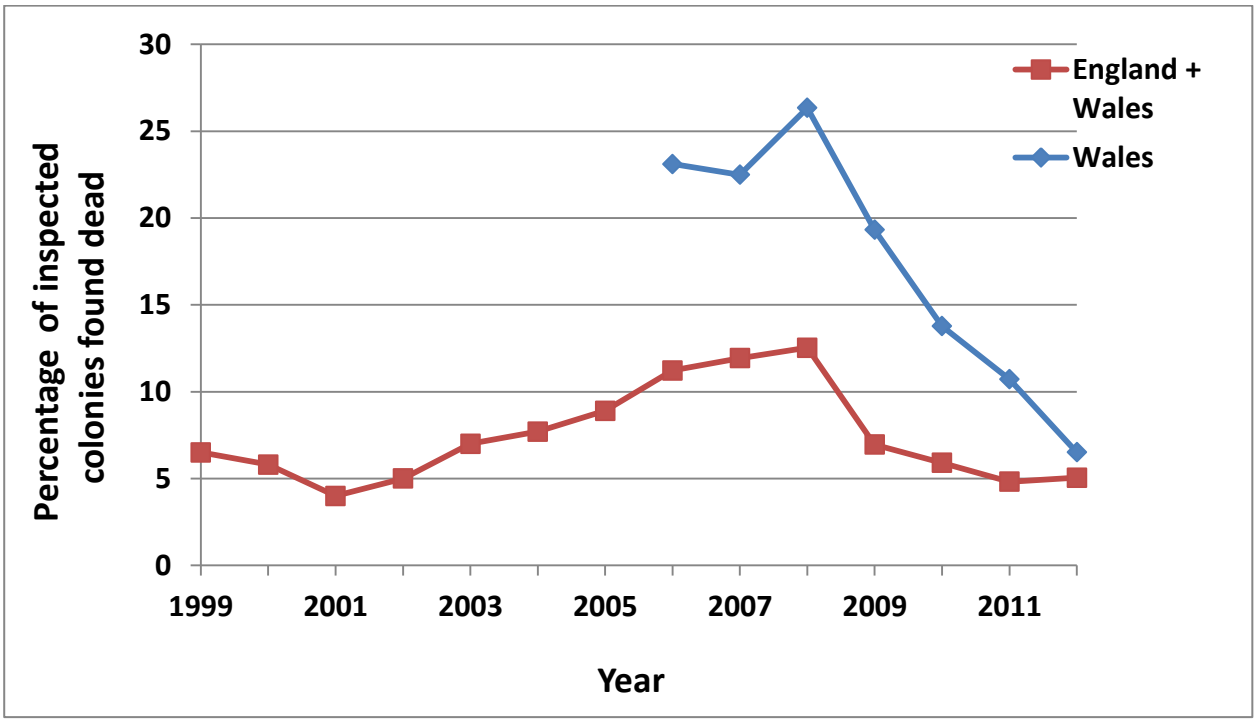
[28] Department for Environment, Food and Rural Affairs and Welsh Government (2009) Report: ***Healthy Bees-Protecting and improving the health of honey bees in England and Wales*** [accessed 4 April 2013]

[29] Welsh Government, ***Consultation on the Draft Action: Plan for Pollinators for Wales*** 9 April 2013 [accessed 9 April 2013]

[30] Potts S.G., Roberts S.P.M., Dean R., Marris G., Brown M.A., Jones R., Neumann P. and Settele J. (2010) ***Declines of managed honeybees and beekeepers in Europe?*** Journal of Apicultural research, 49, 15-22 [accessed 28 March 2013]

The National Bee Unit's annual inspection programme provides data on the number of colonies dying each year.[31] Although this data does not provide an estimate of colony numbers it gives a good indication of trends in bee health. Historically, fluctuations in colony death rates are associated with incidences of severe weather but in the last decade there have been consistent trends in the percentage of inspected colonies found dead per year.[32] Between 2001 and 2008 the percentage of inspected colonies dying steadily increased from around 4 to 13 per cent. Since 2008 the percentage of colonies dying has declined. This trend is particularly pronounced in Wales (figure 1).

Figure 1: Proportion of inspected honeybee colonies found dead each year. Between 20,000 and 35,000 were randomly selected for inspection each year.



Source: Food and Environment Research Agency ***Investigating Honey Bee Colony Losses in England and Wales*** *and* ***BeeBase Inspection Reports*** *[Accessed 28 March 2013]*

[31] BeeBase ***NBU Inspection reports*** (website) [accessed 28 March 2013]
[32] Food and Environment Research Agency ***Investigating Honey Bee Colony Losses in England and Wales*** [accessed 28 March 2013]

Similar trends are seen in the NBU Husbandry survey of overwinter colony losses. Overwinter losses naturally occur and are historically around 10 per cent. In 2007/2008 overwinter losses in England and Wales reached 30 per cent but have since declined to 16.1 per cent in 2011/2012[33] (table 1).

Table 1: Percentage of colonies dying over winter in England and Wales, 2008-2012

Year	Percent of inspected colonies found dead
2007-2008	30
2008-2009	20
2009-2010	21
2010-2011	19
2011-2012	16.1

*Source: BeeBase website, **NBU surveys** [Accessed 28 March 2013]*

2.3.3. Status of wild bees in the UK

As there is no monitoring scheme in place, little information exists on wild bee populations. There are 17 species of wild bee listed as priority species in the UK Biodiversity Action plan, five of which are known to occur in Wales.[34]

A recent analysis published in scientific literature used recorded observations of wild bees to conclude that solitary bee diversity in the UK has declined since 1980 in 52 per cent of the areas assessed. Increases in solitary bee diversity were reported in 10 per cent of areas assessed.[35]

[33] BeeBase ***NBU surveys*** (website)[accessed 28 March 2013]
[34] Joint Nature Conservation Committee ***UK BAP priority terrestrial invertebrate species*** [accessed 28 March 2013]
[35] Biesmeijer J.C., Roberts S.P.M., Reemer M., Ohlemüller R., Edwards M., Peeters T. Schaffers A.P., Potts S.G., Kleukers R., Thomas C.D., Settele J. and Kunin W.E. (2006) ***Parallel declines in pollinators and insect-pollinated plants in Britain and the Netherlands***, Science, 313, 351-354

3. Importance and economic value of bees

3.1. Direct economic value

Over 70 economically important plants in the UK are pollinated by insects, including fruits, vegetables, herbs, animal forage crops and biofuel crops.[36] Insect pollination enhances the quality or quantity of yields and increases genetic diversity of the crop, which is necessary for fighting disease.[37] It is estimated that a total loss of pollinators would reduce agricultural production by 5 per cent.[38] The area covered by insect-pollinated crops is likely to increase as demand for food and biofuel rises.[39]

The UK National Ecosystem Assessment estimated that in 2007 the direct value of pollination services to the UK was £430 million per year.[40] Replacing the pollination services of bees with hand pollination would cost UK farmers approximately £1.8 billion per year.[41]

The Public Accounts Committee estimated in 2009 that honeybees contribute £200 million to the UK economy per year.[42] This estimate included the value of other apiculture products produced by honeybees such as honey, propolis and wax. Honey alone was reported to contribute £2 million to the Welsh economy in 2011.[43]

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[36] The British Beekeepers Association. ***Importance of bees*** (website) [accessed 28 March 2013]

[37] Somerville D.C. (1999) *Honeybees (Apis mellifera) increase yields of faba beans (Vicia faba) in New South Wales while maintaining adequate protein requirements from faba bean pollen*, Australian Journal of Experimental Agriculture 39, 1001-1005

[38] Aizen M. and Harder L. (2009) *The truth about the disappearing honeybees*. New Scientist 2731, 26-27

[39] Breeze T.D., Bailey A.P., Balcombe K.G., Potts S.G. (2011) ***Pollination services in the UK: how important are honeybees?*** Agriculture, ecosystems and environment 142, 137-143

[40] Smith P., Ashmore M., Black H., Burgess P., Evans C., Hills R., Potts S.G., Quine T., Thomson A., Biesmeijer K., Breeze T., Broadmeadow M., Ferrier R., Freer J., Hansom J., Haygarth P., Hesketh H., Hicks K., Johnson A., Kay D., Kunin W., Lilly A., May L., Memmott J., Orr H., Pickup R., Purse B and Squire G. (2011) ***UK National Ecosystem Assessment Technical Report – Chapter 14: Regulating Services*** [accessed 4 April 2013]

[41] Breeze T.D. (2012) *Valuing UK Pollination Services; PhD Thesis*, University of Reading

[42] House of Commons Public Accounts Committee (2009) ***The health of livestock and honeybees in England*** Thirty-sixth Report of Session [accessed 5 April 2013]

[43] National Bee Unit estimated from information provided by Bee Inspectors *in* House of Commons Environmental Audit Committee, ***Pollinators and Pesticides*** Seventh Report of Session 2012-13 [accessed 9 April 2013]

3.2. Indirect value

The UK National Ecosystems Assessment[44] recognised that through pollination of wild plants bees contribute to wide range of ecosystem services, including:

- Maintenance of biodiversity of wild plants and the insects, birds and small mammals which rely on them for food and shelter;
- Enhancement of soil health;
- Carbon sequestration;
- Regulation of water quality;
- Enhancement of landscape aesthetics; and
- Promotion of tourism and recreation activities such as private gardening.

The economic value of these benefits has not been determined, but probably exceeds the direct economic value of pollination services.[45]

[44] Smith P., Ashmore M., Black H., Burgess P., Evans C., Hills R., Potts S.G., Quine T., Thomson A., Biesmeijer K., Breeze T., Broadmeadow M., Ferrier R., Freer J., Hansom J., Haygarth P., Hesketh H., Hicks K., Johnson A., Kay D., Kunin W., Lilly A., May L., Memmott J., Orr H., Pickup R., Purse B and Squire G. (2011) ***UK National Ecosystem Assessment Technical Report – Chapter 14: Regulating Services*** [accessed 4 April 2013]

[45] Parliamentary Office of Science and Technology (2010) POST Note No.348 ***Insect Pollination*** [accessed 28 March 2013]

4. Pressures on bee populations

It is widely accepted that bee numbers are declining. Declines have been attributed to a number of factors, including disease, pests, habitat loss, pesticides and climatic conditions. It is difficult to compare the effects of different factors on bee populations as a combination of factors is often the cause of colony loss. A report for the European Food Safety Authority in 2009 stated that the leading cause of bee decline remained unknown and called for more research to be carried out.[46]

4.1. Bee disease and parasites

Pests and diseases are thought to be a major cause of mortality in cultivated bee colonies but their impact on wild bee populations is difficult to assess.[47] Importation of bee colonies for cultivation is a main pathway of bee disease into the UK.[48] The most widespread diseases affecting honeybees are discussed below.

The parasitic mite *Varroa destructor* feeds on haemolymph (the 'blood') of honey bees. This action is unlikely to kill the bee directly but it weakens the bee's immune system making it susceptible to the viral and bacterial diseases carried by the mite.[49] The *V. destructor* parasite has quickly spread across the UK since its introduction in 1992[50] and has caused the loss of a large number of domesticated colonies. The United Nations Environment Programme states that *V. destructor* is 'the most serious threat to apiculture globally'.[51]

American foul brood (*Paenibacillus* spp.) and European foul brood (*Melissococcus plutonius*) are pathogenic spore-forming bacteria which multiply in the guts of bee larvae and result in death.[52] After the host bee has died, spores can persist for up to 40 years as they are resistant to extreme temperatures and disinfectants.[53] This means they are easily transferred between hives if infected hives or combs are re-used. An antibiotic can be prescribed to colonies lightly diseased with European foul brood but antibiotics for American foul brood are not permitted in the UK. The incidence of disease has been kept low by destruction of infected colonies.[54]

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[46] Hendrikx P., Chauzat M-P., Debin M., Neuman P., Fries I., Ritter W., Brown M., Mutinelli F., Le Conte Y. and Gregorc A. (2009) ***Bee Mortality and Bee Surveillance in Europe***, Report submitted to EFSA

[47] Kuldna P., Peterson K., Poltimaee H. and Luig J. (2009) *An application of DPSIR framework to identify issues of pollinator loss*, Ecological Economics, 69, 32-42

[48] National Bee Unit ***Protecting the honeybee.*** (website) [accessed 2 April 2013]

[49] Breeze T.D., Roberts P.M. and Potts S.G. (2012) ***The decline of England's bees*** [accessed 28 March 2013]

[50] Helen M. Thompson, Michael A. Brown, Richard F. Ball & Medwin H. Bew (2002). *First report of Varroa destructor resistance to pyrethroids in the UK*, Apidologie 33, 357–366

[51] United Nation Environment Programme (2010) Emerging Issues: ***Global Honey Bee Colony Disorder and Other Threats to Insect Pollinators*** [accessed 28 March 2013]

[52] Formato G., Comini A., Giacomelli A., Ermenegildi A., Zilli R. and Davis I. (2010) *Veterinary care of honey bees in the UK,* In Practice ,32, 418-425 doi:10.1136/inp.c5309

[53] *ibid*

[54] BeeBase ***Disease Incidence*** (website) [accessed 3 April 2013]

A number of other diseases and parasites affect bee colonies, including: tracheal mites, chalk brood fungus, *Nosema* fungi, deformed wing virus and chronic bee paralysis virus. These can only be detected by genetic analysis and so often go unnoticed.[55]

4.2. Habitat and forage loss

Between 1930 and 1990 over 90 per cent of species-rich lowland grassland habitat in Wales was lost [56] and since 1980 the number of wildflowers requiring insect pollination in the UK has decreased by 70 per cent.[57] It is not known whether the decline in wildflowers preceded the decline in bee numbers or vice versa but the availability and variety of forage for bees is lower today than in previous decades.[58] A study by Feon *et al.* in 2010 reported that occurrence of semi-natural habitat can be reduced by intensive agriculture and this results in a decrease in wild bee diversity.[59]

The extent of hedgerows has also declined in recent years.[60] Hedgerows act as corridors for safe movement of bees between foraging and nesting sites.[61] The limited dispersal ability of solitary bees makes them particularly susceptible to declines in hedgerow corridors.[62]

In addition, air pollution has been identified as a potential contributing factor to habitat deterioration for bees. The 2010 United Nations Environment Programme report on *'Threats to Insect Pollinators'* states that air pollution disrupts the ability of pollinators to locate food sources using chemical scent trails.[63]

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[55] Formato G., Comini A., Giacomelli A., Ermenegildi A., Zilli R. and Davis I. (2010*) Veterinary care of honey bees in the UK*, In Practice, 32, 418-425 doi:10.1136/inp.c5309

[56] Stevens D.P., Smith S.L.N., Blackstock T.H., Bosanquest S.D.S. and Stevens J.P. (2010) *Grasslands of Wales. A survey of lowland species-rich grasslands, 1987–2004*, University of Wales Press, Cardiff

[57] Biesmeijer J.C., Roberts S.P.M., Reemer M., Ohlemüller R., Edwards M., Peeters T. Schaffers A.P., Potts S.G., Kleukers R., Thomas C.D., Settele J. and Kunin W.E. (2006) ***Parallel declines in pollinators and insect-pollinated plants in Britain and the Netherlands***, Science, 313, 351-354

[58] *ibid*

[59] Feon V., Schermann-Legionnet A., Delettre Y., Aviron S., Billeter R., Bugter R., Hendrickx F. and Burel F. (2010) *Intensification of agriculture, landscape composition and wild bee communities: A large scale study in four European countries*, Agriculture, ecosystems and environment, 137, 143-150

[60] Countryside Survey (2009) ***UK Results from 2007*** [accessed 3 April 2013]

[61] Hannon L.E. and Sisk T.D. (2009) *Hedgerows in agri-natural landscapes: potential habitat values for native bees*, Biological conservation, 142, 2140-2154

[62] Williams N.M., Crone E.E., Roulston T.H., Minckley R.L., Packer L. and Potts S.G. (2010) *Ecological and life-history traits predict bee species response to environmental disturbances*, Biological Conservation, 143, 2280-2291

[63] United Nation Environment Programme (2010) Emerging Issues: ***Global Honey Bee Colony Disorder and Other Threats to Insect Pollinators*** [accessed 2 April 2013]

4.3. Pesticide use

4.3.1. Impacts of pesticide use

Pesticides are routinely applied to cultivated crops to limit damage from pests and hence to increase yields. Before a pesticide can be used in the EU, it must have undergone assessment and approval to ensure the risks it poses to the environment and human health are minimal and reasonable[64] (see section 5.3).

Many insecticides are non-specific, meaning they can have detrimental impacts on non-target insects, including bees.[65] Bees can be exposed to insecticides either directly during the spraying process or indirectly through the consumption of the sprayed produce.[66]

Neonicotinoids are the most widely used type of insecticides in the world.[67] They are nicotine based chemicals that act on the nervous system of insects.[68] Neonicotinoids became widely used in the UK in 2001[69] and are applied to both crop and non-crop plants. Crops treated with neonicotinoids include wheat, linseed and oilseed rape.[70] In the UK, five neonicotinoids are registered for use (imidacloprid, clothianidin, acetamiprid, thiacloprid and thiamethoxam).[71]

Neonicotinoids are usually applied as a seed dressing before crops are sown. This application method has been shown to be efficient in low doses and to reduce the number of insecticide sprays needed throughout the growing season.[72] The FERA Pesticide Usage Survey found that the total amount of agricultural land treated with insecticides in the UK (5.97 million hectares) was unchanged between 1991 and 2011 but the weight of applied insecticides fell by 57 per cent in the same period. This is due to improvements in the effectiveness of the pesticides.[73] Seed dressings gradually disperse into the plant tissue as the plant grows, resulting in trace amounts being present in the pollen and nectar of treated plants. Therefore, insects feeding on the plant have long-term exposure to the insecticide.[74] Bees can

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[64] Food Standards Agency ***Pesticides*** (website)
[65] Pesticide Action Network *Bee Declines and Pesticides factsheet 1- **Different routes of Pesticide exposure*** [accessed 3 April 2013]
[66] *ibid*
[67] Yamamoto I. (1999) Nicotine to Nicotinoids: 1962 to 1997. In Yamamoto I and Casida, J. (eds) *Nicotinoid Insecticides and the Nicotinic Acetylcholine Receptor*. Tokyo: Springer-Verlag. pp. 3–27
[68] Kindemba V. (2009) ***The impact of neonicotinoid insecticides on bumblebees, honey bees and other non-target invertebrates*** (revised version). Buglife report [accessed 4 April 2013]
[69] Thompson H., Harrington P., Wilkins S., Pietravalle S., Sweet D. and Jones A (2013) Report to Department of Environment, Food and Rural affairs. ***Effects of neonicotinoid seed treatments on bumble bee colonies under field conditions***. [accessed 2 April, 2013]
[70] Kindemba V. (2009) ***The impact of neonicotinoid insecticides on bumblebees, honey bees and other non-target invertebrates*** (revised version). Buglife report [accessed 4 April 2013]
[71] *ibid*
[72] Noleppa S. and Hahn T. (2013) ***The value of neonicotinoid seed treatment in the European Union: A socio-economic, technological and environmental review***. Report for Humboldt forum for Food and Agriculture [accessed 5 April 2013]
[73] Food and Environment Research Agency ***Pesticide Usage Statistics 2011***[Accessed 5 April 2013]
[74] Kindemba V. (2009) ***The impact of neonicotinoid insecticides on bumblebees, honey bees and other non-target invertebrates*** (revised version). Buglife report [accessed 4 April 2013]

also be exposed to the insecticide by contact with dust released during the sowing of treated seeds.[75]

Several recent laboratory and semi-field studies have shown neonicotinoids to disrupt the natural behaviour and physiology of bees. For example, neonicotinoids have been shown to reduce colony survival,[76,77] disrupt homing behaviour,[78] memory and foraging behaviour,[79,80] and decrease disease resistance[81] in honey bees, and to reduce growth rate and production of new queens in bumblebees.[82]

However, very few field trials have been performed on the effects of neonicotinoids on bees. The results of the few published field studies largely do not support those of laboratory and semi-field studies. Recent research published in scientific literature found that honeybee colonies placed in fields of oilseed rape grown from clothianidin-treated seed did not differ from those foraging on non-treated oilseed rape in terms of mortality, weight gain or brood development.[83] Similarly, the amount of imidacloprid seed-treated maize in the vicinity of a honeybee colony was shown not to influence colony success.[84]

FERA published results from a field trial in March 2013 which compared bumblebee (*Bombus terrestris*) colonies in areas of oilseed rape that were untreated, seed-treated with clothianidin or seed-treated with imidacloprid. Colonies in the three sites did not differ significantly in colony mass or the number of new queens produced.[85] However, the study was subsequently criticised by the House of Commons Environmental Audit Committee because neonicotinoids were present in colonies at all three sites resulting in there being no true reference condition. This is likely to have occurred because the foraging range of the colonies exceeded the size of the control plot.[86] Further,

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[75] Pesticide Action Network *Bee Declines and Pesticides factsheet 1- **Different routes of Pesticide exposure*** [accessed 3 April 2013]

[76] Lu C., Warchol K.M. and Callahan R.A. (2012) *In situ replication of honey bee colony collapse disorder*. Bulletin of Insectology, 65, 99-106

[77] Gill R.J., Ramos-Rodriguez O. and Raine N.E. (2012) ***Combined pesticide exposure severely affects individual-and colony-level traits in bees***, Nature, doi:10.1038/nature11585

[78] Henry M.,Beguin M., Reguier F., Rollin O., Odoux J-F., Aupinel P., Aptel J. Tchamitchian S. and Decourtve A. (2012) *A Common Pesticide Decreases Foraging Success and Survival in Honey Bees*, Science, 336, 347-350

[79] Yang E.C., Chuang Y.C., Chen Y.L. and Chang L.H. (2008) *Abnormal Foraging Behavior Induced by Sublethal Dosage of Imidacloprid in the Honey Bee (Hymenoptera: Apidae)*, Journal of Economic Entomology, 101, 1743-1748

[80] Williamson S.M. and Wright G.A. (2013) *Exposure to multiple cholinergic pesticides impairs olfactory learning and memory in honeybees,* Journal of Experimental Biology doi: 10.1242/jeb.083931

[81] Pettis J.S., vanEngelsdorp D., Johnson J. And Dively G. (2012) *Pesticide exposure in honey bees results in increased levels of the gut pathogen Nosema*, Naturwissenschaften, 99, 153–158

[82] Whitehorn P.R., O'Connor S., Wackers F.L. and Goulson D. (2012) *Neonicotinoid Pesticide Reduces Bumble Bee Colony Growth and Queen Production*, Science 336, 351-352

[83] Cutler G.C. and Scott-Dupree D. (2007) *Exposure to Clothianidin Seed-Treated Canola Has NoLong-Term Impact on Honey Bees*, Journal of Economic Entomology, 100, 765-772

[84] Nguyen B.K., Saegerman C., Pirard C., Mignon J., Widart J., Thirionet B., Verheggen F.J., Berkvens D., De Pauw E., and Haubruge E. (2009) D*oes imidacloprid seed-treated maize have an impact on honey bee mortality?* Journal of Economic Entomology, 102, 616-623

[85] Thompson H., Harrington P., Wilkins S., Pietravalle S., Sweet D. and Jones A (2013) Report to Department of Environment, Food and Rural affairs. ***Effects of neonicotinoid seed treatments on bumble bee colonies under field conditions***. [accessed 2 April, 2013]

[86] House of Commons Environmental Audit Committee, ***Pollinators and Pesticides*** Seventh Report of Session 2012–13 [accessed 9 April 2013]

inconsistencies in the initial size and release date of colonies made the results difficult to interpret. DEFRA said the results are 'reassuring but not definitive'.[87]

Additionally, herbicides can indirectly impact bee populations by removing wild weed species that bees use as food sources.[88] Monoculture crop stands are less likely to meet the resource requirements throughout the whole lifecycle of a colony.[89]

4.3.2. Current EU debates on neonicotinoid pesticide use

In January 2013, the European Food Safety Authority (EFSA) published a scientific review of the risk of neonicotinoid active substances to bees. The review stated that there was a 'high acute risk' to honeybees from exposure to neonicotinoids at the authorised application levels.[90] The review was presented to the European Commission with the conclusion that neonicotinoids pose 'unacceptable risks' to bees[91].

In the same week as the FERA review was published, the Humboldt Forum for Food and Agriculture produced a report on the economic value of neonicotinoids, funded by Bayer Crop Science and agricultural technology company, Syngenta. The report stated that loss of access to neonicotinoid seed treatment technology would cost the UK economy £630 million each year and result in increased use of alternative pesticides.[92] The Pesticide Action Network Europe group, however, responded that the method of valuation was questionable and the report did not take into account the economic cost of pollinator loss.[93]

In response to the recommendations of the EFSA report, the European Commission proposed a two year ban on neonicotinoid pesticides clothianidin, imidacloprid and thiamethoxam. The proposed ban applied to all pesticide application methods (seed treatments, soil additions and spraying) for all non-professional uses and use on crops including, but not restricted to; maize, oil seed rape and spring planted wheat and barley. The ban did not cover crops which do not attract bees such as potatoes and sugar beet.[94]

In response to requests from Member States, the Commission made minor amendments, allowing neonicotinoid application after crops have flowered and

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[87] *ibid*

[88] Kleijn D., Kohler F., Baldi A., Batary P., Concepcion E.D., Clough Y., Diaz M., Gabriel D., Holzschuh A., Knop E., Kovacs A., Marshall E.J.P., Tscharntke T. (2009) *On the relationship between farmland biodiversity and land-use intensity in Europe*, Proceedings of the Royal Society B – Biological Sciences, 276, 903-909

[89] Breeze T.D., Roberts P.M. and Potts S.G. (2012) ***The decline of England's bees*** [accessed 28 March 2013]

[90] European Food Safety Authority (2013) ***Statement on the findings in recent studies investigating sub-lethal effects in bees of some neonicotinoids in consideration of the uses currently authorised in Europe*** [accessed 2 April 2013]

[91] *ibid*

[92] Noleppa S. and Hahn T. (2013) ***The value of neonicotinoid seed treatment in the European Union: A socio-economic, technological and environmental review,*** Report for Humboldt forum for Food and Agriculture [accessed 2 April 2013]

[93] Pesticide Action network Europe (2013) ***PAN-Europe opinion on the Humboldt report***: *The value of Neonicotinoids seed treatment in the European Union* [accessed 2 April 2013]

[94] AGRAFACTS Article no. 09-13, AGRA-EUROPE Presse-und Informationsdienst, 01 February 2013

exempting crops grown in greenhouses.[95] Several countries in favour of the ban, including Italy, France and Slovenia, have already imposed restrictions on the use of neonicotinoids at a national level.

On 13 March 2013, Member States voted on the ban. A qualified majority was not reached, with the UK abstaining from the vote. The Secretary of State for the Environment raised concerns about the economic implications of the proposed ban and highlighted gaps in EFSA's data.[96] The Secretary of State for the Environment stated that the UK Government would not be able to take a view until the results of field studies undertaken by DEFRA were available.[97] The report on DEFRA's findings was published two weeks after the first vote (see section 4.3.1).[98]

On 27 February 2013, the Welsh Government's stance was that, while results of UK field studies are still provisional, further analysis is required before any regulatory action against neonicotinoids is taken.[99]

However, in its report published on 5 April 2013, the House of Commons Environmental Audit Committee supported the proposed ban and called on DEFRA to introduce a moratorium on imidacloprid, clothianidin and thiamethoxam use in the UK from 1 January 2014[100]. The report concluded that:

> "economic considerations should not form part of environmental risk management decision making".

On 29 April 2013, the EU vote went to the appeals committee. Again, a qualified majority was not reached, with fifteen Member States voting in favour of the ban. The UK voted against the proposed ban. The Commission will now adopt the proposals under its own authority; a two-year restriction is expected to commence no later than December 2013.

4.4. Climatic Conditions

Cold, damp weather and high winds reduce the foraging success of bees, increasing the risk of malnutrition.[101] Variability in bee numbers from year to year is often attributed to variation in weather conditions. Predicted longer term climatic changes may disrupt the synchronised timing of flower opening and bee emergence and thus reduce food supply for bees.[102]

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[95] AGRAFACTS Article no. 23-13, AGRA-EUROPE Presse-und Informationsdienst, 22 March 2013
[96] AGRAFACTS Article no. 09-13, AGRA-EUROPE Presse-und Informationsdienst, 01 February 2013
[97] Owen Paterson, ***Speech to NFU conference***, 27 February 2013[accessed 4 April 2013]
[98] Thompson H., Harrington P., Wilkins S., Pietravalle S., Sweet D. and Jones A (2013) Report to Department of Environment, Food and Rural affairs. ***Effects of neonicotinoid seed treatments on bumble bee colonies under field conditions***. [accessed 2 April, 2013]
[99] Welsh Government Statement, 27 February 2013 ***Approach on neonicotinoid pesticides***. [accessed 2 April 2013]
[100] House of Commons Environmental Audit Committee, ***Pollinators and Pesticides,*** Seventh Report of Session 2012–13 [accessed 9 April, 2010]
[101] Blaschon B., Guttenberger H., Hrassnigg N.and Crailsheim K. (1999) *Impact of bad weather on the development of the brood-nest and pollen stores in a honeybee colony (Hymenoptera: Apidae*), Entomologia generalis, 24, 49-60
[102] Memmott J., Craze P.G., Waser N.M. and Price M.V. (2007) *Global warming and the disruption of plant-pollinator*

4.5. Colony Collapse Disorder

Colony collapse disorder (CCD) is a term given to the sudden disappearance of worker bees from a hive where the cause is unknown and the dead bodies of the bees are not found.[103] Widespread observations of this phenomenon began in 2006 in North America.[104] The decline factors outlined in previous sections could all contribute to causing CCD.

interactions, Ecology Letters, 10, 710-717

[103] BeeBase (2007) ***Colony Collapse Disorder*** (website) [accessed 2 April, 2013]

[104] Ellis J.D., Evans J.D., Pettis J.(2010) ***Colony losses, managed colony population decline and colony collapse disorder in the United States***, Journal of Apicultural Research, 49, 134-136.

5. Legislation affecting management of bees and bee health

5.1. European legislation

General conditions for the production and marketing of apiculture products are governed by Council Regulation 797/2004[105] and implemented under Commission Regulation 726/2010.[106] Under these regulations, Member States produce apiculture programmes for three year periods, which receive funding from the European Commission under Council Regulation 1234/2007[107]on a Common Organisation of Agricultural Markets. For the period 2010 to 2013, the UK received £670,000 per year.[108]

Council Regulation 882/2004,[109] applicable since 1 September 2008, controls animal feed, food, health and welfare. As a consequence of this regulation, a National Control Plan for the UK was published which specifically covered bee health. The initial plan for 2007-2011 was extended to March 2013.[110]

Several pieces of legislation relate to importation of bees, with focus on preventing the spread of diseases, including:

- 'Balai Directive' 92/65/EEC on movement of live animals between Member States;[111]
- Commission Regulation 810/2010, on the requirements for imports from third countries;[112] and
- Council Directive 91/496/EEC[113] on veterinary requirements for trade of live animals between Member States.

[105] OJ L 163/83. 26.04.04 [accessed 4 April 2013]
[106] OJ L 213/29, 13.08.10 [accessed 4 April 2013]
[107] OJ L 299, 01.07.09 [Accessed 4 April 2013]
[108] BeeBase *UK Apiculture Programme* (website) [accessed 4 April 2013]
[109] OJ L 191/1, 30.04.04 [accessed 4 April 2013]
[110] Food Standards Agency, *Food Industries, Regulation and Legislation, National Control Plan for the United Kingdom* (Website) [accessed 4 April 2013]
[111] OJ L 268, 24.09.92 [accessed 3 April 2013]
[112] OJ L 243/16,.09.10 [accessed 3 April 2013]
[113] OJ L 355, 05.12.92 [accessed 4 April 2013]

5.2. The Bee Disease and Pest Controls Order, Wales (2006)

The *Bee Disease and Pest Controls Order Wales*[114] came into force in 2006. Under the order, if a person suspects the presence of American foul brood, European foul brood, small hive beetle or any species of the *Tropilaelaps* mite they must notify the Welsh Government through the National Bee Unit. In response, the movement of anything that could spread the disease or pest is banned until an authorised inspector assesses the colony. If the presence of a notifiable pest or disease is confirmed the colony must be destroyed or treated by an authorised person. Any breach of this order can result in a fine up to £5,000.[115]

5.3. Regulations relating to pesticides

Several European regulations relate to the use of pesticides and are therefore relevant to bee health.

Before a pesticide can be used in the EU it must be scientifically evaluated by its manufacturer under Council Regulation 1107/2009.[116] The EFSA evaluates the scientific evidence on the impact of the active substance to human health and the environment and on its effectiveness against pests. The conclusions are provided to the European Commission which proposes approval or non-approval. This recommendation is subject to a vote by all Member States in the Standing Committee on the Food Chain and Animal Health. Once listed on the approved substance list the pesticide must gain consent at a national level.[117] In the UK, risk assessment and authorisation is performed by the Chemicals Regulation Directorate of the Health and Safety Executive.[118] The honeybee is the only species of bee considered in the risk assessment process. Imidacloprid was listed as an approved substance on 1 August 2009.[119] Clothianidin is listed as an approved substance as a seed treatment only when measures have been taken to minimise leakage into the environment.[120] Approvals can be reviewed in light of new evidence.

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[114] ***The Bee Diseases and Pests Control (Wales) Order 2006*** No. 1710 (W. 172) [accessed 2 April 2013]
[115] *ibid*
[116] **OJ L 309/1, 24.11.09** [accessed 2 April 2013]
[117] Health and Safety Executive, ***Regulation of plant protection products in Europe*** (website) [accessed 4 April 2013]
[118] Health and Safety Executive ***Pesticides Law*** (website) [accessed 4 April 2013]
[119] European Food Safety Authority ***Conclusion on the peer review of the pesticide risk assessment for bees for the active substance imidacloprid***, 19 December 2012 [Accessed 4 April 2013]
[120] European Food Safety Authority ***Conclusion on the peer review of the pesticide risk assessment for bees for the active substance clothianidin***, 14 March 2013 [Accessed 4 April 2013]

The Maximum residue levels from pesticides are standardised across all Member States under European Regulation 396/2005[121] on pesticide residues. Further, Directive 2009/128/EC[122] establishes a framework for sustainable use of pesticides and requires Member States to establish national action plans outlining: provisions to protect water, public spaces and conservation areas; promotion of low input regimes; encouragement of natural pest control mechanisms and training for pesticide operators, advisors and distributors.[123] This is underpinned at a national level by the *Plant Protection Products (Sustainable Use) Regulations 2012*.[124] DEFRA published the UK National Action Plan for the Sustainable Use of Pesticides on 26 February 2013.[125]

[121] **OJ L 70/1 16.3.2005** [accessed 2 April 2013]
[122] **OJ L 309/71, 24.11.09** [accessed 4 April 2013]
[123] Health and Safety *Executive* ***Proposal for a regulation of the European Parliament and of the Council establishing a framework for Community action to achieve the sustainable use of pesticides: Summary of provisions*** [accessed 4 April 2013]
[124] Health and Safety Executive ***New UK Plant Protection Products (Sustainable Use) Regulations 2012*** (website) [accessed 2 April 2013]
[125] Department for Food, Environment and Rural Affairs. ***UK National Action Plan for the Sustainable Use of Pesticides (Plant Protection Products)*** February 2013 [Accessed 5 April 2013]

6. Current activities for managing bee populations

6.1. Welsh Government activities

The previous Welsh Government and DEFRA published a coordinated '*Healthy Bees Plan*' in March 2009 with the aim to provide direction and focus for sustaining the health of honey bees and beekeeping in England and Wales.[126] This programme is run under a Memorandum of Understanding with the FERA and is delivered through the NBU.[127] The Welsh Government currently provides £0.44 million to the NBU each year (2012 figures).[128] The majority of the NBU funding is from DEFRA, which provided £1.8 million in 2012.[129] Around a quarter of this (£0.46 million) was provided through the European Commission under Council Regulation 1234/2007 (see section 5.1).

On 9 April 2013, the Welsh Government published a draft Action Plan for Pollinators, which aims to reverse the decline in pollinator populations.[130] The public consultation on the draft plan closes on 4 July 2013. Four desired outcomes are highlighted in the plan: to provide diverse and connected habitats for pollinators; to maintain healthy pollinator populations; to raise awareness of the importance of pollinators; and to create a coherent policy and sound evidence base on pollinators.

The plan lays out key actions that the Welsh Government will undertake to support pollinators. These are:

- Encouraging farmers to adopt land management practices which benefit pollinators;
- Identifying and conserving sites of pollinator habitat;
- Promoting creation of urban habitats through parks, allotments and pollinator friendly gardening;
- Continuing support for the *Healthy Bees Plan* and National Bee Unit;
- Establishing monitoring programmes for pollinators populations and pesticide use; and
- Raising awareness and issuing best practice guidelines to Local Authorities and the public.[131]

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[126] Department for Environment, Food and Rural Affairs and Welsh Government (2009)Report: ***Healthy Bees-Protecting and improving the health of honey bees in England and Wales*** [accessed 4 April 2013]
[127] The National Bee Unit ***BeeBase*** (website) [accessed 3 April 2013]
[128] Department of Food, Environment and Rural Affairs (2012) ***Updated policies to control pests and diseases of honey bees*** December 2012 [accessed 3 April 2013]
[129] *ibid*
[130] Welsh Government, ***Consultation on the Draft Action: Plan for Pollinators for Wales*** 9 April 2013 [accessed 9 April 2013]
[131] *ibid*

The Action Plan will adhere to the whole ecosystems approach set out in the Welsh Government's Natural Environment framework, '*Sustaining a Living Wales*'.[132]

6.2. The National Bee Unit

The NBU is part of the FERA.[133] It provides statutory and advisory services to beekeepers across England and Wales and implements the UK Apiculture Plan and Bee Health programme. The NBU coordinates many initiatives. Its main roles are to:

- Operate an inspection programme for pests and disease;
- Provide advice, training and education to bee keepers;
- Manage the BeeBase database about the location and number of managed honeybee colonies;
- Undertake research;
- Contribute to evidence based policy development, including horizon scanning and risk assessment; and
- Form contingency plans for emerging threats to bees.[134]

[132] Welsh Government (2012) ***A Living Wales: A new framework for our environment, our countryside and our seas, Consultation document*** [accessed 3 April 2013]
[133] BeeBase ***The National Bee Unit*** (website) [accessed 3 April 2013]
[134] National Bee Unit leaflet ***Protecting the honeybee*** [accessed 3 April 2013]