Department for Environment Food & Rural Affairs

Llywodraeth Cymru
Welsh Government

Healthy Bees Plan Review

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Contents

Executive summary

Healthy Bees, or *'the Healthy Bees Plan'* as it became known, was published with one overall aim:

> To achieve a sustainable and healthy population of honey bees for pollination and honey production in England and Wales via strengthened partnership working between government and other stakeholders.

The government and members of the beekeeping community sought to meet this aim by achieving five targeted outcomes, namely: to bring about low levels of pests and diseases; to promote good standards of husbandry; to encourage effective biosecurity; to ensure sound science supports bee health policy and its implementation; and to work together to protect bee health.

The following chapters provide important insights into how contributors to the Healthy Bees Plan met these challenges.

The Healthy Bees Plan sought to give direction and focus to the government and beekeepers as custodians of honey bee health and in doing so lay the foundations for a collaborative approach. The importance of partnership working emerges clearly in each section. Working together featured extensively in both the creation of the Healthy Bees Plan and its implementation. Several active members of the Bee Health Advisory Forum have contributed to the writing of this report. It is desirable that this collaboration should continue.

The review of the Healthy Bees Plan also highlights the importance of this collaborative approach to combating the bee pests and diseases that threaten our honey bees. The Asian hornet continues to be a significant threat, but through our contingency planning and communications, outbreaks have been identified and eradicated. Contingency plans for other exotic pests have also been written and exercised. It is a priority for our future programme of work that this continues, and capability is maintained as we respond to honey bee pests and diseases.

Under the plan education and training provision for beekeepers has increased substantially, improving husbandry standards across England and Wales, and many thousands more beekeepers have chosen to register on the National Bee Unit's BeeBase website.

With these important findings, this review draws to a close the first Healthy Bees Plan. The honey bee is an important pollinator of our plant and crop species and part of our native fauna. Future strategies to protect and advance the wellbeing of our honey bees will benefit from the findings in this review and the work of the Healthy Bees Plan.

Glossary

AFB	American Foulbrood
APHA	Animal and Plant Health Agency
BBKA	British Beekeepers Association
BBSRC	Biotechnology and Biological Sciences Research Council (BBSRC)
BBVA	British Bee Veterinary Association
BFA	Bee Farmers' Association
BHAF	Bee Health Advisory Forum
CEH	Centre for Ecology and Hydrology
DASH	Disease Assurance Scheme for Honeybees
Defra	Department for Environment, Food and Rural Affairs
EFB	European Foulbrood
Fera	Food and Environment Research Agency (FERA Science Ltd from 2016)
GH	General Husbandry
HBP	Healthy Bees Plan
HEG	Husbandry and Education Group
IPI	Insect Pollinator Initiative
NAO	National Audit Office
NBU	National Bee Unit
NDB	National Diploma in Beekeeping
NERC	Natural Environment Research Council
NFU	National Farmers' Union
NNSS	Non-native Species Secretariat
NPS	National Pollinator Strategy
PRA	Pest Risk Assessment
RBI	Regional Bee Inspector
SBI	Seasonal Bee Inspector
SEAG	Science and Evidence Advisory Group
SHB	Small Hive Beetle
VMD	Veterinary Medicines Directorate
WBKA	Welsh Beekeepers' Association
WG	Welsh Government

Introduction – The Healthy Bees Plan, 2009

In 2009, the Department for Environment, Food and Rural Affairs (Defra) and the Welsh Government consulted on a proposed strategy to support beekeepers in the management of honey bee pests and diseases.

Clear messages emerged. These included the need for continued surveillance and education programmes for honey bee health, an expanded R&D programme, and clarification of the roles and responsibilities of both the government and beekeeping associations.

These messages were reinforced by findings of the National Audit Office (NAO) in their report *'the health of livestock and honeybees in England'* (2009). Limited collaboration was seen to exist between Defra and national beekeeping associations. The NAO endorsed greater expenditure by the government on its bee health programme, particularly towards increasing the registration of beekeepers and broadening the research funding base.

Defra, the Welsh Government and beekeepers agreed, in response, a decade long commitment to collaborate on measures to improve honey bee health. Key contributors were to be from government and national beekeeping associations, as well as beekeepers and delivery partners such as the National Farmers' Union (NFU).

The plan, entitled *Healthy Bees: Protecting and improving the health of honey bees in England and Wales,* was launched in March 2009.

Five outcomes, outlining what contributors set out to achieve through the Healthy Bees Plan, were identified. The outcomes, as worded in the original plan, were as follows:

1) Impacts of pests, diseases and other hazards are kept to the lowest levels achievable

2) Good standards of beekeeping and husbandry minimise pest and disease risks and contribute to sustaining healthy bee populations

3) Effective biosecurity minimises the risks from pests, diseases and undesirable species

4) Sound science and evidence base underpin bee health policy and its implementation

5) Effective communications and relationships operating at all levels

Purpose of the review

With the Healthy Bees Plan concluding in 2019, Defra and the Welsh Government initiated a review to consider the plan's contribution to protecting honey bee health in England and Wales. A series of chapters make up this review.

The chapters are written by contributors to the Healthy Bees Plan and are organised into *outcomes*. Each sets out an area of work, what was achieved, and the challenges faced. The lead author for each chapter was chosen based on their expertise in the field and affiliation with the work area covered.

Successes and areas for improvement are identified and reported. In identifying these, the review provides impetus for future discussions on how government, beekeepers and other stakeholders can best continue to support healthy and sustainable populations of honey bees in England and Wales.

Scope of the review

The results outlined in this review are those where contributors to the Healthy Bees Plan were either central to the work or at least partially involved, and the contributors carried out the work as a member of the Bee Health Advisory Forum (BHAF) under the auspices of the Healthy Bees Plan in England and Wales.

The results outlined are not always, and often cannot be, attributed solely to the Healthy Bees Plan; nationally and globally, the range of work undertaken to protect honey bees encompasses work by vast numbers of collaborators, and often using funds from various sources. It is only where the Healthy Bees Plan and its contributors can be said to have influenced the outcome of the work that we have included it in this review.

The review does not seek to consider the merits of statutory measures taken by the National Bee Unit. Nor does the review attempt to provide evidence for the importance of honey bees, or their importance relative to other pollinating insects.

Method

In line with the plan's emphasis on partnership working, the process of reviewing the Healthy Bees Plan was collaborative.

The evidence required to consider the impact of the Healthy Bees Plan was established by experts in honey bee health, including researchers, beekeepers and policy makers. Compiling, assessing and consolidating these requirements into a manageable set of

priorities took place during a government workshop and through discussions with beekeeping stakeholders at the BHAF.[1]

BHAF members were asked to contribute ideas, data and, in several cases, authorship of chapters within this report.

The emphasis in the report is on qualitative analysis, with consideration given by contributors regarding the impact of their work. Some quantitative analysis is provided where it is deemed to be robust enough to support sound conclusions. Where appropriate, the specific details of the data sources used are documented in each chapter. More detailed data and information that supports some of the conclusions – that isn't included in the following chapters – is included as appendices and, where indicated, on the National Bee Unit's database, BeeBase.

A project management approach was taken to carrying out the review, with a Project Manager and Project Board used to oversee progress. The Project Board comprised members of Defra, the Welsh Government and the Animal and Plant Health Agency (APHA).

Contributors to the Healthy Bees Plan, and to the writing of this review, are listed at the start of each chapter and in the acknowledgments section at the close of this report.

Strengths and limitations

The strength of the review is in the direct authorship of chapters by contributors, lending an authenticity to what is written. Consultation on the evidence requirements and the findings of this review with the BHAF, ensures the review encapsulates a broad range of beekeeping interests.

A limitation of the Healthy Bees Plan – and consequently this review – is the lack of agreed indicators used to measure the impact of Healthy Bees Plan activities. Indicators were drafted during the implementation phase of the Healthy Bees Plan in 2009, but consensus was never reached on what form these should take. It was agreed that determining the effect of activities on honey bee health can be confounded by multiple factors influencing honey bee health (e.g. weather, local disease incidence, husbandry practices, experience of beekeepers). This is a challenge for measuring policy options more generally.

Deliverables that can be measured have been included in the following pages. Whilst they are reported, the extent to which deliverables in themselves have contributed to improved

[1] The government workshop took place in February 2018 and included attendees from Defra, the Welsh Government, APHA and Fera Science Ltd. The BHAF were consulted on the draft prioritised evidence requirements at the 24th meeting of the BHAF on 19th June 2018.

honey bee health is conjecture. Only a tentative and partial description of the benefits is possible.

Summary of conclusions

The Healthy Bees Plan set out to achieve five outcomes that would help support beekeepers and improve the health of honey bees in England and Wales.

The following key conclusions are taken to exemplify the contribution of the Healthy Bees Plan as well as areas that can be taken forward for improvement. This is a precis of what follows in the Review itself.

To bring about low levels of pests and diseases

Operationally and in the field of beekeeping there have been several significant developments. The inspection programme run by the National Bee Unit continued apace during the Healthy Bees Plan, with additional emphasis on exotic threats to honey bees, bolstered by the sentinel apiary schemes. Contingency planning played an important role in building our capability and, vitally, keeping the Asian hornet at bay.

The number of veterinary medicines available to beekeepers significantly improved during the Healthy Bees Plan, increasing from four in 2009 to fifteen in 2019.

An area for improvement was identified in targeting NBU inspections. The NBU use a series of rules in BeeBase to help prioritise visits to apiaries that are at greater risk of disease. At the start of the review, the NBU used the same rules when prioritising visits to detect both American Foulbrood (AFB) and European Foulbrood (EFB). The work in Chapter 1.2 provided good evidence that the rules for prioritising visits to diseased apiaries should be different for AFB and EFB. This evidence will be taken forward to refine the inspection programme.

To promote good standards of husbandry

The role of beekeeper training became fundamental to the Healthy Bees Plan, providing beekeepers with knowledge to support their management of bee colonies and pests and diseases. Importantly, the role of 'training the trainers' became a key theme in how to cascade information from experienced and knowledgeable beekeepers to those newly taking up the practice.

By the end of the Healthy Bees Plan, the Bee Farmers' Association (BFA) had appointed thirty young apprentices to their Apprenticeship Scheme, delivering an increase in the number of bee farmers of almost 10%. Similarly, 7,672 people had passed the British Beekeepers Association's (BBKA) Basic Assessment in beekeeping, with a further 272 Basic Assessment passes reported by the Welsh Beekeepers Association (WBKA). Since 2011, the National Diploma in Beekeeping (NDB) had run short courses, providing more than 1,500 student places to more than 600 students. Importantly, 81% of the total NDB Short Course attendees identified as either currently being trainers or intending to become

trainers in future. An acknowledgement that courses are co-funded under the Healthy Bees Plan should be considered for the next plan.

To encourage effective biosecurity

Biosecurity was a primary focus of the training work carried out and funded under the Healthy Bees Plan. Chapter 1.2 identified that when American Foulbrood or European Foulbrood was detected in a beekeeper's apiary, the other apiaries owned by that beekeeper were at an increased risk of the same disease. This suggests that further improvement can be made and highlights the importance of between-apiary hygiene.

The Disease Assurance Scheme for Honeybees (DASH) became a valuable part of the inspections programme, valued by both bee farmers and the NBU for maintaining disease control whilst helping to manage the inspection burden on large commercial operations.

To ensure sound science supports bee health policy and its implementation

During the lifetime of the Healthy Bees Plan over twenty R&D projects were jointly commissioned by Defra and the Welsh Government. Since 2016, several research projects have been carried out covering different aspects of Asian hornet biology and its ability to spread. Evidence has been gathered from these projects which has helped to support the contingency response as well as provide information for long term management.

To work together to protect bee health

The Healthy Bees Plan provided direction and focus. It put in place a framework for future action, including roles and responsibilities and sought to drive up husbandry standards through education and training. It endorsed partnership working as a means of promoting beekeeper registration and broadening our understanding of apiary health across England and Wales. Collaboration was crucial to ensuring that current and evolving threats to bee health were effectively identified, assessed and acted upon.

Supporting and greatly enhancing the work of the inspectorate, BeeBase registrations increased from around 9,000 in 2009 to over 40,000 in 2019 thanks to the work of beekeeping associations and government in promoting the benefits of registration to honey bee health.

Using existing resources to support the range of beekeeping interests in England and Wales proved challenging. During the Healthy Bees Plan, partners suggested many different actions that could be taken to support bee health. Difficult decisions had to be made about which actions should be taken forward based on their likely impact.

Recommendations

Considering the conclusions from this review, the following recommendations can be made. These should be used to influence future policy and operations carried out by government and beekeeping associations in England and Wales:

- A few (less than five) indicators or measures of success should be developed to assess the impact of the next plan. The previous attempts to produce indicators suffered from trying to measure, and therefore mitigate, external effects on the outcomes. Indicators should focus on the outcomes and what we aim to achieve rather than capture all factors which influence the sustainability of beekeeping in England and Wales. Experience of other policy areas and lessons from our previous attempts should be used to shape the indicators.

- A clear conclusion of project 5.1 was the improved communications achieved through regular BHAF meetings and the partnership working in evidence across several areas. It is acknowledged that the bee health programme needs to offer support across the sector, which can be challenging due to the diverse nature of beekeeping interests in England and Wales. Partnership working will help to facilitate this and it is recommended that this continues to be central to the work of government and beekeeping associations. Quarterly Bee Health Advisory Forum meetings should continue.

- Increasing numbers of beekeepers registered on BeeBase is welcomed and ensures that beekeepers receive messages on local issues from experts at the National Bee Unit. However, it does mean that many more apiaries caught in existing risk rating profiles have stretched resources. Improvements were identified during the review process (see Chapter 1.2) making the profiles more sensitive and better able to target the highest risk apiaries. These adjustments should be implemented in the National Bee Unit's inspection programme.

- Findings of the workshop on science and research, carried out as part of this Review (see Chapter 4.1), should be used to establish what can be achieved by working together in this area and how the plan can add value from existing research programmes. This may include a focus on research at one BHAF meeting per year, specialist meetings, and a focus on how partners can cascade new evidence to beekeepers.

- The programme of training and education – a significant component of the outreach work carried out under the Healthy Bees Plan – should continue but be refined to fulfil the requirements of beekeepers and bee farmers.

- Young beekeepers interested in a career in bee farming should be supported through the Bee Farmers' Association Apprenticeship Scheme. Continuous professional development should be encouraged and supported in bee farmers of all ages to ensure a sustainable and profitable commercial sector.

- Social media – now a key tool used to promote messages by a variety of organisations – should be considered along with the more traditional communication tools as part of the discussions on future implementation plans. Some stakeholders commented that social media, which has already been used successfully in combating the Asian hornet, could be utilised more to promote future policies.

- The DASH Scheme should be maintained and refined as more experience is gained. Feedback from the NBU and bee farmers attests to its value in managing the inspection burden for large-scale beekeeping operations, without reducing the control of disease.

Next steps

This review has been instrumental in the development of a new plan, the Healthy Bees Plan 2030. We have drawn on the conclusions of this review when drafting the new plan and learnt from our experiences of each area, both from the successes where the benefits were clear and from areas that needed a change of approach.

The first Healthy Bees Plan took a more holistic approach to improving honey bee health by sharing different ideas and perspectives when working together. Healthy Bees Plan 2030 has similarly been developed with stakeholders, and stakeholders will play a key role in drawing up the implementation plan and agreeing indicators. The new plan will run for ten years but the implementation plan will be refreshed approximately every three years, which will allow our approaches and priorities to be evaluated. Focus should be directed to areas which have been successful and to those where we should do things differently.

The investment in beekeeper training has been welcomed by stakeholders. We have been able to offer a range of education for different abilities and in different formats. However, the demographics and needs of beekeepers have changed over the last ten years. There have also been developments in educational technology and availability of new teaching platforms. We will therefore reassess our educational offering to ensure that it meets the needs of our beekeepers.

The foundations we have laid for good communications and regular dialogue will be used to develop the next plan and will be extended to cover changes to bee health policy in other areas such as bee health regulation on domestic and international trade controls.

A review with members of the BHAF will also be considered to establish how working together could improve the use of evidence from research into honey bee health to improve husbandry practices, and whether forum discussions could help identify research priorities. The outcome will be fed into the implementation plan.

Working with beekeeping associations on the Asian hornet outbreaks has proved successful. We will continue to develop ways in which we can work together to respond to bee health emergencies.

Acknowledgments

We'd like to thank those members of the British Beekeepers Association, the Welsh Beekeepers' Association, the Bee Farmers' Association and the National Diploma in Beekeeping for their written contributions to this report, and to all members of the BHAF for their participation in workshops to develop the content.

The review

The following chapters outline the important contributions of the Healthy Bees Plan to honey bee health. The chapters are not exhaustive but provide an analysis of work undertaken during the last ten years, including where achievements were made and where areas for improvement have been identified. Chapters are aligned with *Outcomes,* as per the five outcomes identified in the original Healthy Bees Plan. Each chapter includes a short introductory paragraph written by Defra and the Welsh Government.

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Outcome 1 – Impacts from pests, diseases and other hazards are kept to the lowest levels achievable

As part of the Healthy Bees Plan Review, Defra commissioned two projects to consider ***'Outcome 1 – Impacts from pests, diseases and other hazards are kept to the lowest levels achievable.'***

The first of these projects, led by Julian Parker, head of the National Bee Unit, considered the role of the government's Disease Assurance Scheme for Honeybees, also known as the 'DASH' scheme. In particular, the extent to which it benefited bee farmers and contributed to honey bee health and the work of the inspectorate. A small survey was conducted to ascertain the perceived benefits and experiences gained by participants. Full results from the survey are available on BeeBase. The report in this chapter summarises the findings with recommendations for future scheme improvements.

The second project carried was out by Prof. Giles Budge, Dr Ellen Moss and Prof. Steve Rushton, researchers at Newcastle University. It used a model to monitor deployment of NBU resource, testing BeeBase disease rules and delivery of the National Bee Unit's inspection programme over time with simulated scenarios used against inspection outcomes to propose better targeting of inspector effort against disease risks. A summary of the findings, written by Prof. Giles Budge, and Julian Parker and Kate Wilson, both part of the National Bee Unit, is provided as part of this review.

1.1 – Disease Assurance Scheme for Honeybees (DASH)

Julian Parker, National Bee Unit, Animal & Plant Health Agency

Introduction

This chapter looks at whether and to what extent the introduction of the Disease Assurance Scheme for Honeybees (DASH) has benefitted bee health, beekeepers and the inspectorate in England and Wales.

The review concentrates on three areas:

- Operation of the DASH scheme
- Has DASH delivered its aims, which were:
    - To reduce costs associated with disease within commercial beekeeping operations
    - To improve bee health and disease prevalence
    - To reduce inspection burden and increase autonomy for participants
    - To be run effectively
- Consideration of where it may be improved or developed in the future

To gather evidence to assist with answering these review questions, an online survey was sent out to DASH members which ran for the month of June 2019. There were seventy DASH members at the time of the survey with the survey attracting a response rate of 48.5%, providing a good, representative sample of views. (Since June 2019 additional bee farmers have been accepted onto the scheme as discussed later). A copy of the ten survey questions asked and the analysis of responses along with respondents' comments may be found on BeeBase.

Operation of DASH

Principles

DASH is a joint initiative between the National Bee Unit (NBU) and The Bee Farmers' Association (BFA). The NBU is part of the Animal & Plant Health Agency (APHA) and is responsible for the implementation of the Statutory Bee Health Programme in England & Wales.

The aim of the scheme is, via earned recognition, to reduce the costs and inspection burden associated with statutory notifiable disease within commercial beekeeping operations and improve the health of honey bees within the operation. The scheme allows the DASH member to self-manage statutory notifiable disease without involving the bee inspector. The DASH member must, however, continue to notify, and this is achieved

through self-reporting of any incidents of notifiable disease to the NBU. Bee farmers must also provide reports when the apiary is found to be disease-free at subsequent follow-up inspections. This self-reporting means that the NBU is still recording and mapping disease outbreaks to inform wider inspection activities for disease surveillance.

DASH is recognised within the Defra Farming Regulation Task Force Implementation – Earned Recognition Plan August 2013. This plan set out actions being taken to reduce unnecessary regulatory compliance and enforcement burdens on farmers, through increasing data sharing, better co-ordination of on-farm inspections and implementing opportunities to allow farmers to earn recognition to reduce the burden of inspections.

The scheme is entirely voluntary, but actively promoted annually by the BFA.

In the context of this scheme, earned recognition is finding ways to reduce the administrative burden of regulation on those who have a strong track record of reliability and adherence to standards.

It does not necessarily mean a reduction in the total countrywide number of inspections, but rather an opportunity to better utilise available resources to target inspections on those operations where the risks of pests and disease are highest.

DASH seeks to promote and assess effective bee health management and good biosecurity through DASH training, accreditation and partnership working with the bee inspector during Baseline and Audit inspections.

Stages

The DASH scheme is only open to full active members of the BFA that are also registered on BeeBase. Bee farmers wishing to join the scheme make an application via the BFA. The scheme is free to join and there are no annual fees or charges.

Prequalification: Bee farmers that apply to join are sent a pre-qualification questionnaire designed to provide a degree of self-assessment and to establish that, as applicants, they meet the minimum criteria for entry (size of operation, knowledge, experience). This is a recent change and refinement to the scheme and will be discussed later.

Training and Assessment: Applicants that proceed through the pre-qualification stage are invited to an annual DASH training event, through which they are provided with an intensive bee health, biosecurity and disease management course. This course also covers the operation of the DASH scheme. On conclusion applicants must sit an assessment to establish their knowledge and competence to self-manage statutory bee diseases. Applicants must pass this “classroom” stage in order to progress.

Baseline Inspection: Applicants that have passed these stages will then be asked to submit to a full baseline inspection of their stock, in order to assess the current extent of disease within the bee farming operation and to identify any management actions that need to be adopted, such as enhanced barrier management or hygiene practices. During these visits, further advice and help will be given as required. Applicants will pass the

baseline inspection, provided that upon completion there are no findings of concern. A low level of isolated disease, particularly if there is a known outbreak in the area affecting other beekeepers, would not in itself result in a failed baseline inspection.

On passing the baseline inspection, the bee farmer would then be formally accepted onto the DASH scheme.

Audit: At no more than three-yearly intervals (sooner if concerns arise) the DASH member is subject to audit. For the audit, apiaries are chosen to achieve a sample size of 20% of colonies while also being representative of local disease risks. Where, however, this would equate to less than three apiaries (for smaller scale DASH members) then a three-apiary minimum will apply.

The local inspector will agree the day(s) for the audit in advance. The apiaries chosen to be audited are not decided upon until the morning of the visit, as an audit is only truly representative if it is an unannounced sample.

Beyond routine apiary inspection, the audit will also extend to apiary hygiene, biosecurity practices, self-inspection/reporting records and veterinary medicine records.

“Minor findings” requiring attention will be documented and managed with the issue of a minor improvement notice, with a subsequent follow-up to confirm that any matters have been rectified.

The follow-up of minor improvement notices may not require a further inspection visit, where for example, findings relate to documentation, and subsequent corrections or improvements may be evidenced through documents being emailed or posted to the NBU.

A low incidence of foulbrood found during an audit is not in itself something which would automatically trigger an improvement notice, provided this was not at abnormal levels and there was evidence of proper management and DASH protocols being followed.

Widespread findings of non-conformity requiring attention would be considered and documented as a “major finding” and in this instance the local inspector will refer findings to the Regional Bee Inspector (RBI) who will review and discuss with the bee farmer the improvements needed. Depending on the nature of a major finding this may result in the temporary suspension of DASH membership and resumption of normal risk-based inspections until improvements allow reinstatement. Findings resulting in a “major” improvement notice will require a further apiary inspection audit as part of the improvement notice follow-up.

Gross misuse of the assurance scheme or failure to address improvement notices may result in permanent removal from the scheme, as a last resort.

Progress and take-up

The scheme was launched in 2013, with the first applicants undertaking assessment. Baseline inspections for the first year’s applicants were undertaken during the 2014

season, resulting in twenty-three bee farmers being accepted onto the scheme following completion of their baseline inspections. Over subsequent years take-up has increased, illustrated in Figure 1 below, to a point where to date eighty-four bee farmers have been accepted onto the scheme since its inception. There are currently seventy-five active members once withdrawals and retirements are accounted for.

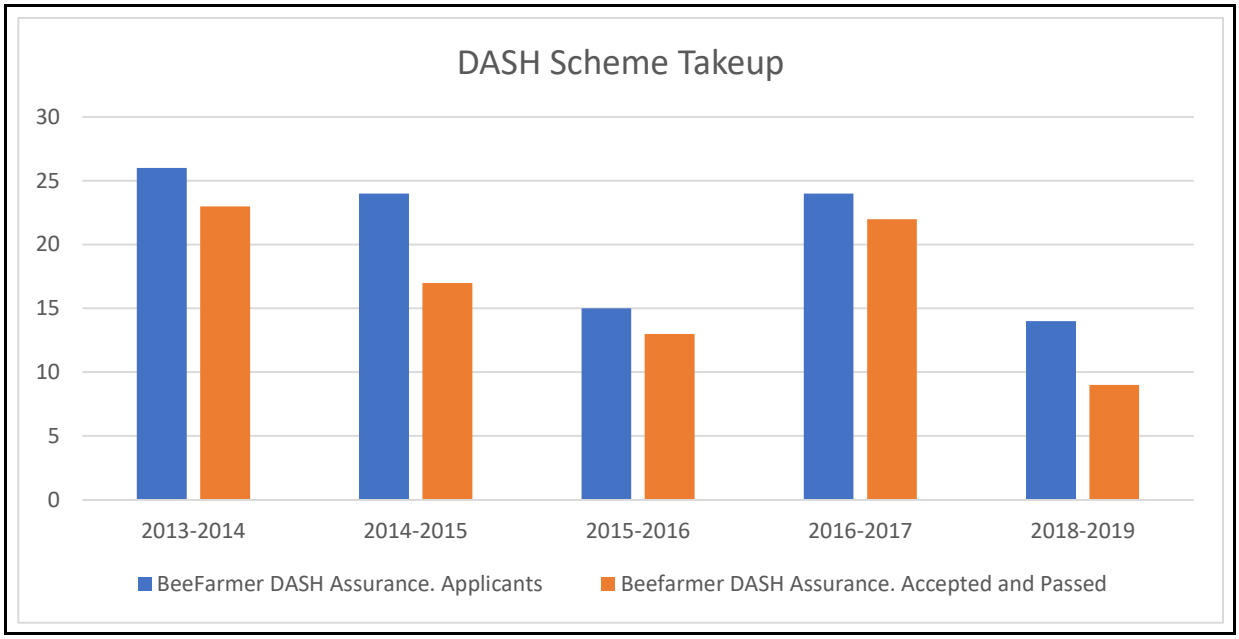


Figure 1

Each year, a few applicants either choose not to ultimately proceed, do not pass the training assessment or do not complete or pass the baseline inspection. This is reflected in the chart above.

Audit visits will normally take place within the year of the third anniversary of the baseline inspection. Consequently, there have so far been three rounds of audit inspections, from 2017-2019. Across the three years, while there have been instances of minor non-conformities, there have been no major findings of concern and therefore to date no bee farmers have failed an audit inspection.

When arranging audits, the NBU have in most years found that a few DASH bee farmers elect to withdraw from the scheme – an average of two per year currently. The reason for this seems to be changing circumstance with bee farmers downsizing, giving up beekeeping (often the smaller-scale early years entrants) or retiring. Figure 2 below summarises.

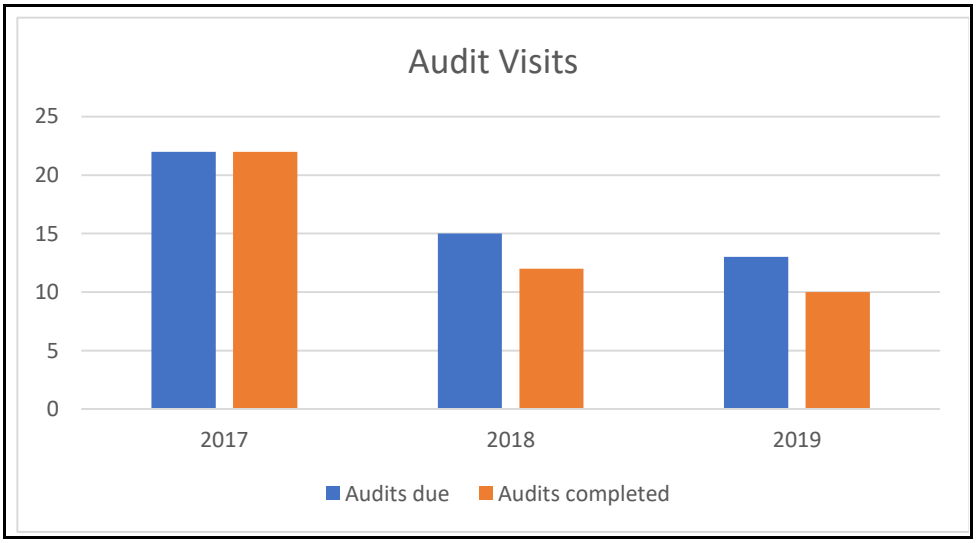


Figure 2

Has DASH delivered its aims?

The DASH survey of members contained targeted questions designed to provide evidence of DASH members' views of the scheme and how they perceived the scheme. This was felt to be the best available method to collect evidence on questions about aims, within the scope and limits of this review.

Reduced costs associated with disease within commercial beekeeping operations

Question 2 of the DASH members' survey asked bee farmers to rank the advantages that DASH potentially provides to them. The answers are presented in Figure 3 below, scored out of 5, with 5 being the highest score. This provides an indication of perceived benefits of the DASH scheme from a bee farmer perspective. All thirty-four respondents answered this question.

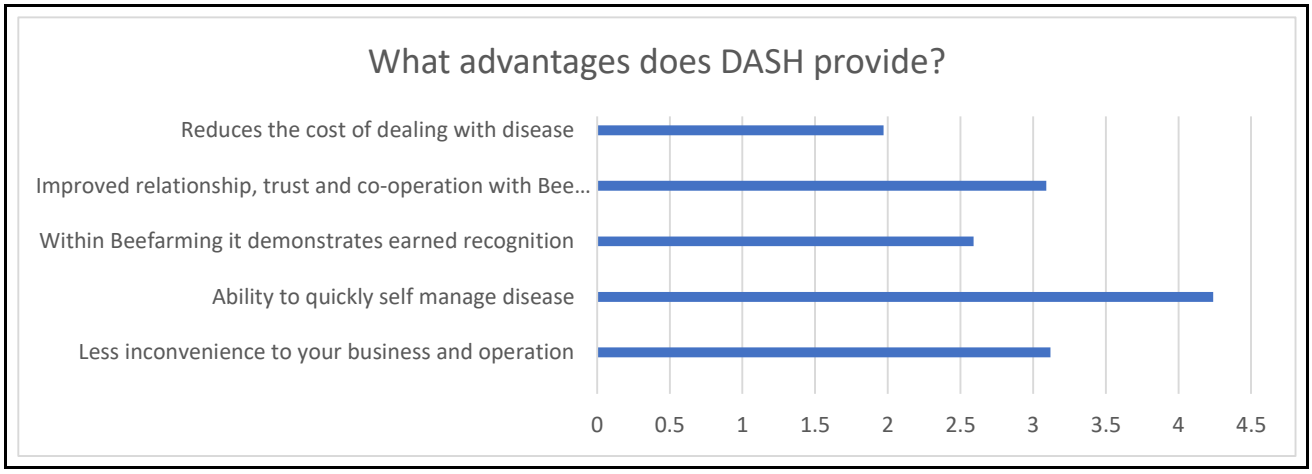


Figure 3

"Reduces the cost of dealing with disease" received the lowest ranking amongst the five statements.

It is arguable that, when reflecting upon this, bee farmers were thinking more about the cost of disease in terms of loss of stocks and production, rather than perhaps time-saving and associated efficiencies arising from the DASH scheme, which flow from self-treatment rather than involving an inspector. Given that *"ability to quickly self-manage disease"* was consistently ranked first and *"less inconvenience to your business and operation"* most often ranked second in the response to this question, it would suggest that the associated time savings and removal of the need to book appointments with inspectors is of most value for DASH members.

Improved bee health and disease prevalence

Training of DASH applicants and assessment is a core principle of the scheme, with applicants undertaking an assessed training course as part of the DASH entry process. This training is intended to establish a common level of bee disease knowledge, management, control, biosecurity practices and general apiary hygiene considerations. It is anticipated that taking this approach at DASH entry ensures that DASH members join the scheme equipped to properly identify and manage disease in their stocks and so contribute towards improved bee health and reduced disease prevalence.

The DASH members' survey investigated satisfaction levels with the DASH training. Figure 4 below summarises the responses. All thirty-four respondents answered this question and 94% of responses were either "very satisfied" or "satisfied".

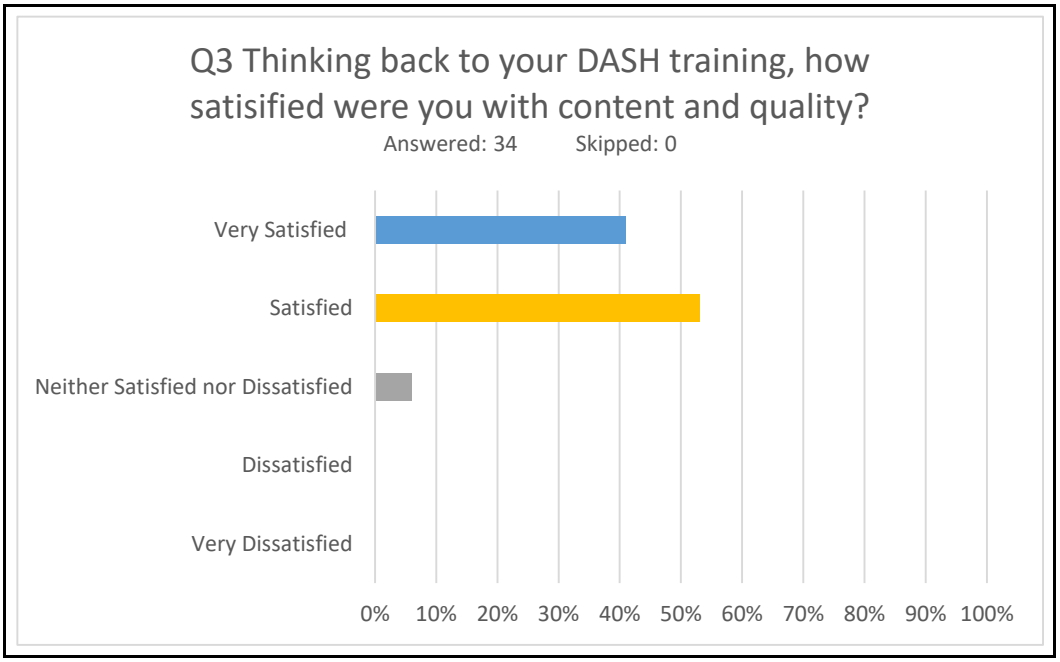


Figure 4

This provides evidence that DASH members' perception of the DASH training is that it is valued and meets or exceeds expectations, given the high satisfaction score. This question also invited respondents to comment upon the DASH training. There were sixteen comments, which generally reflected the positive satisfaction scores, examples such as:

- "It is very useful to actually see examples of disease and discuss with inspectors so we can be more sure of our disease inspections"

- "Good comprehensive training"

- "Very professional"

- "Had already had disease recognition training at the NBU as part of the NDB course and DASH training topped this up. Invaluable in picking up disease at the very early stage before it spreads to other colonies and apiaries."

Equally, there were comments which will be useful when considering future improvements and one theme that appeared several times was the potential to introduce refresher training:

- "I found the day interesting, but the real learning came when looking at the hives for issues. I think a follow up day hands on a year after having completed the online learning/refreshing and subject quiz's the previous day would help reinforce/imprint previous dash training."

- "Should we have refresher training at a set point, e.g. three years, five years, particularly for those members where no EFB/AFB is reported found?"

Other suggestions for future improvement include:

- "More in depth demonstration of shook swarm methods required."

- "Excellent opportunity to see at first hand diseased combs. But rather too many of us looking at them at the same time. Smaller groups would see more un-interferred with combs."

With three years of DASH audits now complete, audit findings show that disease control amongst DASH members is generally good. This suggests that DASH members are controlling disease conscientiously and where inspectors found disease at audit, it was isolated and there was no evidence suggesting that disease was not being managed. In a limited number of instances DASH members need to remember to report clear follow-up checks to close off self-reported disease, but otherwise the standard was found to be generally sound.

Reduced inspection burden and increased autonomy

As mentioned briefly earlier during discussion of Figure 3 from the DASH members' survey, "What advantages does DASH provide?", bee farmers highly value the "*ability to quickly self-manage disease"*, with this response being ranked first most often. This was followed by *"less inconvenience to your business and operation"*, as the next most valued advantage.

This provides evidence that DASH members attach a great deal of value to both autonomy and the reduced inconvenience to their business arising from a lighter touch regulatory compliance and enforcement burden, which is possible with an assurance scheme founded upon earned recognition. The strong favourable responses within the DASH members' survey provide a convincing argument that the DASH scheme is delivering on this objective, from the bee farmers' perspective.

From an inspection viewpoint, while the operation of the scheme inevitably carries a front-loaded overhead with training, baseline inspections and audit, over time a breakeven and eventually beyond this, a resource benefit is achieved. This flows from inspectors, on discovery of disease by the DASH member, no longer needing to manage the disease incident and further, no longer needing to check all of the DASH member's stocks, being otherwise considered contact colonies. These checks are instead carried out by the DASH member as part of their normal rotational checks of their stocks.

It is only now, as the DASH scheme is maturing, that we are beginning to see this resource breakeven being reached and thus potentially now beginning to reap a dividend, most particularly with the longer established DASH members with the most hives.

Has DASH been run effectively?

The survey directed questions towards how the scheme was operating.

Figure 3 explored how DASH members' views of the DASH training demonstrated a high level of satisfaction with the DASH training, that the training is popular and that several suggestions have supported extending this to refresher or follow-up training after a period of years within the DASH scheme.

Similar questions seeking views on the DASH Baseline inspections also showed high levels of satisfaction, with 91% either "very satisfied" or "satisfied". Once again, this question was answered by all respondents. Figure 5 below summarises the spread of responses.

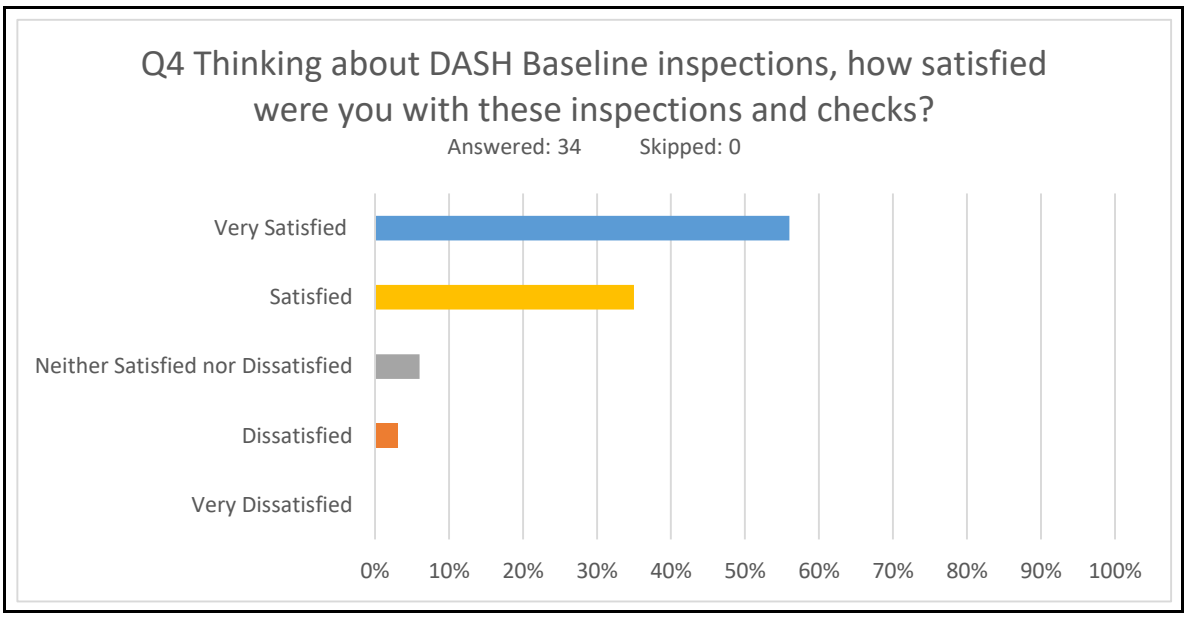


Figure 5

For this question respondents were also invited to leave comments. There were nine comments, which generally reflected the positive satisfaction scores, examples such as:

- "Thorough. Well organised"
- "Both bee inspectors did a great job in tough weather conditions"
- "I was very pleased with my local bee inspector who was very considerate to my needs as a commercial beekeeper. Although inspecting such a large number in main part of the season was inconvenient it was needed to create the baseline. And was worth it in regards to less visits in the future."

There is no doubt still scope for improvement with baselines, which are often challenging due to the need to complete them within one season, at a time that suits both the DASH applicant and the bee inspector. This is always a difficult balance and goes some way to explaining the 3% dissatisfaction (one respondent out of the thirty-four taking part in the survey) and the comment "it was done at an inconvenient time and took two seasons", clearly reflecting that we don't always get it right and even with the overall high satisfaction score against this question, we can always find ways to do things better.

Further questions within the survey explored DASH audits, where 88% of respondents found the frequency of audit (every three years) to be "about right" and 79% considered the number of colonies and apiaries audited to also be "about right". See Figures 6 and 7.

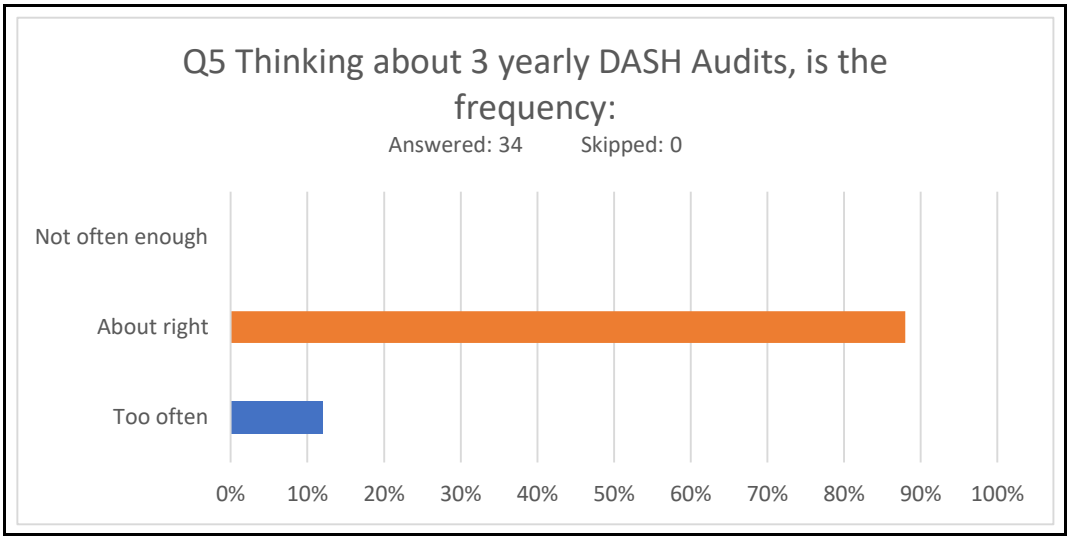


Figure 6

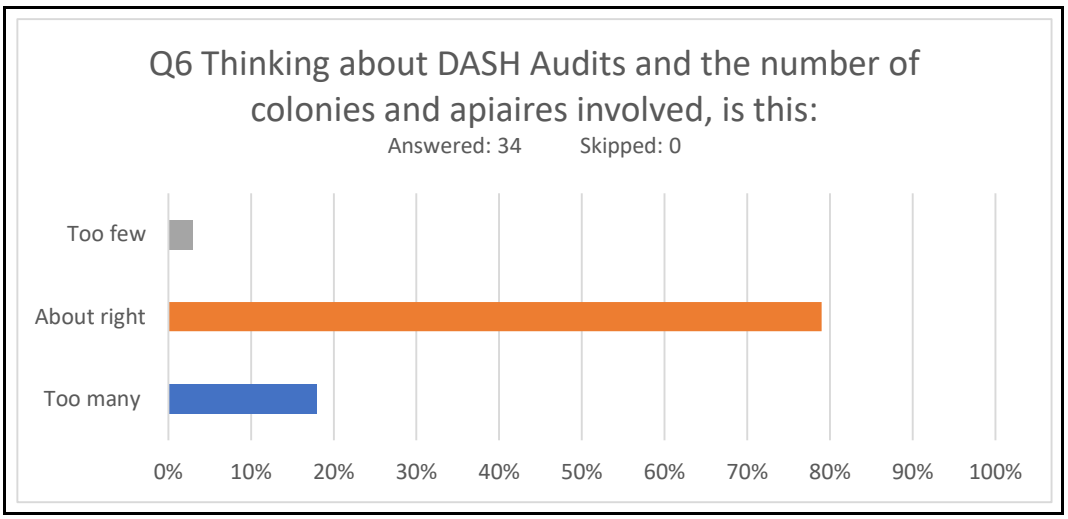


Figure 7

While the frequency and scope received broad support across these two questions, it is clear from some of the comments that the principles of audit within an assurance scheme context are not fully appreciated or understood by all members. We need to better communicate that:

- The principles of "assurance" rely upon audit and without proportionate testing an assurance scheme loses legitimacy.

- Advance notice of apiaries selected for audit is not possible until the morning of audit, as an audit is only truly representative if it is an unannounced sample.

We need to find ways to explain this better during DASH training, but despite this, satisfaction with audits was still notable, with 59% respondents either "very satisfied" or "satisfied" and the remaining respondents (41%) "neither satisfied" nor "dissatisfied".

One other important measure or indicator of how effectively the DASH scheme has been run is perhaps illustrated by the third most popular response to the DASH Advantages question: *"Improved relationship, trust and co-operation with Bee Inspectors"* demonstrates a further valuable outcome, further evidencing that the scheme is proving effective.

Consideration of where DASH may be improved or developed in the future

The DASH members' survey specifically targeted suggestions for improvement or future development both by seeking general comments and feedback against each themed question and also through two direct questions that asked:

- Looking to the future how could the DASH Scheme be improved?
    - twenty-two suggestions or comments were made

- Looking ahead to the next ten years, what can the Bee Unit and Bee Health Policy do to encourage bee farmers to join the DASH scheme?
    - twenty-six suggestions or comments were made

Some common themes from this questioning are worth noting:

- The potential to introduce refresher training or training focussed on particular issues, available once DASH members have been within the scheme for several years. Suggestions were made around either one or three years post joining. Some further thought needs to be given to a suitable timescale; however, the principle is worth exploring.

- The potential to move DASH audit further towards a risk-based approach to determine audit frequency, rather than a simple three-year cycle. This would be worth investigating further; however, we currently only have three years of audit evidence and so we are only now beginning to assemble an audit result profile that might be useable in the future to risk-rate bee farming operations.

- Improved BeeBase interface/screen for DASH members self-reporting

- Inclusion of self-reporting of bee and queen imports being received by DASH members. Currently, due to the elevated risk of Small Hive Beetle, inspection of imports is excluded from DASH self-reporting and still involves a bee inspector carrying out targeted checks.

- Incentives and free/subsidised varroa treatments are recurring themes from some quarters, but there is not really any direct link between varroa treatments and assurance schemes. Earned recognition and the reduced administrative burden of regulation that this confers should in itself be sufficient incentive to adopt DASH. Take up of the scheme suggests this is the case.

- The language and use of “earned recognition” to describe the process whereby a strong track record of reliability and adherence to standards leads to a reduced or “light touch” inspection approach to bee disease, is leading to confusion or the expectation that DASH is a marketing device much like a “Red Tractor” scheme. It is not. It is not about food or honey standards, but instead has more in common with, for example, HMRC’s Business Risk Review, which determines the level of scrutiny received by a business as determined by its compliance risk profile. DASH similarly offers lighter inspection burden for those bee farming businesses willing to demonstrate high levels of compliance, reliability and standards. We should therefore review the language used to describe the scheme to avoid possible confusion.

- Several comments observed that only “true” bee farmers should have access to the scheme. This comment refers to the view held by some parts of the bee farmers membership that members with relatively few colonies are not “true” bee farmers. What constitutes a bee farmer is not really within the scope of this review; however, we have over the last 18 months, or so, revised the application process as DASH was never intended to be open to smaller-scale beekeepers. A prequalification questionnaire was introduced for recent intakes in order to pre-screen applicants, not just for size and scale of operation, but also as a preliminary assessment of bee health, biosecurity and disease management knowledge. This was introduced in consultation with the Bee Farmers’ Association. Prior to this, inspectors were finding that the inspection burden falling on smaller bee farmers (typically forty to sixty colonies) was greater within the DASH scheme than would otherwise have been the case had they not joined, by virtue of the demands of baseline and audit inspections when set against their overall stock size and risk profile. This is, therefore, one improvement that had been commented on within the survey, but where changes have already been identified and made.

Concluding remarks

The DASH scheme is recognised as a popular and successful initiative arising from the Healthy Bees Plan.

Over the six years of its operation, there has been steady annual demand from new entrants and all major bee farmers that joined in the early years have continued to support the scheme. There is always scope for ongoing improvement and going forward suggestions and themes emerging from the survey will be reviewed and where practical adopted.

NBU inspectors asked to comment on the operation of DASH from their perspective shared a range of views that support the views of bee farmers and the findings from the survey. NBU inspectors provided feedback:

- “A good scheme.”

- “The importance of maintaining an ongoing relationship with DASH members to continue dialogue and liaison.”

- “Bee farmer record keeping could be improved when thinking about BeeBase records and veterinary medicine records in some instances.”

- “Little benefit for smaller bee farmers (less than 100 colonies) or bee farmers in low disease areas.”

- “Works well with large bee farmers and has saved valuable time for inspectors.”

- “Some element of refresher training for bee farmers at the audit point should be considered.”

- “DASH scheme is a win - win for both the bee farmer and the NBU.”

- “Initial inspections are time consuming requiring military planning, but this pays off in later years when inspectors are freed up.”

The DASH scheme is thought of positively by inspectors. Some suggestions from inspectors for improvement have already been implemented and others share common observations with bee farmers and will be looked at going forward.

Within the survey, bee farmers were asked:

“To what extent do you agree with the following statement*: I value the benefits that membership of the DASH scheme provides, when thinking about how I manage disease within my bee farming operation*. “

There was almost universal agreement with this statement by respondents with 91% either selecting “strongly agree” or “agree”. The remaining 9% mostly agreed. The results are presented in Figure 8 below.

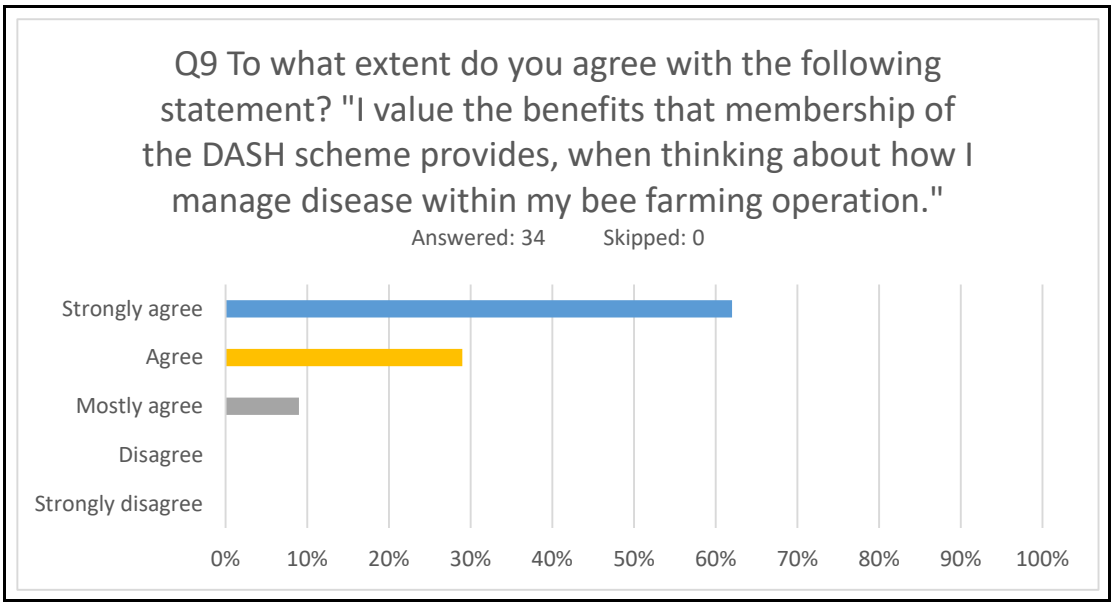


Figure 8

Amongst the comments left in response to this question were:

- "It has worked well for me because my inspector can see the efforts I have made and the results I have achieved in reducing incidents of infection in my livestock. When working together we are discussing all matters bee keeping related and therefore I see him as a go to area when any issue occurs that needs mentioning or possible assistance."

- "After an outbreak of EFB a few years ago I worked closely with my bee inspector and we eradicated it. By going on the course I was able to continue the work and be ready to identify and deal with any disease that might occur. With the convenience of being able to deal with it myself without burdening my local inspector checking and reinspecting large numbers of hives."

- "It has made us aware of the benefits of doing some inspections only to look for disease. Also given us confidence in our own abilities."

- "I am currently operating in an AFB area and the DASH has given me the confidence and tools to feel safe."

- "It has certainly made me more bio secure between sites and try to work towards having supers just for each site."

These comments go some way to providing evidence as to why the DASH scheme is valued and attracts high levels of satisfaction amongst members. Importantly, DASH has delivered on its aims, does have an ongoing role and there remains scope for further improvement in future years.

1.2 – Key findings from an assessment of National Bee Unit inspections

Giles Budge, Newcastle University,

Julian Parker and Kate Wilson, National Bee Unit, Animal & Plant Health Agency

As part of the Healthy Bees Plan review, work was commissioned to gather evidence to assess how the additional investment from the Healthy Bees Plan was used for apiary inspections by the National Bee Unit (NBU). This short report highlights some key findings of the work completed by Newcastle University. The full report by Newcastle University can be found on BeeBase.

Inspection effort

The number of apiaries registered on the NBU database known as BeeBase increased consistently during the Healthy Bees Plan from 25,195 in 2009 to 54,156 in 2017. This reflected improved partnership working between beekeeping associations and government, with more associations agreeing to share beekeeper information with the NBU, as well as the NBU investing in a BeeBase Coordinator to help increase awareness of beekeeper registration and improve data recording.

The Healthy Bees Plan represented significant new investment into NBU inspections which led to an increase in visits that focused on providing training to new beekeepers, controlling statutory notifiable brood disease, and monitoring for new incursions of pests and diseases from abroad, as well as commissioning a large-scale survey of bee health that visited 4,600 apiaries between 2009 and 2011. The number of apiary visits reflected this investment, with visits doubling between 2008 and 2009. However, following a policy review and consultation on bee health in 2012, which resulted in increased focus on surveillance of new incursions of pests and diseases from abroad, the numbers of apiary visits steadily declined. Three changes may account for this decline. Firstly, the focus on exotic pest inspections led to a growing proportion of inspections taking longer, as exotic pest inspections take far longer to complete than foulbrood inspections. Secondly, since the inspectorate became part of the NBU became part of APHA in 2014, there have been ongoing resource and recruitment challenges meaning that up to 20% of field inspectors have been absent for a significant period of most seasons. Thirdly, following the start of Asian Hornet incursions in 2016, fewer inspections have taken place in September (and more recently August) as inspectors have been called to Asian Hornet outbreaks.

The number of apiaries perceived as being at high risk of statutory notifiable disease or at risk of new incursions of pests and diseases from abroad also went up, as the number of at-risk sites increased. As such, a lower proportion of ‘high risk’ apiaries were visited as the Healthy Bees Plan progressed.

Inspection rules that focus on controlling brood disease

The NBU are responsible for the control of two notifiable bacterial brood diseases, American foulbrood (AFB) and European foulbrood (EFB). The NBU use a series of rules in BeeBase to help prioritise visits to apiaries that are at greater risk of having these diseases. Currently the NBU use the same rules when prioritising visits to detect both AFB and EFB. This work provided good evidence that the rules for prioritising visits to diseased apiaries should be different for AFB and EFB.

American foulbrood (AFB)

AFB control options have remained the same since the 1940s and involve burning diseased colonies and scorching/sterilising equipment. We assessed the effectiveness of the different rules that prioritise apiary visits for the discovery of AFB. The discovery of AFB within 3 km of another diseased apiary was the most important rule for highlighting AFB risk. When we varied the distance to disease from 500 m to 10 km, it was clear that AFB cases were not detected at distances greater than 5 km. Inspections above 5 km from known AFB cases are not likely to detect further cases of AFB. The second most important rule for detecting AFB was associated with apiary ownership. When a beekeeper had AFB in one apiary then the other apiaries owned by that beekeeper were at increased risk of disease, highlighting the importance of between-apiary hygiene. The final rule that proved important for identifying AFB cases was visits triggered by beekeepers themselves, suggesting the beekeepers were able to identify a problem with their bees. Interestingly, the proportion of beekeeper call-outs that identified AFB did not change during the Healthy Bees Plan.

Rules which looked at apiary and beekeeper disease history did not detect additional AFB cases, suggesting that the current disease control methods deal with disease in the same season as it is discovered, with minimum disease carryover between years.

European foulbrood (EFB)

EFB has three control options; diseased colonies can either be controlled using antibiotic treatment, using a husbandry-based method known as shook swarm, or can be destroyed as with AFB. The control choice has changed in recent years, with fewer antibiotic and shook swarm treatments. Instead, colony destruction has become the predominant method of control, which is in line with recommendations from a 2012 policy review and reflects a tightening of rules inspectors follow when determining treatment method. Antibiotic is now only used in exceptional circumstances.

We assessed which rules that prioritise apiary visits were the most effective for the discovery of EFB. Many rules contributed to the discovery of EFB. The most important considered proximity of an apiary to another apiary with EFB within the last 2 seasons. As with AFB, apiary ownership was also important. When a beekeeper had EFB in one apiary then the other apiaries owned by that beekeeper were at increased risk of disease, again highlighting the importance of between-apiary hygiene. Some EFB cases were identified by visits triggered by beekeepers, and as with AFB, the proportion of beekeeper call-outs

that identified EFB did not change during the Healthy Bees Plan. Interestingly EFB carryover between years decreased from 55% in 1996 to only 25% in 2017, suggesting improved control, but checking apiaries from previous years remains an important rule for identifying new cases of EFB. When we varied the distance to disease from 500 m to 10 km, it was clear that EFB cases continued to be discovered up to 10 km. This suggested EFB has larger clusters than AFB.

Inspection rules that monitor for new incursions of pests and diseases from abroad

Certain locations, such as honey bee importers, honey packers, ports and airports are considered higher risk from new incursions of honey bee pests and diseases coming in from abroad. Currently within BeeBase, all apiaries within 10 km of such a location are flagged as high risk and need to be visited by NBU inspectors every year. The existing protocol is not useful, because the estimate of apiaries that require visits in a year exceeds the potential that can be realistically achieved by a factor of five times.

We used published research to classify locations as high risk, medium risk or low risk and assessed whether visits to the nearest apiaries for each site was a more efficient method for detecting apiaries with disease than the existing method. The new 'nearest neighbour' method was more effective than the existing protocol.

Future implications of the work

The above work has led to the design of a new set of BeeBase rules for implementation from April 2020, which increase the effectiveness of disease detection for both American and European foulbrood, as well as improving the coverage of visits to locations with increased risk of new threats from abroad. Newcastle University created a tool that allowed the NBU, with Defra, to explore various inspection rules, and see the outcome(s) for the control of pests, diseases and threats from abroad. This tool was used to help the NBU assess the effects of implementing the suggested changes flowing from the findings by Newcastle University. The project team will continue to work with the NBU to help implement these findings.

Outcome 2 – Good standards of beekeeping and husbandry minimise pests and disease risks and contribute to sustaining healthy bee populations

*To consider **'Outcome 2 – Good standards of beekeeping and husbandry minimise pests and disease risks and contribute to sustaining honey bee populations – prevention is better than cure'**, Defra commissioned two projects, the first to collate results from the annual husbandry survey carried out by Fera/Fera Science Ltd[2] and the NBU, and the second to consider the work of the Veterinary Medicines Directorate (VMD) under the Healthy Bees Plan.*

As authors of the chapter on veterinary medicines, Anna Burrows, Miles Munro and Tahira Kauser (VMD) sought to consider the impact of the partnership approach between the VMD and beekeeping associations, advocated by the Healthy Bees Plan, and whether this approach had encouraged the development, marketing and uptake of new bee medicines.

Fera Science Ltd, the data-processor for the annual husbandry survey, were tasked with collating and combining the results from each year's survey into one report. This report is included at Annex 2. A short outline of the survey is provided here, written by Defra's Bee Health Policy Team. This introduces the survey and acknowledges the limitations of the dataset which should be understood and acknowledged by researchers when considering its use for further study.

[2] See Appendix 1 for details of the changes to the Food and Environment Research Agency (FERA) during the life of the Healthy Bees Plan.

2.1 – Husbandry survey

Louise Mount, Bee Health Policy, Defra

Background

Since the start of the Healthy Bees Plan, Fera/Fera Science Ltd have conducted an annual survey of beekeepers. The survey has been sent to around 6,000 beekeepers in England Wales each year that are registered on BeeBase. The selection of beekeepers was made at random but did include a percentage of keepers that managed a larger number of hives relative to the UK average. The number of responses per year is provided in Table 1 of the results in Appendix 2.

The information gathered during the survey has been used in a number of ways, including informing COLOSS returns and in supplementing the information we used to support the UK's participation in the EU Apiculture Programme. Over time, the number and format of the questions in the survey changed to reflect the various information requirements.

Interpretation

It is not possible to assess how changes to the order, the wording or the insertion of additional questions may have impacted the responses provided.

Whilst the selection of beekeepers receiving the survey was randomised, there was an element of self-selection as beekeepers could choose whether they wished to respond to the survey or not. It is possible that those who chose to respond might as a group have had different views and approaches to those who chose not to respond. Indeed, when we analysed the data, we found different responses to questions for those responding by email and post. The responses are also subject to variation due to beekeepers' interpretation or perception. For example, the number of beekeepers recording that they have purchased a queen from an EU breeder has fallen over the course of the plan but BeeBase data indicates the number of imports has increased over the same period.

As a result, the information obtained should be seen as a snapshot of each individual year, rather than a cohesive dataset which indicates how practices have or have not changed over the ten years of the plan.

Only some of the questions were asked every year so the absence of data should not be interpreted as a dramatic change in beekeeping practices.

Although the survey results cannot be used to indicate trends or developments in beekeeping over the course of the plan, it does remain a valuable dataset that provides a series of pictures of the beekeeping sector over the ten years of the plan. The responses

for each question by year are provided in Appendix 2. Defra is committed to open data and the anonymised survey results may be useful information for researchers to draw on.

Next steps

The review has highlighted the importance of gaining expert advice before setting up a survey, which includes defining the information needed so that the questions can be framed correctly using the same wording every year. The questions asked should also be statistically robust, permitting the monitoring of changes in survey responses over time. With the original Healthy Bees Plan now complete, a new survey is likely to take shape, one that builds on the lessons learned from the husbandry survey.

2.2 – Availability of veterinary medicines

Myles Munro, Anna Burrows, Tahira Kauser, Legislation Team, Veterinary Medicines Directorate (VMD)

Introduction

A lack of available veterinary medicines for the treatment of disease can result in compromised animal welfare and have indirect impacts on rural industries and food safety. This is particularly common for minor species, such as bees. The market for veterinary medicines to treat honey bees is small and at the start of the Healthy Bees Plan this deterred many pharmaceutical companies from developing new medicines.

Prior to the introduction of the Healthy Bees Plan in 2009, only four authorised bee medicines were available on the UK market.

In response to this lack of treatments, the Veterinary Medicines Directorate (VMD) worked with interested parties to develop a 13-point action plan. The plan was initially developed by writing to the British Beekeepers Association (BBKA) asking how vets could help them. Following consultation with manufacturers, beekeepers and National Bee Unit (NBU) bee inspectors, the VMD identified short, medium and long-term measures that included:

- A pragmatic approach to regulating bee medicines, to balance consumer safety and bee health
- Exploring ways of making products authorised in other countries available in the UK
- Proposing a change to the EU Directive to allow nationally qualified bee experts (SQPs) to prescribe for bees
- Introducing reduced fees for applications for medicines for minor species including bees
- Compiling a list of vets with knowledge of apiculture who are willing to help beekeepers
- Initiating a compilation of products for bees authorised across the EU
- Encouraging companies to submit Mutual Recognition applications
- Encouraging companies to submit new applications for products under the minor species scheme
- Waived fees for applications for veterinary field trials

Since the Healthy Bees Plan was published in March 2009, the number of medicines authorised for bees has increased from four to fifteen. A full list of all authorised bee medicines can found on GOV.UK: https://www.vmd.defra.gov.uk/ProductInformationDatabase/.

Cascade

At the start of the Healthy Bees Plan, three of the four available medicines were authorised to treat Varroa. With Varroa showing increasing resistance to the medicines, some beekeepers resorted to using unauthorised treatments.

The aim of using the prescribing cascade was to improve the range of bee medicines available to beekeepers. It is still in use today.

If there is no suitable UK authorised medicine available to treat a bee disease, vets can apply to import a bee medicine authorised in another EU country under the Special Import Scheme. The VMD worked with the Commission and other Member States to compile a list of bee medicines which are available in other Member States.

Under this system, once a beekeeper identifies a problem with their hives, they consult their vet or provide their vet with an assessment of the situation in the hive. The beekeeper and vet decide on a course of action. The vet then applies for a Special Import Certificate (SIC) on behalf of the beekeeper and instructs the beekeeper on the correct use of the product highlighting any particular safety issues.

Recognising that most beekeepers did not have a vet, the VMD compiled a list of vets with knowledge of apiculture who were willing to help beekeepers.

If a beekeeper does not have a vet, they initially consult with qualified beekeepers or bee inspectors, who could indicate if there was a need for an imported product rather than a UK product. The beekeeper contacts a beekeeping organisation or the VMD to ask for a vet in the area that could help.

Further guidance on this system can be found on the bee medicines page on GOV.UK. Within the guidance is advice for vets and beekeepers to help them legally import bee medicines when a UK authorised product is not suitable.

Stakeholder engagement

The VMD's aims in communicating and engaging with stakeholders were to:

- raise awareness about the activities and services we deliver as a public organisation to assure the safety, quality and efficacy of veterinary medicines
- educate and inform our stakeholders about key issues on the regulation of veterinary medicines, including encouraging changes in behaviour and practice

- involve stakeholders in developing and improving our work and the services we provide

The VMD provided a series of articles about veterinary medicines for BBKA News. The first article was published in the April 2010 issue and explained legislation for veterinary medicines. Two other articles to explain the authorisation of bee medicines and the prescribing cascade and importation of veterinary medicines into the UK have also appeared in BBKA News.

The VMD gave a joint presentation at the European Medicines Agency's (EMA) workshop *Medicines for bees – What the agency can do to increase availability,* with the Food and Environment Research Agency (Fera), then a government department[3]. VMD officials visited a bee farm on the 7th June 2010 to improve their knowledge of the challenges facing beekeepers in the UK.

The VMD now attends events such as the Honey Show, to make sure that stakeholders are kept up to date on the medicines available for bees and other related issues.

The VMD holds a liaison meeting with key stakeholders (including the BBKA and the Bee Farmers' Association (BFA)) and representatives from relevant departments in Defra and Devolved Administrations. This meeting is open to all interested parties. The VMD also attends the quarterly Bee Health Advisory Forum (BHAF), run by Defra.

Further information on bee medicines is published by the VMD on GOV.UK – https://www.gov.uk/guidance/bee-medicines-availability-in-the-uk.

Bee medicine record card for use by beekeepers

As part of the Healthy Bees Plan's Communications Working Group, the VMD worked with Fera and BBKA to develop a bee medicines campaign including developing a medicine record card for beekeepers.

As bees are considered to be food-producing species, beekeepers must keep records of all medicines given to their bees. The medicines record was launched in July 2012 by BBKA, can be found on the veterinary medicines page on BeeBase and helps beekeepers keep the required records.

The card includes the name of the product, the batch number, the date they bought it, how much they bought and who from.

Beekeepers must then record the date they administered the medicine to the bees, how much of the medicine they administered, the hive identifier and the withdrawal period.

[3] See Appendix 1 for details of the changes to the Food and Environment Research Agency (FERA) during the life of the Healthy Bees Plan.

When disposing of unused medicine beekeepers must record the date of disposal, how much of the medicine they disposed of and where it was disposed.

These records must be kept for five years after the medicine is given to the bees, even if the beekeeper no longer has the bees in their possession. All records must be durable, permanent and made available for inspection on request by a duly authorised person.

This card has contributed to the Healthy Bees Plan outcome of improving husbandry.

Residues in honey

Monitoring of residues of veterinary medicines in honey is an important part of the Healthy Bees Plan (Outcome 2: Good standards of beekeeping and husbandry minimise pests and disease risks and contribute to sustaining honey bee populations – prevention is better than cure). The UK operates a National Surveillance Scheme which monitors residues of veterinary medicines in food-producing animals. The primary purpose of the scheme is to safeguard human and animal health by ensuring harmful substances do not enter the food chain.

The cost of the (honey) residues surveillance programme is approximately around £35k per annum and is funded by Defra. The number of samples required to be taken by the UK is underpinned by European Regulation 96/23.

Samples are taken by the NBU and then submitted to Fera Science Ltd for analysis. Positive samples (above the permitted Maximum Residue Level (MRL)) are then investigated by the Animal & Plant Health Agency (APHA) with follow-up action taken if necessary.

Over the last ten years the VMD has commissioned two bee related research projects on residue limits in honey:

VM02156 September 2007 to March 2010 *'Investigation into the experimental protocols required to determine Maximum Residue Limits (MRLs) in honey: Preliminary study using organic acids as model compounds to propose ways in which withdrawal times might be calculated'*. This project used organic acids as model compounds to establish which external factors have an effect on the depletion of residues in honey.

VM0504 September 2011 to March 2015 *'Development of protocols for the establishment of MRLs in honey'.* The purpose of this study was to build upon the initial findings of VM02156 and to establish a robust protocol for the determination of MRLs in honey. The outcome of project VM02156 recommended that ciprofloxacin was to be used as a model compound for any future study on establishing a protocol for MRL in honey.

Research is important to ensure the continued availability of safe and effective veterinary medicines to protect animal welfare and ensure sustainable food production.

Further information on these projects, and a further two bee related research projects, can be found online at http://randd.defra.gov.uk/.

Outcome 3 – Effective biosecurity minimises the risks from pests, diseases and undesirable species

Defra commissioned one project to consider developments in contingency planning during the Healthy Bees Plan. This was to support the review of ***'Outcome 3 – Effective biosecurity minimises the risks from pests, diseases and undesirable species.'***

The following chapter is written jointly by Julian Parker, head of the National Bee Unit, Nigel Semmence, Contingency Planning and Science Officer within the National Bee Unit, and Belinda Phillipson, Louise Mount, Kevin Beattie and Frank Petherbridge of Defra's Bee Health Policy Team, and Kathleen Carroll of the Welsh Government. The chapter details government bee health contingency planning during the Healthy Bees Plan, placing it in the context of early 'Response Plans', risk assessments and horizon scanning. Capability building is also considered as well as surveillance operations and the important role of beekeepers in monitoring for pests and diseases.

3.1 – Contingency response – Asian hornet

Julian Parker and Nigel Semmence, National Bee Unit, APHA

Belinda Phillipson, Louise Mount, Frank Petherbridge, Kevin Beattie, Bee Health Policy, Defra

Kathleen Carroll, Welsh Government

Introduction

This chapter looks at how Defra, the Welsh Government and APHA's contingency response for exotic pests has developed across the life of the Healthy Bees Plan, and how the changes introduced have sought to counter the increased risk from exotic pests over the last decade.

Exotic pests and diseases are those considered absent from the UK. Outbreaks of *invasive*, exotic pests and diseases can constitute a serious hazard to the UK environment and its biodiversity.

This review concentrates on four key areas:

- What contingency response provisions existed at the start of the Healthy Bees Plan?
- How has capability improved over the lifetime of the plan?
- What has the influence been of the Asian hornet establishing within mainland Europe?
- What has the influence been of the Small hive beetle establishing within southern Italy?

Pest-specific contingency plans in England and Wales were drafted during the Healthy Bees Plan in line with government principles on handling animal pest and disease outbreaks. The plans set out government strategy and identified the actions to be taken by Defra, the Welsh Government, operational teams and stakeholders, in response to a suspected or confirmed outbreak of an exotic bee pest: specifically, the Small hive beetle (SHB) and *Tropilaelaps* mite. An initial response plan for Asian hornet was also developed and later this was converted into the same format as the Small hive beetle contingency plan.

These contingency plans, and the operational activities they cover, were updated regularly and contributed towards delivery of outcomes 1 and 3 of the Healthy Bees Plan.

> Outcome 1: Impacts from pests, diseases and other hazards are kept to the lowest levels achievable

Outcome 3: Effective biosecurity at all levels minimises risks from pests, diseases and undesirable species

Context – the contingency response pre-2009

At the start of the Healthy Bees Plan the 'response plan' was a template for reacting to incursions of any exotic honey bee pest or disease that might be discovered in England and Wales. Particular attention was given to the notifiable pests, the Small hive beetle and *Tropilaelaps* mite.

The plan recognised that globalisation, trade and the movement of honey bees around the world had increased the risks to bee health. Pathways were present for major pest and disease threats of the European honey bee to reach Europe and the UK, potentially resulting in environmental and economic damage to apiculture and a reduction in pollination services. Imports of live honey bees were considered the greatest risk for introducing new invasive species or pathogens.

At this time, the response plans had no dedicated contingency resource, but instead a Regional Bee Inspector (RBI) within the National Bee Unit (NBU) was delegated with lead responsibility for exotic pest surveillance and contingency planning. There were plans to introduce Sentinel Apiaries, but these had not yet been set up, and only approximately 5% of inspections were for exotic pests.

Contingency exercises were held annually, typically shared between two regional teams. However, whilst fieldwork was practised, no command structures were set up, and no laboratory testing of diagnostic capability took place.

Improvements in capability over the lifetime of the Healthy Bees Plan

This formative capability building nevertheless provided an important foundation upon which the government carried out vital contingency planning over the course of the Healthy Bees Plan.

Pest Risk Assessments (PRAs) and Sentinel Apiaries

In 2010, Small hive beetle and *Tropilaelaps* Pest Risk Assessments (PRA) were completed, detailing the latest understanding in risk pathways, impacts, and the likelihood of pest establishment and spread in the UK. A total of eight pathways were identified in the PRA for Small hive beetle, with illegal imports of bees from countries where Small hive beetle is present being the highest risk. In the event of entry to the UK, the PRA indicated that Small hive beetle is likely to establish, with a high potential for spread from the site of any primary incursion. The PRA for *Tropilaelaps* mite indicated that the most likely pathway for entry is through imports of entire or nucleus colonies of honey bees. The analysis from both PRAs indicated that the UK had a suitable climate for the mites to establish.

Since completion, these PRAs have influenced government policy-making and NBU operations including consideration of control options, the targeting of inspections and risk

points, as well as government communications to beekeepers on risk mitigation and good husbandry.

One of the first actions under the Healthy Bees Plan was a survey of honey bee pests and diseases undertaken by the NBU, commissioned by Defra and the Welsh Government. The NBU carried out the survey between 2009 and 2011, visiting and taking samples from 5,000 apiaries selected at random from BeeBase. The results were used to inform the Defra and Welsh Government policy review published in 2013. This review led to Exotic Pest Survey (EPS) surveillance targets being increased on an annual basis during the remainder of the Health Bees Plan, rising from approximately 500 apiaries inspected in 2009 (5% of all apiary inspections) to 3,000 apiaries (45% of all apiary inspections) by the end of the plan period in 2019.

Similarly, BeeBase exotic pest risk points were expanded, responding to improved knowledge of Small hive beetle and Asian hornet, reflecting a better understanding of likely risk pathways for these pests.

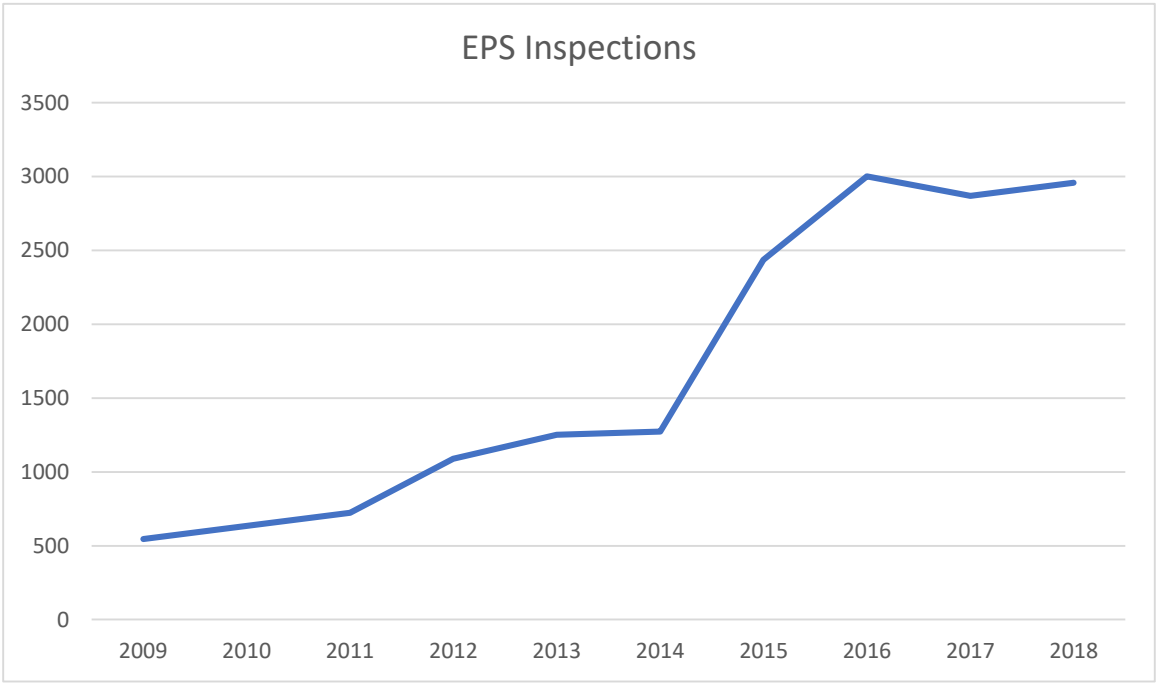


Figure 1: Exotic Inspections during the Healthy Bees Plan

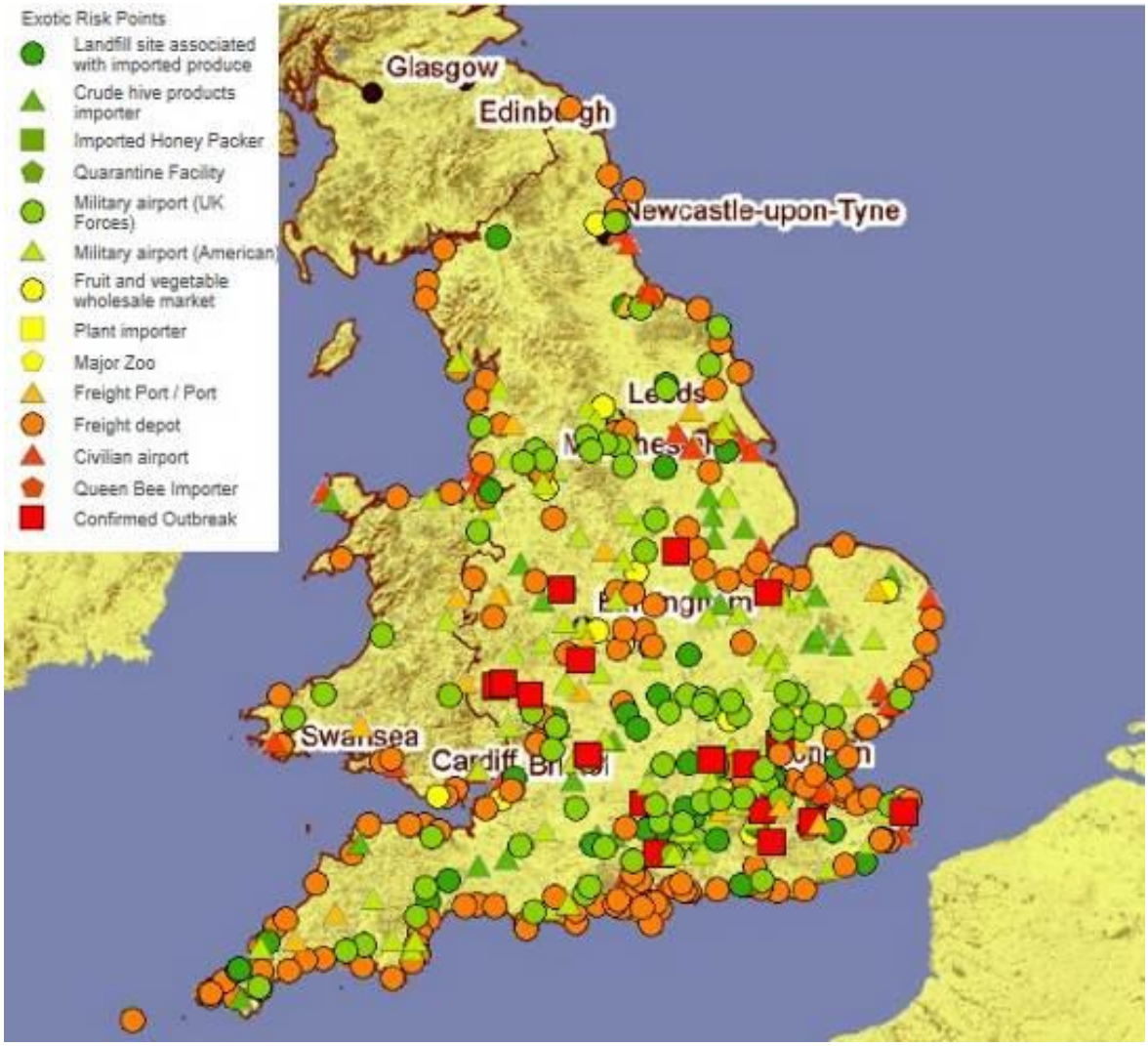


Figure 2: Exotic Pest Risk Points (at the time of writing)

The planned (voluntary) Sentinel Apiary programme was established in 2010 to provide a network of surveillance apiaries with beekeepers submitting hive debris samples several times a year for exotic pest screening. These apiaries remain in place today close to exotic risk points with each region having approximately fifteen voluntary sentinel apiaries.

Enhanced Sentinel Apiaries were also established in 2016, following the results of modelling carried out by a research team at Warwick University and the NBU. BeeBase risk point ratings for exotic pest risks were revised and, in addition to the voluntary Sentinel Apiary programme, an Enhanced Sentinel Apiary programme was established whereby two apiaries were selected as close as possible to each permanent high-risk point. The selected apiaries were visited by inspectors three times a season. A full EPS inspection was carried out and floor/debris scrapings collected for exotic pest screenings.

Risk points were reassessed to respond to potential new pathways identified during risk assessments. These risk points, such as major ports and airports, hive product importers and freight depots, were added to BeeBase to direct the work of the bee inspectors. They have also been reconsidered as part of the findings of this review.

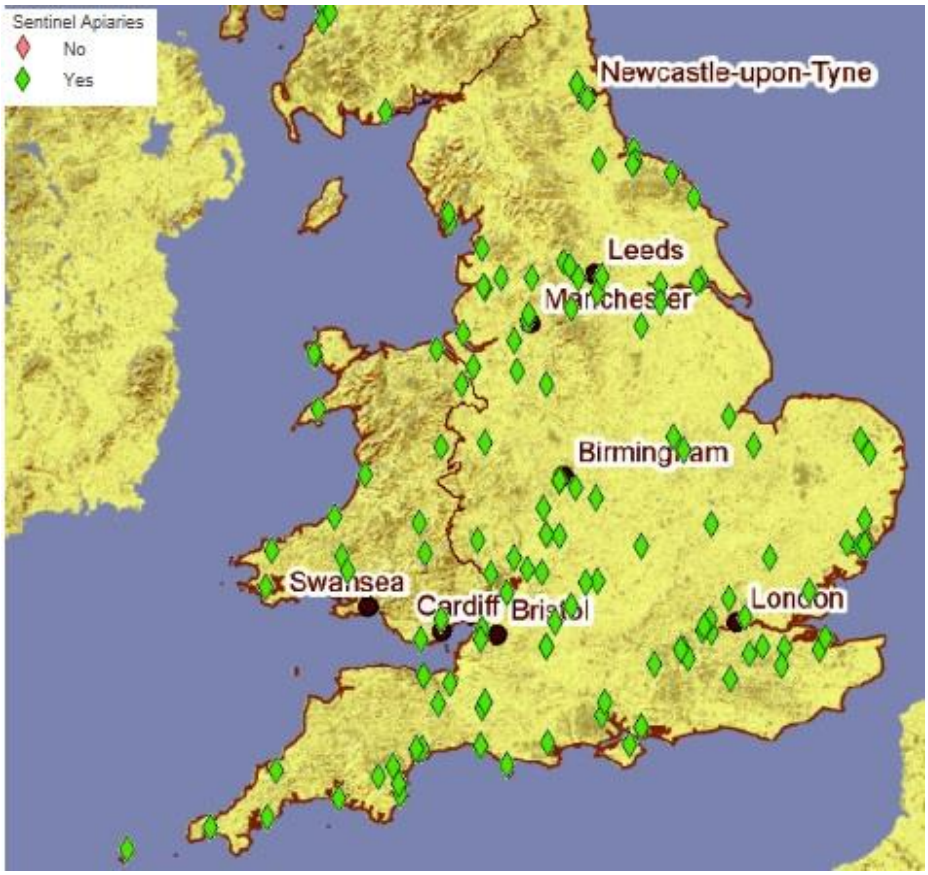


Figure 3: Sentinel Apiaries

Contingency planning and exercises

Over the ten years of the Healthy Bees Plan the contingency response to exotic pests was refined and developed, and today is far more sophisticated than it was prior to 2009. A Pest-Specific Contingency Plan covering the Small hive beetle and *Tropilaelaps* was published during the HBP period, setting out the procedures for dealing with an outbreak, from management structure to roles and responsibilities. Detailed instructions for field staff were laid down in Standard Operating Procedures (SOPs). During the course of the Healthy Bees Plan the risk from Asian hornet increased. As the Asian hornet likes to prey on honey bees it was agreed that action in the field would be led by the NBU. Therefore, in 2017 the initial response plan was replaced by a pest-specific contingency plan similarly detailing the actions to be taken during an outbreak, as well as management structure and roles and responsibilities.

Prior to 2014 responsibility for contingency planning and responses was assigned to a Regional Bee Inspector. In 2014, responsibility for contingency planning was brought together with the NBU's Science Co-ordinator post to create a new role of Contingency Planning and Science Officer. This enabled the NBU to dedicate more time to contingency planning, helping with the development of the new plans and allowing inspectors to test the plans in more complex scenarios. For example, contingency plan exercises became more sophisticated, ultimately featuring multi-site incidents and the rehearsal of full command and control arrangements. These exercises were practised annually, in different

regions, selected at random. More recent exercises were unannounced to expose teams to the experiences of reacting to unplanned incidents. In addition, in recent years exercises commenced with the unannounced submission of an exotic pest sample debris to test laboratory screening effectiveness. Lessons learned exercises were carried out after all exercises to further improve and develop the response plans. Dealing with Asian hornet outbreaks also gave the NBU experience in how to adapt their approach to new situations and information; for example, the use of contingency boxes helped to improve the speed and efficiency of establishing a Forward Operating Base (FOB) for a local field response. The annual technical training was used as an opportunity to update all inspectors on the latest developments and lessons learned from previous outbreaks.

Since joining the Animal and Plant Health Agency in 2014, the NBU have had access to specialist contingency teams and local resilience forums, as well as experts in the Wildlife Team and GB Non-Native Species Secretariat (NNSS). This has had a number of benefits including drawing on the Agency's contingency planning experience and contacts to quickly establish Forward Operating Bases in outbreak areas. The use of mapping and modelling developed over the course of the plan provided valuable materials for field operations. The NBU also maintained contact with agencies and people in countries where the exotic pests became endemic and regularly reviewed the latest evidence from research findings to ensure that the contingency plans were based on up to date information. More recently, the NBU's training has focussed on improving beekeepers' ability to identify exotic pests of bees.

Influence of the Asian hornet establishing in mainland Europe and subsequent incursions into the UK

Vespa velutina, also known as the Asian hornet, is an invasive non-native species from Asia. Following its arrival in Europe in 2004 the Asian hornet spread rapidly outward from the Bordeaux region of France where it is thought to have arrived in a consignment of pottery. By 2010/11 the hornet had reached as far north as the northeast coast of France, the Belgium border and into northern Spain. By 2012 it had reached northern Italy, Germany by 2015 and then Alderney and Jersey in 2016. In September 2016 the Asian hornet was confirmed for the first time in the UK in Tetbury, England. The operational and tactical operations that followed formed the NBU's first Asian Hornet outbreak response. Since 2016 there have been annual incursions of small numbers of Asian hornets into the UK.

Inevitably, dealing with these incidents enhanced the contingency response. The protocols used for finding nests improved, reducing the time and resource required. The first nest in Tetbury took eight days to find and up to twenty-one field staff, while in 2019 it took around two to three days to find a nest with six to seven inspectors. This improvement was made possible by NBU inspectors drawing on observations in the field about the behaviours and preferences of Asian hornets as well as the experience that the inspectors gained. A reduction in the required resource also meant that the inspectorate had the capacity to deal with more than one outbreak and could continue operations while simultaneously dealing with notifiable diseases. Inspectors benefitted from visiting locations as part of their

training where the Asian hornet was established (Jersey and Bordeaux) to see first-hand the many different actions involved in management and control.

Rapid identification and detection of nests is critical for controlling outbreaks. Early contingency plans for responding to Asian hornet outbreaks recognised the importance of members of the public reporting possible sightings. A web based alert system was set up and managed by the UK Centre for Ecology and Hydrology (UKCEH). Following the first findings in 2016, Defra funded an App which provided guidance on how members of the public could identify hornets and asked people submitting sightings to include a photo and a location using the phone's Global Positioning System (GPS). To encourage reporting, emphasis was placed on awareness raising by Defra, the NBU and GB NNSS within government, with additional wide-ranging communications and education carried out by beekeeping associations. The Asian hornet has also attracted a great deal of press attention.

With large numbers of reported sightings, few of which were Asian hornet, it was necessary to triage reports. The NBU have worked with UKCEH to refine the process with input and screening, in part, carried out by volunteer experts from national recording schemes and societies. This ensures that only the most likely sightings are sent to the NBU for further investigation by the inspectors.

As honey bees are preyed on by Asian hornets, beekeepers have also taken action to help find and eradicate outbreaks of Asian hornet. The BBKA has helped to facilitate a network of Asian Hornet Teams (AHTs), formerly known as Asian Hornet Action Teams (AHATs), across England and Wales, who support the NBU by raising awareness of the Asian hornet, following up leads and extending the surveillance zones during contingency responses by monitoring their own apiaries. In addition, AHTs have provided expert opinion on sightings to determine if they are credible. There are AHTs present in many but not all areas of England and Wales, and these have become integral to the NBU's ability to effectively triage and respond to each year's Asian hornet reported sightings. In conjunction with the BBKA, a joint protocol for working with voluntary groups has been agreed and implemented.

More recently the NBU have had discussions with pest controllers who have valuable experience in dealing with insect pests and are likely to be a first point of contact for a household with a hornet nest on their property.

The contingency plan now recognises that not all hornets sighted in the UK come from an established nest. There have been several individual hornets spotted in the UK, some of them workers which individually would not be able to build a colony. These are most likely to be lone hornets unwittingly brought to the UK through one of the identified risk pathways. As part of the initial response the NBU now gather further information and carry out surveillance in the area to check if there is a local nest before establishing a local field response. If there is no evidence to suggest that there is a nest, then the local AHTs are alerted and asked to monitor for further sightings.

Previously, Seasonal Bee Inspectors (SBIs) finished work at the end of September. However, in the UK some Asian hornets have been discovered between September and October when more workers were foraging and therefore the SBI contracts have been extended to cover October to take action against these findings. At the end of each season the Contingency Planning and Science Officer carries out a lessons-learned review. Information gathered from this is used in discussions with policy, communication and operational experts to refine the contingency plans and communications, so that they are more effective for the following season.

Influence of Small hive beetle (SHB) establishing in southern Italy

Small hive beetle (*Aethina tumida*) was confirmed in Calabria (southern Italy) and Sicily in 2014. Protection areas and monitoring areas were established that remain in place (on the date of publication of this report). Export of bees from these areas is not permitted. Despite eradication efforts by the Italian authorities, the beetle has established in the area of Calabria. In Sicily, after a spell of Small hive beetle freedom, another case was discovered in 2019. In other areas of Italy bee movements and trade continue. The UK imports a significant volume of packaged bees and queens from Italy and this has increased since the introduction of the Healthy Bees Plan. These imports are believed to be higher risk than from other European countries as the risk of illegal movements from Calabria to other parts of Italy cannot be ruled out.

The risk of introduction of Small hive beetle into England and Wales has been a priority area for the NBU since the start of the Healthy Bees Plan and since the arrival of the beetle in Italy, which highlighted the threat it posed to European apiculture. The regular field contingency exercises carried out by the NBU have focussed on Small hive beetle scenarios. Enhanced Sentinel Apiaries have now deployed “Beetle Blaster”-style traps for Small hive beetle monitoring. When the beetle arrived in Italy, the UK Government reassessed its risk-based import checks on bees. For bees from Italy, the NBU increased checks from 25% to 50% of all consignments (and 25% to 100% for bees from Sicily over the short period during which movement restrictions were lifted). The NBU and Defra have also worked with European colleagues in Italy and the EU Reference Laboratory, based in France, to improve the European preparations for the potential spread of Small hive beetle: the project included sections on the legal position, possible containment measures and contingency planning.

Concluding remarks

Over the lifetime of the Healthy Bees Plan exotic pest risks have increased and, in the case of the Asian hornet, to some extent been realised, with incursion events now seemingly an annual occurrence. The NBU’s contingency preparedness, knowledge and skillset have increased substantially over this same period as the evidence above illustrates. Significant progress and improvements have been delivered over the plan period and outbreaks have been well managed.

There remain challenges. Trade is based upon managed or acceptable risk, rather than zero risk, so surveillance measures must remain sufficiently robust to manage this. The

ten-year period of the plan has seen increasing demands upon the NBU to deliver more surveillance commensurate with increased risk and trade. The NBU also need to maintain a balance between competing priorities such as foulbrood inspections and control, exotic pest surveillance, monitoring imports and contingency responses. This needs to be delivered with a finite number of inspectors and resources.

In future it will be important to continue horizon scanning for new and emerging threats combined with risk analysis so that contingency responses can be prepared, and further actions taken as appropriate. Following the UK's exit from the EU it will also be important to regularly review the risks posed by imports and the approach to managing these.

Outcome 4 – Sound science and evidence base underpin bee health policy and its implementation

As part of the review of the Healthy Bees Plan one project was commissioned to consider the work carried out against ***'Outcome 4 – Sound science and evidence base underpin bee health policy and its implementation'****.*

The project was led by Laura Stevens and Belinda Phillipson who, at the time of writing, were working in Defra in evidence and policy roles respectively. The chapter they have written describes the research and development work undertaken to improve our knowledge of bee health, particularly of the bee pests and diseases known to afflict honey bees. The chapter also outlines the contribution this work has made to developing policy and operational activities carried out by government during the Healthy Bees Plan.

4.1 – Review of Defra funded bee health R&D projects carried out during the lifetime of the Healthy Bees Plan (2009-2019)

Laura Stevens, Evidence and Analysis, Defra

Belinda Phillipson, Bee Health Policy, Defra

Summary

Protecting bee health aims to ensure that there is a sustainable population of honey bees for pollination services and honey production. The Defra and Welsh Government bee health programme, the Healthy Bees Plan, beekeepers and bee farmers all contribute to this in different ways. There are three areas under the government bee health programme; policy, operations and research. The latter is key for providing evidence to inform policy and operations. The importance of this is highlighted by this objective in the Healthy Bees Plan - 'to ensure that sound science underpins bee health policy and its implementation'. During the lifetime of the Healthy Bees Plan a range of projects have been carried out. This included developing detailed risk assessments, investigating potential control methods for exotic threats and mapping bee health stakeholders. There are many interesting results from the projects which include; (i) beekeepers, in particular new beekeepers, are hungry for information and training; (ii) a mobile phone app for Asian hornet which brought major benefits to supporting the contingency response and (iii) a nematode product that can be used for control of Small hive beetle. Defra also contributed to research on pollinators more broadly under the Insect Pollinators Initiative which helped inform the National Pollinator Strategy.

Introduction

Before research can be commissioned, policy and operational needs should be assessed to identify the questions that need to be addressed. This will include horizon scanning and risk assessments to identify new and emerging threats as well as evidence gaps. Research projects can then be commissioned to meet these needs. This can be done in different ways. If the project requires a unique set of expertise or access to specific material (for example, exotic pests) or data, then a project is commissioned directly with the researchers. When the questions to be answered are wider and could be addressed in a number of ways, a competition is run. Researchers submit proposals for research projects which are then assessed to select the project that is considered will best answer the question(s). During the lifetime of the Healthy Bees Plan over twenty projects have been commissioned. These projects will be covered in more detail in later sections of this chapter.

Defra also works in partnership with others to jointly fund research. In March 2009, Defra, the Biotechnology and Biological Sciences Research Council (BBSRC), Natural Environment Research Council (NERC), Wellcome Trust and the Scottish Government agreed to establish the Insect Pollinators Initiative (IPI). The funders agreed that there was an urgent need for innovative research to provide a basis for reducing current declines and sustaining healthy and diverse populations of pollinating insects for the future. From a total budget of £10m, nine projects were selected for funding over a five-year period. The projects covered a range of subjects including pests and diseases of honey bees (European foulbrood, *Varroa destructor* and viruses), factors influencing changes in pollinator populations such as land use or the urban environment, as well as the impact of chemicals on the learning capacity of bees. Results from these projects also helped to develop and implement the National Pollinator Strategy.

Outcome 4 of the Healthy Bees Plan is to ensure that sound science underpins bee health policy and its implementation. This chapter will cover the projects that have been commissioned during the lifetime of the Healthy Bees Plan and which have contributed to this objective. The review will include details of the work that has been done, the findings from the projects and how these have been used to inform policy and operations.

The projects fall under five broad headings:

1. Small hive beetle
2. Asian hornet
3. Other pests and pathogens
4. Other pollinators
5. Social science (or communications and beekeeping practices)

Each of these headings will be covered in more detail.

It should be noted that during the period covered by the Healthy Bees Plan a great deal of other research has been carried out which can be used to inform bee health. This includes research done by academic research institutes both in the UK and abroad, projects commissioned by beekeeping associations as well as studies carried out by individual beekeepers. This was beyond the scope of this review. However, the value of this research and the information that it provides should be recognised and captured in any future plans.

Small hive beetle

The Small hive beetle (SHB), *Aethina tumida*, is a statutory notifiable invasive species in the EU. It would pose a significant threat to beekeeping if it were to establish in the UK, as it is currently causing severe economic and ecological impacts in countries where it has spread and established. SHB is native to Africa, and is widespread throughout the continent, particularly in sub-Saharan Africa. Since 2002, outbreaks of the beetle have been confirmed in Australia, all of the forty-eight contiguous states of the USA, Canada, the Caribbean, some South American countries and the Philippines. In September 2014, the presence of SHB was confirmed in the Calabria region of south-west Italy in two

apiaries approximately 1 km apart. Since the initial findings, there have been over a hundred confirmed cases of the beetle in Calabria, and two findings in Sicily, the first in 2014 and another in 2019.

Although the Italian veterinary authorities put a surveillance and eradication programme in place after the initial confirmation of SHB, the continued findings of new cases illustrate that it is very difficult to eradicate this pest once it becomes established. It is suspected that the spread of SHB beyond its native range is due to the international apicultural trade and/or migratory beekeeping practices. Additionally, the beetles are strong fliers and natural dispersion cannot be discounted. Therefore, there is a real concern that SHB could arrive and establish in the UK which would threaten the health of the apiculture industry as well as posing a wider threat to agriculture and the wider environment due to the potential disruption to pollination services.

The biology and lifecycle of SHB are relatively well understood, and this knowledge has informed Defra-funded research into potential control options for the beetle. The lifecycle begins with the emergence of adult beetles from their pupation sites within soil surrounding hives. The adults locate and invade new hives and females lay their eggs within the hive. Once hatched, larvae feed on brood, pollen and honey, thus depleting the population of the hive as the next generation of bees fail to develop. Additionally, stored honey within the hive can become unfit for consumption due to contamination with yeasts spread by the activity of the beetles. Heavy infestations of SHB can cause bees to permanently vacate the hive. Fully grown larvae exit the hive and pupate within the soil surrounding its base. As different stages of the lifecycle are found within and outside the hive, at least two different control methods could be deployed to treat an outbreak of SHB.

During the course of the Healthy Bees Plan a number of research projects focussing on SHB were commissioned by Defra:

PH0510 - Development of an evidence-based risk assessment for small hive beetle to provide input for the contingency plan

PH0513 - Investigation into potential control measures for small hive beetle

PH0526 - Investigation of potential treatments for eradication of small hive beetle

PH0527 - Review of potential treatments for eradication of small hive beetle

PH0528 - Analysis of SHB treatments under environmental conditions

The main findings from these research projects are summarised below.

Evidence base and literature reviews

In 2010, a project was commissioned to review all available literature on SHB, in order to inform a contingency plan for SHB (PH0510). The project aimed to determine the likelihood of SHB being introduced, establishing and spreading in the UK, as well as

examining the potential economic, environmental and social consequences of SHB introduction.

Eight separate pathways in which SHB could be introduced to the UK were identified, with importation of honey bees (in particular illegal imports) and movement of beekeeping equipment being identified as the most likely pathways. The PRA showed that SHB is likely to be able to establish in the UK in the event of it being introduced and there is a high potential for spread, with impact on the beekeeping sector being assessed as moderate. Risk management options for all pathways were considered and recommendations were made to strengthen existing legislation surrounding the import of honey bees into the UK. Further investigation of potential chemical, biological and/or other integrated control measures effective against SHB in an outbreak situation was recommended. To this end, a number of further projects were commissioned in order to find suitable control methods for use in the UK.

As part of the initial work carried out on SHB, a paper was produced which included the full literature review, and an additional article on the lifecycle of the SHB was published in BeeCraft.

Chemical controls

Control programmes in countries where SHB has spread have found the most effective method of controlling SHB is to destroy infested apiaries and treat the soil underneath each infested hive with an insecticide. It is preferable to dig up the soil and then treat it in order to ensure that all of the soil is uniformly treated, rather than apply a treatment directly to the ground. A number of potential soil drenches have been identified by research projects over the course of the HBP, with the most promising one for use in the UK initially found to be a spinosad formulation marketed as Tracer® (Dow Agrosciences) (PH0526, PH0527, PH0528). The efficacy of spinosad was tested in various projects, including at different temperatures and on a range of different soil types. The product did give control of SHB but not full control under laboratory conditions. So, it is one possible chemical treatment that, subject to regulatory approval by the Health & Safety Executive, could be deployed in the event of an outbreak of SHB. However, successful control is thought to need greater efficacy and use of an additional or alternative product (PH0526, PH0528).

Biological controls

In addition to or instead of a chemical control, biological control agents may also be used to control an outbreak of SHB, were it to be found in the UK. Over the course of the HBP, three different species of entomopathogenic nematodes (EPNs), *Steinernema feltiae*, *S. kraussei* and *S. carpocapsae,* have been assessed for their ability to infect and kill pupating SHB larvae under laboratory conditions (PH0513, PH0526, PH0527, PH0528). Entomopathogenic nematodes are able to invade the insect host body, where they spread a bacterium from their gut which multiplies within the host and causes death within 24-48 hours. The nematodes feed and reproduce within the dead host, with the next generation of juvenile nematodes being released into the soil about seven days from initial host infection. Experiments with EPNs indicate that under laboratory conditions they can give

full control of SHB under laboratory conditions, but further experiments are ongoing to determine whether these results can be replicated under different environmental conditions and within different soils.

Further work has indicated that a combination of chemical and EPN treatments may be the most effective option for controlling SHB outbreaks (PH0528). It has been demonstrated that the EPNs are compatible with spinosad and are able to survive in a solution of the chemical for up to two hours. As spinosad appears to have no effect on the ability of the nematodes to infect SHB larvae, both treatments could be used as part of an integrated pest management (IPM) programme. Further work is ongoing to determine the efficacy of a treatment mix in different soil types, including with other chemical and adjuvant products.

Other control methods

Other potential control measures for SHB have been considered as part of literature reviews, including the use of slaked lime and powdered limestone as soil treatments (PH0513, PH0527). However, due to published evidence that SHB larvae are able to burrow down through lime treated soil layers to pupate successfully, allowing high levels of adult emergence, these methods were not considered further by Defra.

Diatomaceous earth (DE) was also considered as a potential treatment for SHB, as this material has previously been reported to be effective in controlling various insect pests (PH0513, PH0527). This material is made up of the fossilized remains of diatoms, which are ground into a fine powder and applied as an insecticide, where it causes dehydration and mortality of arthropods and gastropods. However, its effectiveness depends on a number of factors, including the physiology of the target pest, water pressure and the relative humidity of the surrounding environment, therefore DE was not considered further as a treatment for SHB.

Biopesticides were identified as potential alternative control methods to synthetic chemical treatments in a literature review examining treatments for SHB (PH0513, PH0527). These control methods are defined as either naturally occurring compounds of botanic origin or are microbial agents such as bacteria, fungi and viruses which cause disease in invertebrate pests. *Bacillus thuringiensis, Beauveria bassiana* and *Metarhizium anisopliae*, all well-known microorganisms used to control a wide range of insect pests, have been identified as potential controls for SHB needing further evaluation. Azadirachtin, a compound derived from neem seeds, is known to be active against beetles but is not approved for use in the UK, so was not considered further as a potential control. However, the literature review suggested that further research into the effects of garlic-derived compounds could have some merit, as a non-synthetic chemical option may be desirable in some cases. There is some evidence that extracts made from garlic can have toxic effects on beetles, but it is considered unlikely that any such compound would give full control of SHB. Biopesticides could be considered in the future if synthetic compounds become unavailable due to changes to the legislation around chemical treatments.

Trapping of SHB adult beetles has been explored as part of literature reviews of control options for SHB (PH0513, PH0527). Traps can be deployed to slow down the growth of in-

hive SHB populations and reduce the number of larvae produced. Most literature reviews conclude that although traps can be a useful part of SHB control repertoire, their use should be combined with good hive management practices.

As SHB has spread far from its native habitat and has established in countries around the world, it is possible that new methods of control will arise and could be considered as part of the UK's response to an incursion of this pest.

Asian hornet

Asian hornet, an invasive non-native species from Asia was first recorded in the Bordeaux region of France in 2004 but since then has spread widely through Europe. Most regions of France have been colonised by Asian hornet as well as northern Spain, parts of Portugal, Belgium, Italy and Germany, suggesting that the hornet is highly mobile. In the Risk Assessment carried out in 2011 by the GB Non-native species team, seven potential pathways for entry were identified. Of these, movement on freight or other transport vehicles was considered to be a relatively low risk. However, experience in the UK has shown that Asian hornet is very good at hitch hiking, with individual hornets arriving in the UK via camping equipment and a ferry. In recent years there have been several findings in the Channel Islands with more than sixty nests found in 2018. From the first UK incursion in 2016 up to the end of 2019 there had been eighteen confirmed sightings of Asian hornet including nine nests which had been destroyed.

The hornets predate on social wasps and bees including honey bees which means they are likely to have a high impact on insect pollinator populations and beekeeping activities. Initial detection of Asian hornet incursions can be difficult as they are found in the wider environment and not just associated with honey bees. The most effective means of reducing population levels is by destroying the nests before new queens emerge and therefore much research has focused on developing methods for detecting nests. There are two types of nest; (i) a small primary nest built by the Asian hornet queen when she emerges after overwintering to establish the colony and (ii) a larger secondary nest built by workers from the primary nest to produce new queens. Although the secondary nests have a distinctive structure, they can be difficult to spot as they are often built in high places including trees and man-made structures. Various innovative methods for nest detection have been tested but to date following hornets by eye along lines of sight back to the nest has proved to be most effective. Spotting nests and then deploying suitably trained people with the correct equipment to treat and destroy nests is very resource intensive. Various actions/methods to make the process of detecting nests more effective have been considered including citizen science and genetic analyses.

In the longer term if Asian hornet were to become established, destroying all the nests in a particular area will not be possible so research has been carried out on possible control methods. The key issue is to manage the Asian hornet population levels. Significant numbers of Asian hornets need to be trapped and killed without having an impact on non-target invertebrates.

Since 2016, Defra has funded a number of different research projects covering different aspects of Asian hornet biology and ability to spread. Evidence has been gathered from these projects which have helped to support the contingency response as well as provide information for long term management. The projects fall under the broad headings of detection or control and key findings are described below.

Detection – finding the first incursion

How to support citizen science?

The importance of citizen scientists and members of the public for recognising and identifying non-native invasive alien species has long been recognised in the UK. As part of the early plans developed in 2010 for dealing with incursions of Asian hornet, a web-based alert system was developed. This allowed members of the public, beekeepers, amateur insect collectors and others to submit potential hornet sightings. The sightings were then assessed by experts to determine if they were credible and required further investigation. The first outbreak of Asian hornet in the UK occurred in September 2016 and during this month there were over 800 alerts. All alerts have to be checked and those that are credible followed up with contact/a visit by a government official for those deemed to be high risk.

Defra commissioned a project in winter 2016 to develop an App to assist people submitting reports using mobile devices. There were two main objectives; (1) to include an identification guide to reduce confusion with other species and (2) to encourage accurate locations with GPS as well as photos to be submitted with all possible sightings (PH0529 – Hornet Watch: developing a mobile phone app for Asian hornet, *Vespa velutina* surveillance). In 2018 there were over 8000 alerts of which 1670 were received from the App.

Modelling the contingency response

In recognition that a high level of resource would be needed to eradicate Asian hornet should it establish in the UK, a project was also commissioned in October 2016 to develop and strengthen an Asian hornet spread and response contingency model (PH0531 – Yellow-legged Asian hornet [*V. velutina*] spread and response modelling for GB). The model established baseline estimates of spread which could be applied in a GB context. This is useful for testing different control scenarios depending on resource and other key parameters. Initial findings suggested that positive citizen science engagement can reduce the overall cost of nest removal which is dependent not only on the amount of resource applied but also the abilities of search teams to track hornets and locate nests.

Determining the number of nests

Determining the number of nests present in the early stages of an incursion is difficult because usually only single flying hornets are observed. A project was carried out in spring 2017 to determine whether genetic analysis could be used to assign *V. velutina* individuals to a specific nest (PH0533 – Feasibility study to determine whether *Vespa velutina*

individuals can be assigned to specific nests). The results showed that the genetic analyses could be used to estimate the number of nests present but had a tendency to overestimate and therefore should be combined with other information from an outbreak situation.

Can technology be used to track Asian hornets?

Various technologies have been used to track animals and so a project was carried out during summer 2017 to determine if this could also be used to track hornets back to their nests (PH0532 – Evaluation of off-the-shelf technologies for their potential to track Asian hornets, *Vespa velutina*). Of the two methods reviewed, the Biotrack radio tracking technology was found to be most effective in the range of habitats and environments where Asian hornet nests are likely to be found. Methods using the Biotrack tags were developed and successfully used in the field to find previously undiscovered nests in both France and Jersey. However, this method is dependent on finding Asian hornets with suitable body weights which are able to bear the weight of the tag. It is also likely to require a reasonable level of expertise with the technology.

What are the control options for Asian hornet?

Suitable control methods are required to eradicate and/or prevent the spread of the Asian hornet if it is found in the UK. A review was carried out (PH0530 – Review of control options for suppression or elimination of the Yellow-legged Asian hornet, *Vespa velutina nigrithorax* in the UK) which evaluated a wide range of techniques including physical/mechanical, chemical and biological control methods and their applicability for use against Asian hornet. It was concluded that there is no single method which provides complete control and in the short term, finding and destroying all the Asian hornet nests is the most effective means of eradicating the pest. In the longer term if Asian hornet were to become established further control methods would have to be developed such as lure and kill approaches which specifically target Asian hornet, minimising the capture of non-target insects. Other complex methods such as Sterile Insect Technique and RNA interference could be investigated for Asian hornet, but this would require significant investment, personnel and specialised facilities over a long period of time.

Other pests and pathogens

In addition to Small hive beetle and Asian hornet there are other pests and pathogens which are of concern to beekeepers in England and Wales. These include *Varroa destructor*, *Nosema apis*, *Nosema ceranae* and several viruses. In addition to SHB there is another statutory notifiable pest, *Tropilaelaps* species as well as two notifiable pathogens, American and European foulbrood. Each of these pests and pathogens has different impacts on honey bee health and is influenced by factors such as forage availability, periods of time spent in the hive and local climate.

Nosema species

In 2004 concerns were raised by Spanish beekeepers about the impact of *Nosema ceranae* but by 2008 it was clear that the pathogen was already widely distributed in Europe. As part of a project looking at a range of pests and diseases, historic samples of UK adult honey bees were tested (PH0506 – control and risk management of honey bee pests and diseases). The results indicated that *N. ceranae* had been present in the UK since 2004 and possibly earlier. Tests on attendant worker bees from third country queen imports were also positive for *N. ceranae* indicating that this pest could have been introduced via imports. A risk assessment was carried out to assess the impact of *N. apis* and *N. ceranae* on UK colonies but there was insufficient evidence to determine whether or not *N. ceranae* was more virulent than *N. apis* (PH0509 – Development of an evidence-based risk assessment for Nosema species that infect honey bees). Experimental studies showed that infection with UK strains of *N. apis* and *N. ceranae* led to an equal risk of death to adult *A. mellifera* individuals. In addition, National Bee Unit colonies containing both *Nosema* species survived for four years without the need for treatment (PH0506).

Varroa

Virtually all honey bee colonies in Europe are now infested with Varroa with some beekeepers struggling to manage it. In 2013 a consortium of researchers including Fera successfully bid for an EU funded project on Sustainable Management of Resilient Bee Populations – SMARTBEES (PH0515). The project aimed to improve understanding of the underlying resistance mechanisms to infectious and parasitic diseases of honey bees. Existing honey bee breeding strategies could then be adapted to provide a sustainable solution for the control and integrated management of Varroa. Bee breeding is well established in Europe and Fera were keen to draw on this expertise which Defra supported by providing matched funding. A great deal was learnt about different breeding approaches and people's motivations for breeding bees, but it proved difficult to transfer the European breeding strategies to the UK because of the way in which the project was run.

Use of modelling to help manage pest and disease threats

Due to their differences in biology, the analysis of threats from pests and diseases often requires diverse approaches. For example, developing strategies for controlling Varroa will need a good understanding of mite biology, skills in integrated pest management and potentially expertise in bee breeding. For management of European foulbrood knowledge of pathogenic bacteria and strain typing will be valuable. However, some skills can be applied to a range of pests and diseases. These include Pest Risk Assessment to evaluate whether a potential pest or disease threat will have an impact on bee health in a particular country and modelling to assess how far a pest or disease will spread if it reaches the UK. These methods require different expertise together with knowledge of honey bee biology and the pests and diseases that affect them. A Strategic Evidence Partnership project was commissioned to build stronger links between researchers with modelling skills at Warwick and scientists with honey bee expertise at Fera (PH0517 – stress testing and optimisation of early interception networks for invasive pests of pollinators).

The researchers used previously gathered data on the spread of Varroa to develop a model. As Tropilaelaps mites have a similar life cycle to Varroa (with the exception that they cannot survive on adult honey bees for more than a few days) the model could be adapted to predict the spread in the event of a Tropilaelaps outbreak. The researchers also used the model to test the Sentinel Apiary Network, a network of apiaries selected for their proximity to potential exotic risks. The beekeepers who own these apiaries have training to help them identify exotic pests and diseases. Twice a year they also send hive debris samples to the NBU for exotic pest screening. Findings from this project were used to make suggestions about how to optimise the location of the Sentinel Apiary sites based on exotic risk locations. This is key as the Sentinel Apiaries are intended to act as an early warning system to detect exotic pest threats.

Other pollinators

There are many insects including honey bees that pollinate both cultivated and wild plants with some flowers being visited by several species of insects. Consequently, changes in floral resources could have impacts on a wide range of pollinators. Other threats facing both managed and wild insect pollinators include emerging pests and diseases, habitat loss, intensive agriculture and climate change.

Insect Pollinators Initiative

In 2008 five funders (Biotechnology and Biological Sciences Research Council [BBSRC], Defra, Natural Environment Research Council [NERC], Scottish Government [SG] and the Wellcome Trust) came together to launch a £10 million initiative to promote innovative research aimed at understanding and mitigating the biological and environmental factors that adversely affect insect pollinators (PH0511 – Insect Pollinators Initiative - IPI). Nine research projects were funded which included modelling of how to manage European foulbrood, research on the impact of habitat structure on bumble bees and assessing whether bees can meet their nutritional needs in the UK landscape. Field based experiments were carried out for some of these projects and several thousands of insects were collected. To preserve this valuable biological resource, a specimen archive was created with 50,000 insects which is kept in long term storage at the Natural History Museum in London (PH0522 – Development of the IPI specimen archive). Several articles in peer reviewed journals have been published covering the results from the projects funded under the IPI. In addition, a series of short summary documents entitled 'Policy and Practice notes' were prepared by a knowledge exchange expert (PH0519 - Preparation of a series of Policy and Practice Notes based on findings from the Insect Pollinators Initiative).

National Pollinator Strategy

The findings from the IPI projects provided a better understanding of the threats and their impacts on pollinators but while the findings were still emerging it became clear that action was required to address these threats. In 2012, the Welsh Government worked with industry and stakeholders to look in more detail at the evidence and issues around pollinators and their conservation in Wales. Following consultation, the Action Plan for

Pollinators was launched which sets the strategic vision, outcomes and areas for action to improve conditions for pollinators and work to halt and reverse their decline in Wales. In 2013 Defra agreed to bring together all interested parties to develop the National Pollinator Strategy to address the threats faced by pollinators. As part of this process a review of the published literature was completed (PH0514 – status and value of pollinators and pollination services) which was then used to inform a workshop with scientific experts and stakeholders. The evidence was complex, and it was clear that gaining agreement on the future status of pollinators and the measures required to reach this would be challenging. Therefore, an additional project to allow preparation and support for the workshop was commissioned (PH0516 – National Pollinator Strategy - support for workshop). During the workshop the evidence was critically reviewed, key gaps identified and actions by government and other stakeholders agreed. This includes work to establish how pollinator populations are changing across Great Britain.

Social science research

Beekeeping has changed a great deal in the past ten years becoming increasingly popular with a wide range of people. There have also been many changes in day to day life with increased use of the internet, emails and the arrival of social media. Social science research can be used to review how people have adapted to these changes. With respect to beekeeping this research can be used to determine how best to support beekeepers in providing information and who should be involved in discussions about honey bee health.

Influences and information sources

In 2009 Defra commissioned a study to build an understanding of how beekeepers choose to access and respond to advice and information about beekeeping and husbandry (PH0508 - A Study of Beekeeping Practices: Influences and Information Sources). This was to help Defra, WG and stakeholders to deliver the Healthy Bees Plan. The project made some interesting findings including the point that information preferences tended to reflect beekeepers' level of experience. Newer beekeepers were more likely to express a preference for obtaining information from other beekeepers, while more experienced beekeepers, who are likely to have a greater degree of confidence in their practical skills, were more likely to prefer written sources of information. Other interesting comments included the statement that it was no longer possible to be a *"leave alone beekeeper"* because of the increase in pests and diseases, in particular Varroa.

Who has an interest/stake in honey bee health?

This study paved the way for a larger project commissioned in 2012 entitled 'Understanding honey bee health stakeholders' (PH0512). One of the objectives of the Healthy Bees Plan was to get everyone to work together on bee health. The study recognised that there are a wide variety of people who are concerned about bee health. However, they may also have different interests, motivations, attitudes, beliefs or practices which can make it challenging to agree policies to address bee health issues. The researchers identified seven categories of stakeholder. These were: (1) beekeepers and bee farmers; (2) beekeeping education/ training and beekeeping media groups; (3) public

interest groups, campaigning groups and mainstream media; (4) suppliers of beekeeping equipment, honey and other bee-related products; (5) land and ecosystems management groups; (6) Government and government-funded bodies; (7) researchers and research funding bodies. All of the stakeholder categories viewed honey bee health as one of two general framings of honey bee health. One framing places honey bee health within the broader, longer-term context of an 'agro-industrial paradigm' where potential solutions to honey bee health issues lie in radical changes to land use and agricultural systems, while questions of husbandry are secondary. For the second more pragmatic framing, potential solutions lie in improving floral resources within current land use and agricultural systems, and in better pest and disease identification and management by beekeepers, to be achieved through education and knowledge exchange. However, as well as the conflicts there were also some shared concerns including a need for more floral resources for all pollinators and more long-term field-based research on a range of issues. There were a number of recommendations in the final report with a particular focus on knowledge exchange strategies.

Conclusions

As outlined in the introduction, research projects are commissioned to address questions and inform policy/operations. It can often take several projects carried out over a long period of time to provide solutions to specific issues. Although the research findings gathered from intermediate projects cannot be directly implemented into policy and operations, the information gathered from these projects is still of value for policy officials and inspectors as well as the wide range of people interested in bee health. During the lifetime of the Healthy Bees Plan several projects using a variety of different approaches have been carried out. Many of these have focused on the major threats to bee health. For example, valuable information has been gathered about the biology of Small hive beetle and several different treatments analysed to identify a potential control option. The use of novel technology for detecting Asian hornet has also been explored. It was successfully deployed in an experimental setting but had limitations for use in a contingency response. However, technology is continually being developed and improved so in future it may be possible to use this method for the detection of Asian hornets. In contrast the Asian Hornet Watch app was rapidly developed and launched in spring 2017 which has since supported submission of potential sightings. From a wider perspective, beekeepers are keen to get information that supports their beekeeping practices. There are also a wide range of people interested in bee health so for effective knowledge exchange there needs to be a range of different communications. The findings from the research projects carried out during the Healthy Bees Plan have helped bee health policy, operations and beekeepers. In some cases, they have also supported work on other insect pollinators and non-native species. There continues to be worldwide interest in bee health research with several papers and articles published on a monthly basis. Beekeepers are also increasingly becoming involved in research particularly in husbandry practices. Future work will need to consider how best to draw on all these elements and the information that is generated to help sustain bee health.

Outcome 5 – Effective communications and relationships operating at all levels

A key feature of the Healthy Bees Plan was partnership working. A need was identified at the outset for collaboration. This would ensure a cohesive programme of work was put in place to protect the honey bee and support beekeepers in England and Wales.

To consider the impact of the Healthy Bees Plan under ***'Outcome 5 - Effective communications and relationships operating at all levels'****, Defra commissioned four projects. The projects were to review: the role of strengthened partnerships; how the dissemination of information was used in a programme of beekeeper training and education; the nature of beekeeping and bee farming during the life of the Healthy Bees Plan; and how advisory materials produced by the National Bee Unit helped to support beekeepers maintain healthy colonies.*

The chapters in this section were drafted in consultation with the Bee Health Advisory Forum, with written contributions provided for chapter 5.2 and 5.3 by the British Beekeepers Association, the Welsh Beekeepers' Association, the Bee Farmers' Association, and the National Diploma in Beekeeping. The chapter on strengthened partnerships (5.1) was informed by a workshop with the Bee Health Advisory Forum, whereby input from forum members was collated during facilitator-led groups on a range of topics. Chapter 5.4 was written by the National Bee Unit and outlines the material produced by the NBU during the ten years of the Healthy Bees Plan.

5.1 – Strengthened partnerships

Louise Mount, Bee Health Policy, Defra

Introduction

This project aimed to gather evidence of how government and beekeeping associations have worked together to improve bee health in line with the fifth objective of the plan. The intention was to make an assessment of the benefits of these partnerships. The project focussed on the relationships between the organisations represented on the Bee Health Advisory Forum (BHAF).

It is a qualitative study based on information/experiences gathered from a workshop held at the November 2018 BHAF and from minutes of previous forums and working groups. Forum members were also invited to send additional comments, but the report mainly draws on the workshop as well as case studies provided by forum members. Not all the examples used in the case studies were under the auspices of the plan but involve two or more of the BHAF members working together to improve bee health.

Background

Governance of the plan

Working together has been fundamental to the delivery of the plan and from the outset a regular meeting where stakeholders and government could meet to discuss key issues facing beekeepers was considered vital to its success. The BHWF was set up in 2012 to oversee the plan and its implementation. Prior to this, oversight was carried out by the Healthy Bees Plan Project Management Board. All the major players involved in the development of the plan were represented on the first forum and have continued to be involved. The secretariat for the forum initially sat in Fera; however, reorganisation of the National Bee Unit (NBU) meant that this transferred to APHA in 2014. The chair of the forum was also initially in Fera but transferred to Defra where bee health policy now sits.

We have met quarterly mainly at Defra/Fera offices in London or York but more recently have used teleconferencing for some meetings to reduce the time and expense of travelling – especially during summer when the season is at its height. We are also exploring the use of Webex document sharing to improve the experience of members joining by phone.

Attendance at meetings has remained high since the beginning of the plan. Non-government stakeholder groups are able to claim travel expenses for one representative to attend the meeting. Forum meetings have consistently been attended by senior representatives of stakeholder groups, indicating a good level of stakeholder confidence and engagement in the forum. Both government and stakeholders have seen it as a valuable opportunity to air concerns and share information. In many cases the

representatives have remained on the board for several years and this provides a strong base of knowledge and consistency of approach whilst new members provide interesting new perspectives to discussions.

Changes to structure/working practice

When the plan started, three subgroups were set up to report to the Management Board. These covered science and evidence, husbandry and education, and communications. They were seen as an important way of delivering specific pieces of work which could be presented to the forum for final agreement. As time moved on and specific projects were delivered by the groups a review suggested that future work could be handled by the newly established forum without the support of the groups: the chairs of the groups were represented on the forum. The sub-groups could be commissioned by the Forum to work on projects as the need arose. Some of the groups were perhaps more effective than others, particularly where there were clear tasks to be delivered. For example, the communications sub-group produced several leaflets which are still in use today.

When the forum was first established the following groups were represented: Welsh Government, Welsh Beekeepers' Association, National Farmers Union, British Beekeepers Association, Bee Farmers' Association, National Diploma in Beekeeping, Veterinary Medicines Directorate, Fera. Changes in the structure of government mean that the Animal and Plant Health Agency and Defra are now on the forum. Additionally, the British Bee Veterinary Association was established in 2015 and now attend the forum. Norman Carreck has also been added to the forum to represent the honey bee research community.

Policy and Communications

Some common themes emerged from our discussion on the areas where we have worked together on policy or raising awareness. One clear theme was the improved relationships between members of the forum. When the plan commenced there were tensions between the government and the beekeeping community. Whilst there was not always agreement between the forum members, the meeting provided an opportunity to air issues and concerns raised by both government and stakeholders. The forum provides a place for honest and frank discussions. There is confidence that news shared within the group is treated with appropriate discretion. This has meant that the government has been able to provide timely (though occasionally embargoed) updates to the forum on bee health issues, such as the arrival of Asian hornet in 2016.

Another theme to emerge was that shared information and experience can benefit the whole group. One example raised by the Scottish Government was their experience of dealing with a major foulbrood outbreak. The shared experience of the forum members and assistance from the NBU helped the Scottish Government to deal with the outbreak. There has been great mutual benefit between the forum and the Scottish Government, particularly as we consider how to increase the number of queens reared in England. Learning from one another has helped us all to improve how we tackle the challenges facing bee health.

"By working together, we can achieve more" was another clear message coming through. This can be seen in the response to the threat of Asian hornet which is explored further in the case study below. Another example was the joint statement by the Council of the National Beekeeping Associations of the United Kingdom and Ireland (CONBA) following the arrival of Small hive beetle in Italy. Having a clear message from the industry forum members (in particular BBKA and the BFA) regarding their concerns about the risk of SHB introduction was helpful to ensure that NBU resources could be used on additional checks and to support a robust position in negotiations with the European Union. CONBA have also provided industry forum members with a virtual platform to aid the exchange of views on apiculture issues.

One area where we could have done better is embracing the opportunities provided by new technologies and communication methods. We are starting to use Webex and teleconference to reduce the amount of travel for members. The NBU's BeeBase website also provides a wealth of information available to all. However, better use of social media by the government could have improved the reach and impact of messages to beekeepers and others.

Case studies – policy and communications

(i) Asian hornet

Asian hornet arrived in France in 2004 and quickly established in the country. For many years the NBU has prepared for its eventual arrival in the UK by raising awareness amongst beekeepers to aid early identification, which is vital to our chances of eradication. In 2016 Asian hornet was first found in the UK. Our established channels of communication with the BHAF enabled early notification to keepers which was of benefit when government clearance processes occasionally provided a challenge for early dissemination to the media. This has been addressed by introducing a rolling news page on gov.uk. Lessons learned in 2016 and 2017 led to an acknowledgement that beekeepers would form a key element of tackling Asian hornet in the future. Local associations and nationally the BBKA began to form Asian hornet action teams. The NBU have worked with the BBKA to achieve a level of consistency amongst the teams and clear understanding of roles and responsibilities. Defra commissioned an app to be developed for reporting Asian hornet and the BFA provided the opportunity to launch the app at their Bees in Business event in London. This example shows how we have worked together to adapt to new evidence and situations and how working together we can make the best use of limited specialist resources.

(ii) BeeBase Registration

At the beginning of the HBP only 9,000 beekeepers were registered on BeeBase. The BBKA and BFA were key to increasing the number of registered beekeepers. They advocated the benefits of signing up to BeeBase and the BFA now require that all its members are registered. To date, more than 40,000 beekeepers have registered on the system. It is important both for beekeepers and government. BeeBase allows the NBU to pass on important messages to beekeepers which can help them manage their bees –

starvation alerts, disease outbreaks (e.g. European foulbrood cases). For the NBU it helps identify apiaries which could be at risk of or a source of foulbrood outbreaks and those at risk when investigating Asian hornet sightings.

(iii) Advisory Leaflets

One of the aims of the Healthy Bees Plan was to raise standards of husbandry through provision of guidance and education on key principles of beekeeping. The Husbandry and Education Subgroup of the BHAF identified key themes to cover in educational leaflets. Several leaflets were developed by the group including the essence of beekeeping, inspecting colonies and identifying disease. The group contained members from several organisations who worked as a committee to develop and finalise the leaflets. The leaflets continue to be available on BeeBase.

Education

Education has been a key element of the plan from the outset. It has also been an area where Defra and APHA have provided some support to the other organisations to deliver training either directly through funding or in terms of speakers. One of the themes emerging from the discussions on education is that together we can achieve more. Working together we can maximise the number of beekeepers trained by allowing all members of each organisation to access training. One example is the small amount of funding provided to the Bee Farmers' Association to support the apprenticeship scheme. Using this funding the Bee Farmers' Association have been able to gain greater levels of funding from commercial sponsors to help run the apprenticeship scheme drawing on their own contacts (this is explored further below).

Working together we can also maximise the range of the training provided: the NBU can provide specialist training on disease and pest recognition while other aspects of beekeeping can be taught by experienced and trained beekeepers within the beekeeping organisations. The use of "train the trainer" courses and "course in a case" helped to further extend the reach of our education programme. One workshop participant commented 'Courses could not be run without the material provided by the National Bee Unit.' Cooperation is essential to deliver healthy bee days where NBU inspectors contribute to a programme arranged by a local association. Fera is also active in raising awareness of bee health issues through laboratory visits by local associations. Drawing on the specialisms of each organisation we have offered a range of training which is suitable for beginners, seeking to learn the basics of beekeeping, to experienced beekeepers, looking to expand their knowledge and keep up to date with the latest developments.

Case studies – Education

(iv) Apprenticeships

Prior to the Healthy Bees Plan the average age of bee farmers was sixty-two. Defra, the NBU, BFA, bee farmers and others have worked together in partnership to provide opportunities to new apprentice bee farmers.

The scheme has created a new support network for young farmers and the farms they work within. Bee farmers starting up a business are given impetus by what they have learned during the course. The scheme is described in more detail in a separate part of the Healthy Bees Plan review, but it has consistently met the targets for the number of apprentices being trained each year and has had real success stories from those participating. Of the ten apprentices which have qualified, nine have remained in bee farming and all have jobs. One of the apprentices said, “Completing my bee farming apprenticeship has empowered me beyond what I ever thought was possible.”

Defra provided some seed funding to enable the Bee Farmers’ Association to generate income from commercial sponsors and have continued to provide some funding for the administration of the scheme. BFA worked with the City and Guilds to develop the scheme. Defra experienced the benefits of the scheme as the hives on Nobel House were cared for by one of the apprentices.

(v) Healthy Bee Days

Disease awareness, vital to the control of endemic disease, is significantly improved by holding Healthy Bee Days. In 2018, among many other events attended or organised by NBU inspectors, seventeen Healthy Bee Days were held across England and Wales and were attended by more than 900 beekeepers in total. Early notification of exotic pests also maximises the chance of eradication.

Beekeeping Associations, the NBU and bee farmers work together in partnership to talk about disease. Often bee farmers who are DASH accredited provide diseased material (foulbrood) so attendees get the opportunity to see the disease. There are only low levels of foulbrood in the UK so having the opportunity to see disease in a comb is valuable for beekeepers. Beekeepers benefit from the experience and training of inspectors while bee inspectors are able to focus on their priorities of inspections and raising awareness of notifiable pests rather than the logistical arrangements for training events. These training days can result in beekeeper call-outs when they suspect there is disease present in their hives. This is valuable for the NBU as it can help identify an outbreak of notifiable disease as well as giving the inspector the opportunity to provide additional information and training to deal with the issue raised.

Science

The main benefit from this area was seen as the benefits arising from the regular meetings and enhanced opportunities for networking. These enabled issues to be discussed and opportunities for collaboration to be developed. Networks established through a project were thought to last beyond the funded project and lead to further co-operation and sharing of data (for example the EU COST networks). However, where there was competition for funding it was felt that researchers were less likely to share data.

It was perhaps the least successful subgroup and that may reflect the diverse approaches and priorities for honey bee research. This meant that it was difficult to identify agreed research priorities which could be pursued through other funding streams. There was an expectation that research projects could be commissioned under the plan, but this did not come about.

Due to the competitive element of funding, research may not be as natural a fit for partnership working as other aspects of the plan. However, projects which are funded by a partnership between stakeholders and government can be successful and obtain funding from research councils.

There is a wealth of information arising from honey bee research but the BHAF has not been entirely successful in distilling this into useful information for beekeepers (although it should be noted that not all research leads to practical applications for beekeepers). It was felt latterly that a few more research articles are now being written for grey literature.

Case Studies – Science

(vi) Chronic Bee Paralysis Virus (CBPV)

Infection of honey bees by CBPV causes severe chronic paralysis disease with symptoms including abnormal trembling, flightlessness and shiny, hairless abdomens. Until recently it occurred rarely and, in the random apiary survey carried out between 2009 and 2011, there was only a 0.75% prevalence. However, since 2015 there have been increased reports of the virus, in particular by bee farmers. The BFA highlighted this to the NBU who looked into this in more detail and found that beekeepers in the USA and Italy were also experiencing increased problems with CBPV. The NBU researchers decided that a thorough scientific analysis was required and therefore submitted a grant application to one of the research councils. As a contribution in kind the BFA pledged to provide access to colonies suffering from CBPV. Defra offered to provide a Government Partnership Award which boosted the ranking of the grant during the selection process. The application was successful, and research is now underway to analyse in more detail why this virus is having an increased impact and to develop management tools.

This is an example of partnership working between the beekeepers, NBU scientists, the University of Newcastle, Defra and a UK Research Council.

(vii) BeeConnected

BeeConnected is an online tool that aims to bring farmers and beekeepers together, and keep beekeepers notified when a neighbouring farmer is applying insecticides to their crops. BeeConnected was developed collaboratively by beekeepers (BBKA), farmers (NFU) and the crop protection industry (CPA). The aim is that farmers or spray operators can register for free with BeeConnected and enter the details of when and where they are planning to spray an insecticide that may present a risk to bees (for instance on a flowering crop, or where the field has a conservation buffer strip). As a result, a simple notification will be sent to neighbouring beekeepers who have registered with the system.

BeeConnected uses technology to offer a simple free tool connecting beekeepers with farmers and informing them of crop protection activities nearby. Use of the system is voluntary and the challenge is getting enough farmers and beekeepers in an area using the system to make it effective. While the industry has widely promoted BeeConnected, to date not enough farmers or beekeepers are using the system. This is an example of partnership working between beekeepers (BBKA), farmers (NFU) and the crop protection industry (CPA).

Conclusions

Relationships built through regular meetings help foster a partnership approach. This helps to make best use of specialist resources and improve uptake and reach of initiatives as witnessed by the dramatic increase in membership of BeeBase.

There have been times when lack of clear communication and competing priorities have meant that working together may have been challenging but the relationships built over several years and the shared goal of protecting bee health has allowed successful delivery of the plan.

There has been much to value in terms of working together and it should be an important element of any future plan. Neither the government nor beekeepers can meet the challenges facing the sector alone.

5.2 – Increased delivery of education, including apprenticeships

Content contributed by the British Beekeepers Association, the Welsh Beekeepers' Association, the Bee Farmers' Association and the National Diploma in Beekeeping

Chapter compiled and introduction added by Frank Petherbridge, Bee Health Policy, Defra and Rebekah Clarkson, National Bee Unit

Introduction

The delivery of good quality education and training to beekeepers of all levels of ability and experience has been a key element of the Healthy Bees Plan (Outcome 2 – Good Standards of Beekeeping and Husbandry). There are more than 40,000 registered beekeepers in England & Wales, the vast majority of whom are "hobbyists", each typically keeping a small number of colonies. Collectively, however, based upon estimates from the Bee Farmers' Association (BFA), at least 60% of UK colonies are managed by these hobbyist beekeepers. It is thought that those new to beekeeping may be more easily discouraged from continuing if they lack confidence in managing pests and disease.

Local and national beekeeping associations have long recognised the need for good training, particularly since the age profile of beekeepers remains high and so attracting and retaining new beekeepers is important. The British Beekeepers Association (BBKA) reports that during the period of the Healthy Bees Plan 7,672 people passed the Basic Assessment in beekeeping, with a further 272 Basic Assessment passes reported by the Welsh Beekeepers' Association (WBKA). BBKA substantially expanded its range of courses, both in terms of content and the variety of venues available. The BFA Apprenticeship Scheme has proved very successful in providing training for young beekeepers in relation to commercial beekeeping enterprises. Access to ongoing training is also very valuable for experienced beekeepers, as it allows them to keep up to date with new developments in husbandry and management of pests and disease, and to be better equipped to take on a training role themselves.

Under the Healthy Bees Plan, funding was made available through Defra and Welsh Government to contribute towards the provision of training. The key organisations involved in delivery of training, namely BBKA, National Diploma in Beekeeping (NDB), BFA, WBKA and the National Bee Unit (NBU), have continued to develop their modules and courses during the ten-year period of the plan. In doing so, the needs of beekeepers have been assessed through surveys and other feedback from those who have attended courses, or from local beekeeping associations.

In addition to education and advisory material provided by the NBU, Defra and Welsh Government worked with Bee Health Advisory Forum (BHAF) stakeholders to understand gaps in education and provided funding to meet the needs identified. In the first year of the

plan Defra contracted the BBKA to develop a training course termed “Course in a Case” (CiC), which is described below. CiC was made available to associations and continues to be available to beekeepers.

Healthy Bees Plan procurement from 2012-13 sought to diversify the level and locations of bee health education, and a tendering process to provide education throughout England and Wales began. Contracts were split into three lots: BBKA developed and delivered intermediate level training; NDB developed and delivered courses for experienced beekeepers, more likely to become involved in training others; BFA proposed that funding should be used to support their Apprenticeship scheme.

All contractors were required to ensure that applicants were registered on BeeBase and teaching outcomes were aligned with the aims of the plan. In 2015-16, the education contracts were put out to open tender and these three organisations were again successful. This review chapter focusses on what has been delivered under the bee health education contracts.

BBKA

Membership of the BBKA gradually increased from 18,475 members in 2010 to around 27,200 in 2019. Alongside the consistent increase in membership over that period, continuous efforts to provide education and training have led to an increased proportion of members holding intermediate beekeeping qualifications (Figure 1). These include BBKA modules, and courses in General Husbandry and Advanced Husbandry. In 2010, only 254 BBKA members (1.4% of total membership) had attained intermediate qualifications, while in 2018 the number of members who qualified in BBKA modules, General Husbandry or Advanced Husbandry stood at 3,661 (13.9% of total membership). BBKA attributes this increase in beekeeping knowledge and skills almost entirely to the promotion of the craft of beekeeping, the provision of education at all levels and the BBKA examination system, which aims to assess beekeepers’ learning in a constructive way.

Figure 1

A great deal of work was done in 2010-11, close to the start of HBP, to develop educational materials and begin delivery of CiC, available to beekeepers at various competence levels: “Novice”, “Improver” and “Proficient” (colour-coded yellow, red and green). A plan was developed in consultation with interested parties including the Healthy Bees Programme Board Husbandry and Education Group, for the delivery of an approval system for trainers of beekeepers, and a system of optional credits for beekeepers who attended courses, should they wish to collect credits as part of their Continuous Professional Development.

Once the educational materials for CiC had been produced, the materials were marketed but proved to be too expensive for beekeepers. The materials were subsequently made available digitally, via a memory stick, and this proved to be popular and user-friendly.

Education roadshows were held in village halls and other local venues to publicise the BBKA’s new education initiative. BBKA employed an Education Co-ordinator, initially for a one-year fixed-term, and this was subsequently extended. BBKA believe that the effectiveness of CiC was demonstrated by the increase in the number of intermediate certificates awarded through the BBKA examination framework (Fig.2).

BBKA certificates awarded (Intermediate qualifications)

		2010	2011	2012	2013	2014	2015	2016	2017	2018
Modules	**Number of candidates**	331	327	667	632	590	573	490	512	485
	Pass	231	235	490	441	445	420	325	361	361
	Pass rate	*70%*	*72%*	*73%*	*70%*	*75%*	*73%*	*66%*	*71%*	*74%*
General Husbandry	**Number of candidates**	19	76	46	25	58	62	31	33	30
	Pass	13	54	31	19	40	41	17	21	17
	Pass rate	*68%*	*71%*	*67%*	*76%*	*69%*	*66%*	*55%*	*64%*	*57%*
Advanced Husbandry	**Number of candidates**	13	8	15	20	24	40	20	32	25
	Pass	10	4	5	11	9	17	8	18	17
	Pass rate	*77%*	*50%*	*33%*	*55%*	*38%*	*43%*	*40%*	*56%*	*68%*
BBKA membership		18475	22728	24531	24118	24771	25457	25462	25382	26413
Intermediate qualifications gained (each year)		254	293	526	471	494	478	350	400	395
Intermediate qualifications gained (cumulative)		254	547	1073	1544	2038	2516	2866	3266	3661
Intermediate qualifications as % of membership		1.40%	2.40%	4.40%	6.40%	8.20%	9.90%	11.30%	12.90%	13.90%

Figure 2

Training and education activities in the last nine years have sought to increase awareness of the importance of pollinators as well as improving beekeeping skills and knowledge. Thirteen trainers have been delivering courses in eight regions covering all of England and Wales. The demand for education and training has now shifted into more specific areas which address two important issues in managing honey bee colonies: bee health and queen production. Currently, a significant number of queens used in colonies in the UK are raised overseas and imported into the country. This presents potential risks in terms of bringing in exotic pests and diseases that are currently not present.

In response to these issues BBKA developed and launched two new certificates in 2017, aimed specifically at improving the management of pests and diseases as well as improving queen raising skills. These were the “Honey bee health certificate” and “Honey

bee breeding certificate". BBKA believe that further training and support for those looking to attain these new qualifications is needed in the near future to respond to the demand for education relating to these topics.

BBKA General Husbandry Training initiative

As a result of the large influx of new beekeepers into local associations, demand increased for training pitched at a level beyond "beginner" level. Consequently, a need also arose for higher numbers of competent trainers and assessors. BBKA addressed this need by setting up a General Husbandry (GH) Training initiative, funded by Defra. This aimed ultimately to support local associations to increase the number of their members trained to GH level and, consequently, to increase the number of potential "trained trainers".

The initiative aimed to provide local support for training candidates at the GH level, and to ensure that potential new trainers and assessors would themselves be trained to at least one level beyond that of the course they were delivering or assessing. This would therefore ensure good quality training, as well as higher numbers of trainers. Each trainer was qualified to at least Master Beekeeper level and was familiar with the GH assessment procedure.

BBKA recognised that in previous years there had been a significant failure rate among candidates taking the GH Assessment and resolved to support candidates by, for example, making sure that they knew what to expect from the assessment, including offering mock assessments. The intention was not to supplant existing good practice and training, but to provide support where needed.

The role of the trainer was partly to act as a tutor, mentor and facilitator for students to continue to improve at their own pace. Trainers were given the freedom to adopt their own approach and style to deliver training to best effect.

The GH course comprised a mixture of theory and practice: it could include attendance at lectures and conventions, as well as demonstrations and apiary visits. The course typically involved around 16 hours of indoor study work, held in the period January to March. When the active season began the group would meet again for a half day of apiary work. Where relevant training opportunities already existed, they were used in preference to training being duplicated.

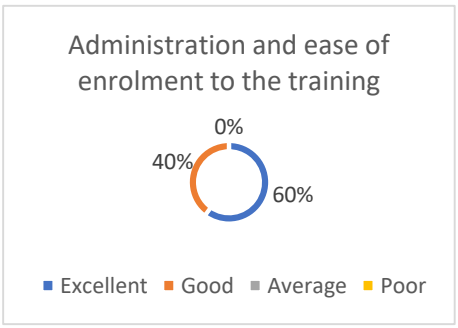
BBKA arranged for a central point of contact to be available to individuals and local associations interested in taking part. Trainers held an introductory meeting with their student group: a training plan for the group was then devised, and a series of study meetings scheduled. The enrolment fee for the GH course in 2019 was £90 per student per year of study (£300 for the Advanced Husbandry course).

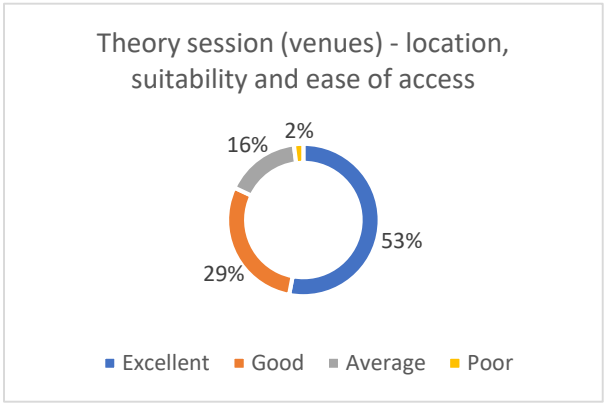
Seven training areas across England and Wales have been used, each with two trainers and a maximum of twelve students per course. The areas were Yorkshire, North West, Midlands, South West, East, South Wales and South East.

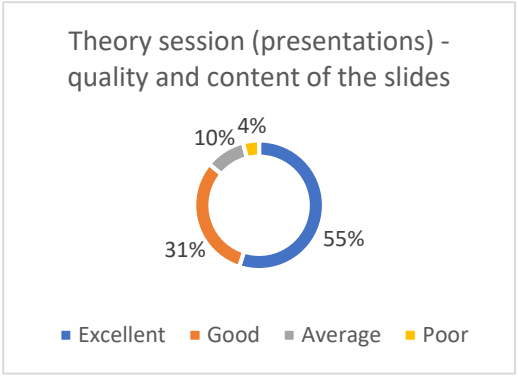
Summary of conclusions and recommendations from recent BBKA General Husbandry Training Reports 2017-19

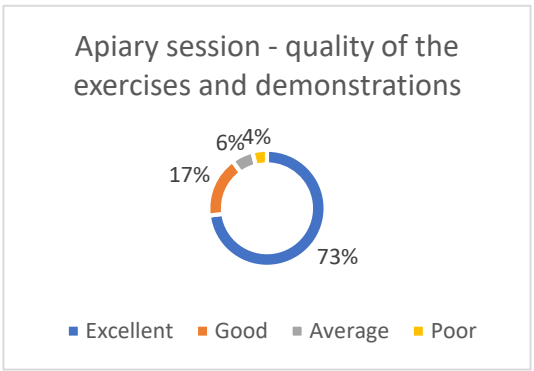
- Survey responses from trainees and associations (Figs. 3 and 4 show data from 2017, for example) indicated that local associations were not meeting the demand for training, so there was a role for BBKA
- Candidates generally found the GH training useful and informative: most stated that the training met their expectations
- Suggestions for improvements included more emphasis on practical work and apiary sessions and less on classroom theory
- Queen rearing and swarm control were the areas of most interest and where candidates felt least prepared
- There was a shortage of Master Beekeepers, including those trained to support the GH initiative

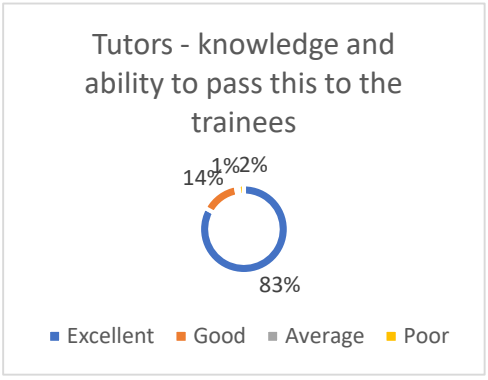
Twelve candidates who attended the GH training in 2017 also took the GH assessment and ten passed, a pass rate of 83%. In contrast, the pass rate for GH candidates who did not attend the training was 55%. While it can be argued that the GH training helped to increase the pass rate, BBKA acknowledge that this would only be an assumption since the pass rate for the former group of candidates, had they not attended the training, could not be known.



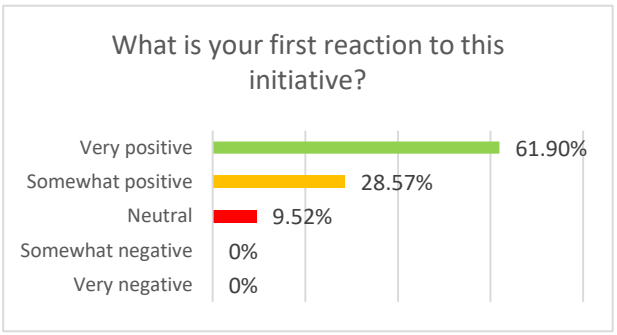


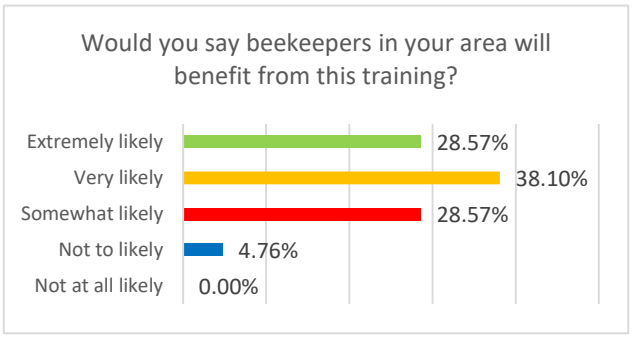


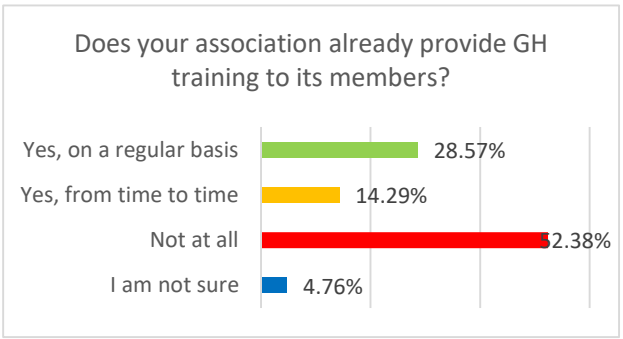


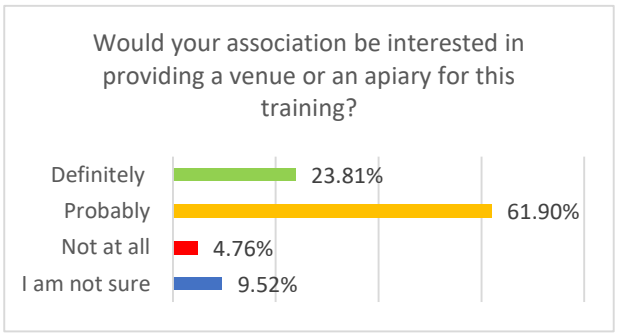


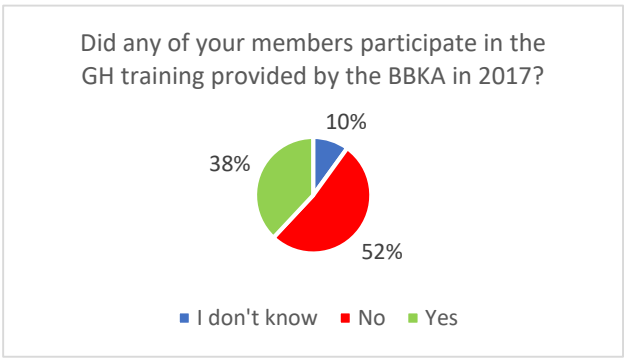
Figures 3-8: Results of 2017 BBKA survey of trainees (sixty-four respondents, from eighty-eight trainees)











Figures 9-14: Summary of results from the 2017 BBKA survey of Beekeepers Associations (twenty-one associations took part)

While the GH course in 2018 was subscribed to capacity with eighty-six trainees as in 2017, initial interest in 2018 was significantly lower. To tailor supply to the apparent

demand, GH assessment training in 2019 took place in only three locations rather than seven. A total of forty-two places were available in 2019 and thirty-nine were filled. BBKA believe that most of the potential candidates for this course have now attended the training and expect that in 2020 the demand for GH training will be even lower. The GH assessment training may be offered in only one location in 2020; this is likely to be Stoneleigh as it is fairly central and the BBKA own the facility.

Survey responses from 2018 and 2019 trainees again indicated that local beekeepers' associations were not able to offer sufficient training, so there still appeared to be a role for BBKA to provide training.

In terms of training format, queen rearing, disease recognition and more practical work with bees were the three aspects that most candidates stated they would like to see more of. Given the emphasis on own queen production in future, and on disease management, there is need and space for training courses tailored to those wishing to improve their skills in these areas.

The tutor to trainee ratio of 1:7 was commented on by several trainees, who suggested a lower ratio for the apiary sessions. This could be addressed in future training, where an extra tutor could be appointed for the apiary day only.

Summary of conclusions and recommendations from the 2018 and 2019 Advanced Husbandry reports

- Demand for Advanced Husbandry training in 2019 (17 applicants, of whom 15 were accepted onto the course) remained similar to 2017 and 2018 and was expected to continue at this level for the foreseeable future

- The format of one course per year at one venue (Stoneleigh) for the whole country seemed to work well

- Trainees who did not already have the microscopy certificate felt that they would have benefited from some practical microscopy work – this could be addressed in future

- Following feedback received in 2018, the 2019 course was residential, running over a three-day weekend. This reduced the amount of travel, provided an opportunity for the trainees to socialise and learn from each other's experience, and provided additional time for practical work and discussions

- A survey conducted following the 2019 course was completed by ten of the fifteen participants. They indicated that they would like to see further practical work and time for discussion included in the course.

  The average score for the question, *"How helpful was the training to you in becoming a better beekeeper or gaining confidence in taking the AH assessment?"*

was 90, where a score of 100 corresponded to “extremely helpful” and zero “not helpful at all”.

The other scores were:

97 for Content of Training

94 for Quality of Practical Work and Exercises

99 for Tutor Knowledge and Quality of Training

77 for Accommodation and Catering

Accordingly it is not proposed that the format or content of the training should be altered in 2020 but using different accommodation will be considered.

Queen rearing

In late summer 2019, with the support of Defra, the BBKA ran five weekend queen rearing courses around the country. A total of sixty-two beekeepers attended the courses, with beekeeping experience ranging from two to sixty-five years. The courses were pitched at intermediate beekeeper level and included an even split between activities in the apiary and classroom.

The course tutor for each course was Sean Stephenson, a Master Beekeeper. Sean was assisted by a local Master Beekeeper, with the intention that each area would continue the course in subsequent years. All course materials were made available to attendees and permission given for the materials to be used on future courses.

The BBKA provided a mini nuc for each candidate which they set up for the introduction of a queen cell and took away at the end of the course. Where possible, the candidates populated the mini nucs with bees and queen cells. Some of the attendees later reported that they had been successful in producing mated queens.

Each course was run over two days, with the first focussed on practical aspects of queen rearing and the second day following up with colony manipulations relating to queen rearing. Going forward, the course could be compressed into one day giving the possibility of accommodating more beekeepers in a weekend.

The queen rearing courses were run at various association apiaries around the country as well as at the BBKA training apiary at Stoneleigh:

- Quantocks, Somerset 3-4th August
- Gregynog Hall, Wales 10th-11th August
- Stoneleigh, Warwickshire 7th-8th and 14th-15th September
- Cleveland, 5th-6th October

Photo: Left: "Miller frame" with queen cells. Photo credit: BBKA. / Right: Populating mini nucs with bees. Photo credit: BBKA.

Following each course, the attendees were invited to complete an online survey and, where possible, the feedback was used to improve the subsequent course. Thirty-eight of the sixty-two attendees responded and, on the whole, the responses were extremely positive, with over 80% awarding top marks for each topic.

All respondents were either satisfied or very satisfied that the course had met their expectations, and almost all agreed or strongly agreed that the facilities at the course venue were appropriate for the course.

The comments below from attendees provide a flavour of how the course was received:

"I learnt a lot and came away with some great tips and plenty to think about in formulating my queen rearing plans for next year. As might be expected, we covered some areas I was already familiar with, but even that was delivered with a new perspective. A very worthwhile 2 days."

"Pitched just right for my level of experience by an excellent tutor who was not afraid to own up to mistakes. Both enjoyable and even inspirational."

"If possible I would have liked the course a bit earlier in the year so that then I could try things out at home whilst they were still fresh in my mind. I appreciate that beekeepers are busy earlier in the year however."

"The course made me feel much more confident about queen rearing, and keen to try the techniques out next year."

"Excellent coverage of the subject from both a theoretical and practical perspective. The balance between time in the classroom and practical work in the apiary was ideal. I went home with a thorough understanding of queen rearing and a plan to put it into practice next Spring."

"Really fabulous course run by knowledgeable yet approachable teachers. Wish I'd done it one or two years ago. Many thanks."

"I thoroughly enjoyed the weekend and the content was excellent. I don't think anything needs changing apart from the weather!"

Recommendations and the future

Feedback from the courses indicates that they were well received and that the BBKA should run further courses if possible. The opportunity to populate mini nucs was a highlight for the attendees, who also appreciated having a Master Beekeeper from another county to run the course.

Potential changes include:

- Running the course earlier in the season, say July/August
- A one-day course, based upon the first day of the 2019 course
- Splitting the attendees (twelve per course) into three or four groups for practical sessions
- Engaging more Master Beekeepers as course leaders
- Having two local association assistants for each course

It was not difficult to fill the places on the 2019 courses, so it seems that there is demand for the increased capacity that one-day courses would provide.

There are plans to run "Queen Rearing Made Simple" workshops at the BBKA Spring Convention, as well as an advanced workshop on running a one-day queen rearing course.

National Diploma in Beekeeping

Introduction

The National Diploma in Beekeeping Examination Board (NDB) were originally commissioned by Fera (now Defra) under the Healthy Bees Plan to create and execute a series of 'Short Courses' for the purpose of improving beekeeping competencies in England and Wales.

In England and Wales, since 2011, the NDB have run short courses, providing more than 1,500 student places to more than 600 students, enabled by the funding provided by Defra.

The high proportion of beehive numbers in the UK (>60%) owned and managed by hobbyist beekeepers provides a vulnerability to the wider pollination benefit they provide.

Hobbyists generally keep bees for fun, with the honey/products of the hive providing minimal contribution to their income. As such, they are less inclined to invest in professional training and, if conditions become adverse (e.g. Pests & Diseases) they may exit the hobby rather than upskill to meet new challenges. This was clearly demonstrated when Varroa first arrived in the UK (1992), which saw a widescale loss of beekeepers who didn't wish to learn the new techniques for Varroa management.

> *"For me it was perfect. Compared to the local training I am used to, the professionalism was a welcome relief" (Student CB).*

Availability of good, accessible training has improved under the Healthy Bees Plan, but invariably there is churn in beekeepers, and new threats are omnipresent. The NDB has aimed teaching at Advanced Beekeepers meaning not just those with many 'hive years' of experience, who are naturally sought out by newer beekeepers to answer questions, but those who show particular aptitude for teaching. By targeting those providing teaching/advice within their own club/geographic areas, the target audience benefitting from our teaching far exceeds just the individuals attending our training. Through a cascade of teaching by our students down into their own clubs, it can reach a much wider audience. Continuing to teach pro-active beekeepers who seek out training, ensures they become well respected for their theory and practical skills, and in doing so, cements their positions within their own clubs, and the idea that education and competency are skills to be encouraged.

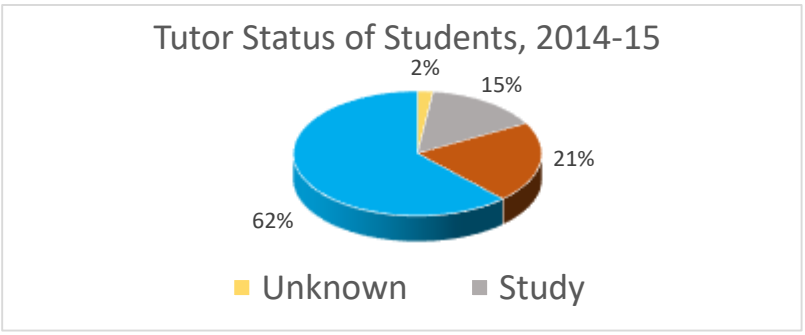


Figure 15: 83% of students already or plan to teach

Training Requirements

Each short training course is conducted over two days, which has proved very effective for student learning with lots of positive feedback. Rather than covering the topics in a single intense day, the more relaxed pace provides more opportunities for interaction with students, and with two NDB tutors on each course (and an average of just over nine students per course) the extremely low student to tutor ratio provides an extremely high student engagement with the learning. Feedback has confirmed how important the high levels of interaction and ability of the NDB tutors to engage in discussions are for our students.

Rather than teaching by 'rote' this relaxed pace allows students to really discuss the underlying ideas and concepts and be sure to have understood them before we move on.

The NDB Short Courses are aimed at advanced students, looking to improve their beekeeping competencies. Beginner beekeepers are best catered for by teaching which is 'closer to home' provided by local beekeeping clubs and businesses, who can provide one-to-one support with minimal travelling.

The range of courses is diverse, covering a wide range of areas such as handling skills, nutrition and disease. A full list of training titles is shown below:

Adult Bee Diseases	**Anatomy and Dissection**	**Asian Hornet**	**Botany for beekeepers**
Brood Diseases	**Colony manipulations**	**Handling skills**	**Honeybee Behaviour**
Integrated Pest Management	**Microscopy for beekeepers**	**Migration for pollination**	**Pollen & Nutrition**
Queen Raising and Stock Improvement	**Seasonal management**	**Swarm control**	**Teaching beekeeping**
Branch Microscopist	**Asian Hornet*** **(1-day course)**		

This range of training courses has been found to be very successful in balancing practical 'in season' teaching, when many beekeepers are busy, and more theoretical courses well suited to the winter months. On average, each student attended 2.2 courses. Ninety-one students each attended four or more courses, underlining the perceived quality of the training and the appeal of the range of titles on offer.

In the early years of the plan, the emphasis was on 'train the trainers', i.e. focussing the limited time and people available on training current and potential trainers, and having those trainers cascade new skills and information locally. Course application forms showed that 81% of the total NDB Short Course attendees identified as either currently being trainers or intending to become trainers.

> *"I just have to say how brilliant the course was this weekend - it was a true privilege to have such well informed, helpful, approachable tutors and facilities were just stunning. (Student JS)*

> *"The course exceeded all my expectations and I feel I learned a huge amount. Thoroughly recommended" (Student AG)*

> *"I was absolutely enthralled by this course. I particularly enjoyed the interaction with other beekeepers and the very practical advice from our experienced tutors all clearly explained" (Student Anonymous)*

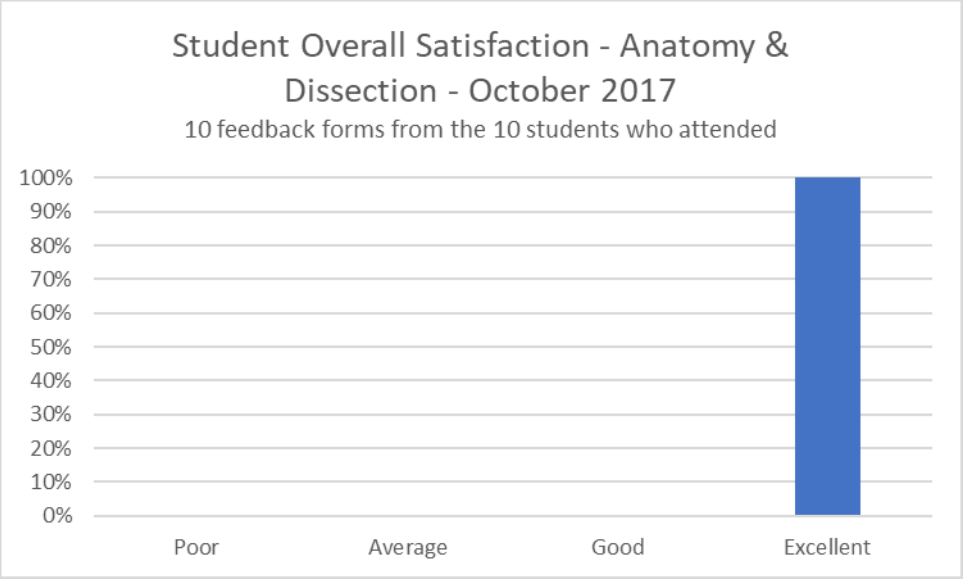


Figure 16: Student Satisfaction Graph

Feedback forms show consistently excellent satisfaction at meeting the students training needs. Students are requested to provide suggested improvements as well as any additional training needs.

"An excellent course which has influenced my outlook and plans" (Student RP)

"Excellent Course + has improved my confidence and skills" (Student DC)

Measurable outcomes

The BBKA and WBKA have operated beekeeping examinations for many decades. In both systems, the 'advanced beekeeper' certificates were Advanced Theory, Advanced Husbandry, and Master Beekeeper.

Reviewing the examination successes of English and Welsh candidates as published by the BBKA between 2011 and 2018, the following figures emerged:

- 66% of new Advanced Husbandry certificate holders attended NDB Short Courses
- 54% of new Advanced Theory certificate holders attended NDB Short Courses
- 64% of new Master Beekeepers attended NDB Short Courses

This system of advanced examinations operates independently of NDB's activities and NDB believes that the above figures demonstrate that its Short Courses have indeed been successful in attracting those 'advanced beekeepers' across England and Wales.

Five of the Short Course students during this 2011-2018 period have achieved National Diploma in Beekeeping awards. This is the highest UK qualification in beekeeping, which generally requires Master Beekeeper status as the entry qualification. A further three Short Course students enrolled in the 2019 examinations. In each case, it was the Short Course programme that introduced students to studying for the Diploma.

Written student feedback has shown consistent satisfaction with the Short Courses (averaging rating 3.9 out of 4), and a number of consistent positive themes have emerged:

- Quality of tuition, demonstration and training facilities
- Ability to mix with other like-minded attendees from across the country
- Ability to use course skills/knowledge in students' local training activities

- Valuable for those preparing for the BBKA & WBKA examinations and assessments

> *"I found the ratio of trainers to students exceptionally good and it was very good to have such knowledgeable teachers" (Student Anonymous)*

> *"Good lively interaction & ability to flex" (Student DP)*

> *"Thank you for encouraging questions and & dealing patiently with all levels of competence" (Student SM)*

Bee Farmers' Association Apprenticeships

The Bee Farmers' Association (BFA) has tackled the issue of attracting younger people to pursue careers in bee farming by setting up the successful Rowse/BFA Apprenticeship scheme. This has involved working with sponsors including Defra which, although not initially involved, has latterly contributed around 7% of the funding for this scheme.

In 2014 six young people were recruited onto the programme to work towards a newly designed qualification: The Wax Chandlers Diploma in Excellence in Bee Farming. The qualification was written for the BFA by City and Guilds with the assistance of the Livery Companies Skills Council.

In 2019 BFA appointed its 30th apprentice, which was impressive for an organisation of around 460 members. The scheme has delivered an increase in the number of bee farmers of almost 10%. The BFA is extremely proud of the scheme: the level of support each apprentice has received has allowed them to develop to their full potential, with three of the first ten apprentices to complete the course passing with distinction.

Photo: The first six apprentices to qualify, pictured with the then Master of the Wax Chandlers

The apprenticeship involves three years on the job training, which aims to make apprentices into future industry leaders. Almost all the apprentices have continued in the industry - an enviable record for apprenticeship schemes in the UK. BFA has achieved all of its Key Performance Indicators with regard to the scheme.

BFA is extremely pleased that Defra became a partner in this scheme, albeit Defra's involvement came at a late stage. BFA are also pleased to say that two apprentices have helped look after the bees on the roof of Defra's London offices.

Each apprentice works for three years on a commercial bee farm. Each year there are two block release weeks at BFA's study centre at East Surrey Bees in Caterham where apprentices pool their experiences and focus on the academic side of the job.

The subjects studied by BFA apprentices are:

Introduction to beekeeping	**Queen rearing and stock improvement**	**Setting up a business**
Microscopy	**Seasonal Management**	**Finance**
Diseases	**The modern processing of beeswax**	**Business structures**
Anatomy and dissection	**The uses of beeswax in the modern world**	**Marketing**
Integrated Pest Management	**Bottling and presentation**	**The competitive environment**
Pollen and nutrition	**Equipment cleansing and recovery**	**The industry worldwide**
Botany and forage sources	**Basic carpentry skills**	**First Aid**
Food hygiene	**Health and safety**	

Apprentices are monitored weekly throughout the three years by assessors and verifiers through BFA's e-learning platform OneFile. Many take up the opportunity to study abroad during their apprenticeship.

Photo: Minister with responsibility for honey bees Lord Gardiner (third from right) meets BFA chairman Ged Marshall (left) with apprentices (left to right) Phoebe Lamb, Richard Cooper and Shelley Glasspool.

These are the stories of some of the first apprentices to qualify:

Richard Cooper was the first BFA apprentice to achieve a distinction. He worked his apprenticeship under the tutorship of his father at Built House Bees in Kent. Richard says he got plenty of hands on experience – not just looking after honey bees but in woodwork, presentation skills and how to add value to a small business. When he joined the company honey production was the main source of income. Richard realised quickly that this was very dependent on good weather. He decided to develop new products using the beeswax – candles, cosmetics and polish. He says he learned much from his week-long block release sessions run by our assessors – David Rudland, Celia Rudland and Gay Meyrick – all working bee farmers. Richard says he discovered that beeswax was a wonderful substance to work with. He lost track of how many candles he tested, and he delivers an interesting talk on this showing how he learned from his mistakes. He has now taken many of his new products to market proving what an asset he is to the business.

Timothy Davis has worked at Field Honey Farm – trained by Master Bee Farmer Robert Field. It is through his employer's links with the New Zealand bee industry that Timothy was one of the first apprentices to spend time training on a Manuka farm. He made a great impression on his hosts in New Zealand – not least by turning up in muddy boots at the airport which were promptly confiscated by immigration officials! Tim has proved an asset to his business – turning out at 3am one morning because he was worried that there was something wrong with the bees. He has also proved a rather good wildlife photographer – a stunning bee photo of his appeared on the front cover of a prestigious bee magazine.

Rebecca Marshall was the first apprentice to join the scheme. She worked her three-year apprenticeship on her father – Master Bee Farmer Ged Marshall's – farm. Daughter and father are the epitome of what this scheme is all about: passing on industry skills for future generations. Ged is an expert in raising good queen bees – Rebecca has not just learned from him but travelled far and wide in her studies – Australia, New Zealand and Denmark. She has also gained much from working with our major sponsors, Rowse Honey. Rebecca achieved a distinction.

Hannah Reeves completed her apprenticeship with urban bee farmers – the London Honey Company. She is known to many for her high profile in the industry – seizing all opportunities to publicise the bee farming apprenticeship scheme. Hannah looked after the

bees at Defra Nobel House, meeting many politicians and ministers in that role. She also achieved the accolade of being mentioned in Parliament. She, too, has travelled widely in pursuit of her studies and produced articles for bee magazines demonstrating her enthusiasm for bee farming.

5.3 – Beekeeping and bee farming during the Healthy Bees Plan

Content contributed by the British Beekeepers Association, the Welsh Beekeepers' Association, the Bee Farmers' Association and the National Diploma in Beekeeping.

Compiled by Rebekah Clarkson, National Bee Unit and Frank Petherbridge, Bee Health Policy, Defra

Introduction

This chapter of the Healthy Bees Plan review presents some insights from major beekeepers' organisations into aspects of beekeeping and bee farming during the course of the Healthy Bees Plan in England and Wales.

The associations which contributed to this chapter are the British Beekeepers Association (BBKA) and the Welsh Beekeepers Association (WBKA), both representing hobbyist beekeepers, and the Bee Farmers' Association (BFA) representing commercial beekeepers. All three of these organisations are members of the Bee Health Advisory Forum (BHAF). They were invited to reflect on successes, areas for development, and the health of the beekeeping and bee farming sector generally. This chapter addresses various themes such as association membership, research and efforts to encourage young people to take up beekeeping, whether commercially or on an amateur basis.

The BBKA was established in 1874 as a London-based beekeepers club. It soon began to affiliate county associations, and now supports over 260 local affiliate beekeeper associations throughout England. The BBKA currently has its headquarters at Stoneleigh, Warwickshire. The association campaigns, informs, educates and engages in partnership working to secure the future of honey bees with and on behalf of the beekeepers it represents, and to benefit food production and the environment.

The WBKA is the service and facilitation body to which nineteen local Welsh beekeeping associations are affiliated. WBKA is managed by a team of volunteers on behalf of a Council made up of delegates from each of the local associations. The National Bee Unit's (NBU) Regional Bee Inspector covering Wales, along with Welsh Government's Bee Health Policy Advisor, attend Council meetings. WBKA makes it a requirement that Welsh beekeepers associations register their members on the NBU's BeeBase website.

The BFA is the voice of professional beekeeping in the UK. Its objectives are to increase UK honey production and availability by recruiting more bee farmers and increasing the productivity of bee farming businesses; to provide managed and targeted pollination services to improve crop yields; to provide services, information and support to members; and to represent the industry. The BFA is the commercial trade association for the sector, and its members throughout the UK produce honey and apiculture products including

beeswax, pollen, propolis and royal jelly. Products are supplied in bulk, for wholesale and for retail. The BFA makes it a condition of membership that bee farmers register on BeeBase.

Bee farmers provide contract pollination services through the BFA, helping growers to increase their yields. The BFA manages 40,000 movements of hives annually and believes that the majority of commercial pollination in the UK is carried out by its members. Supply exceeds demand: not enough pollination contracts are available and the BFA have more colonies available to provide pollination services. The BFA often feel that the contribution they make to pollination is undervalued, as pollination can improve both the yield and quality of fruit. The BFA has a dedicated pollination office delivering highly specialised guidance to calculate the ratio between crop type, area and required number of beehives.

Membership

BBKA membership has steadily increased from 18,475 in 2010 to 27,200 in 2019. BBKA has noted a reduction in the level of churn among its membership, i.e. more new members now persevere with beekeeping rather than giving up within a short space of time. Previously observed levels of churn may be attributable to new beekeepers lacking awareness of the amount of work involved or experiencing the loss of their first colony at an early stage. WBKA has suggested that gaining a better understanding of the reasons involved could be a useful area for research. The reduction in the level of churn may be to do with the fact that more training and education opportunities now exist for beekeepers, or that there is more emphasis on improving skills through mentoring, but it is not possible to say this conclusively.

The total number of Welsh local association members has fluctuated over the last decade or so, but there has been an overall upward trend. In 2011, for example, membership stood at 1,655 but by the end of 2019 it stood at 1,945. WBKA understands that the actual number of beekeepers in Wales far exceeds this and so, through its associations, constantly seeks ways of attracting these beekeepers to join. Anecdotally, fluctuations in membership levels and demand for training courses seem to be linked to the amount of media coverage given to beekeeping and the perceived plight of honey bees. Overall, the demand for courses appears to have grown year on year and most associations now have thriving annual beginner courses; some also provide ongoing mentoring which can help to reduce the likelihood of new beekeepers abandoning beekeeping.

The BFA represents 465 professional bee farmers in the UK. Of this number, 178 have joined since 2010, and that increase has been achieved without having instigated any membership recruitment drive. BFA has a very low dropout rate: most members remain with the organisation for at least ten years. BFA has very strict membership criteria, in the sense that applicants must prove they are running a business. Around the start of the Healthy Bees Plan in 2009, BFA's policy was that membership was open only to bee farmers operating a minimum of forty hives. This minimum no longer exists, as the association decided that the key factor should be whether a potential new member is

operating a business. The BFA currently charges an annual membership fee of £200 per year.

Education

Education is discussed very briefly here, as education funded by HBP is covered in Chapter 5.2.

BBKA has shown continued commitment and support towards the Healthy Bees Plan over the course of the plan, to inform and educate its membership and latterly through the delivery of intermediate level education. Sustained efforts to provide members with education and training have resulted in a higher proportion of members holding intermediate beekeeping qualifications. This has been achieved alongside the consistent increase in membership noted above.

BBKA has expanded its activities in relation to the provision of education, both in terms of the courses available and the provision of courses more widely across the country. BBKA's headquarters is currently being converted into an education centre, primarily but not exclusively with the idea of encouraging visits from schools. It will include a special glass-fronted feature hive, allowing close observation of bees in action.

WBKA publicises among its members the more advanced beekeeping courses currently provided by the BBKA and the National Diploma in Beekeeping (NDB), subsidised by Defra. Over the last decade, both the NBU and Welsh Government have contributed to the development of bilingual science-based educational booklets on the main aspects of beekeeping; these are provided free of charge by WBKA to all members of local associations, with sufficient provision every year for all beginners. The most recent of these are recognition cards covering all the pests and diseases likely to be encountered by beekeepers. WBKA seeks guidance from members regarding subjects that they would like to see covered in future booklets.

The BFA receives many enquiries from hobbyist beekeepers interested in scaling up to become bee farmers and offers relevant training. The BFA's flagship apprenticeship programme, which began in 2013, equips young beekeepers with the skills they need to succeed as bee farmers. The programme was developed in association with City & Guilds and BFA worked to ensure that it was consistent with the pollinator strategies of the four UK administrations. To date, thirty apprentices have received comprehensive practical training through the programme, primarily in technical aspects of bee farming but also in useful business skills such as communication, marketing and business planning.

Research

BFA and its members are involved in a number of research projects relevant to commercial beekeeping. For example, the BFA is a consortium member of the Chronic Bee Paralysis Virus Project, whose objectives are: modelling the epidemiology and drivers of chronic bee paralysis (CBP); CBP virus evolution, transmission and virulence; quantifying the impact of co-stressors on disease development; developing a management

toolkit to mitigate chronic bee paralysis. Other consortium members include UK universities and the NBU.

BBKA has a research committee and awards grants for research projects and PhDs being carried out at universities and other institutes. In 2018, for example, four new projects were funded including work on Varroa tolerance mechanisms and an investigation of foraging behaviour of colonies located in urban and rural environments. In 2017, a large grant helped to fund the building of a laboratory in Plymouth which is able to produce standardised cultures of bee cells, to aid testing of potential drug treatments and understand the mechanism of conditions such as deformed wing virus.

Most of the Welsh associations have contributed to research in some way, including funding for the REViVe programme organised by Bee Diseases Insurance Ltd. Members of the Llyn and Eifionydd Beekeepers Association, for example, commenced recording of winter losses in 2010 with emphasis on comparing colonies treated for Varroa with non-treated colonies. Records indicated that non-treated hives were surviving better than had been expected and this has generated a lot of interest from academic and research organisations, contributing to research at universities in the UK and abroad. A separate non-treatment apiary has been set up to evaluate whether locally adapted bees on Anglesey have increased their ability to tolerate/resist Varroa.

Issues affecting beekeeping and bee farming

Over the past several years, there has been a great deal of interest in beekeeping from individuals whose primary motivation is concern for the environment. Similarly, many organisations keen to help bees have set up beehives on their premises, often on roofs. BBKA's response to such interested parties now tends towards encouraging them to plant for pollinators, as it takes the view that in some locations, e.g. London, there is an issue in terms of lack of available forage for bees. Some organisations who wish to get involved in supporting honey bees now prefer to make a donation, either to the BBKA or to local beekeepers' associations.

BBKA recognises that habitat loss, loss of forage, and monocultures where forage is only available for a limited time are major issues, and so it works with local authorities and organisations such as Buglife to encourage planting of field margins.

BBKA has also endeavoured to promote public campaigns and land management plans that are consistent with Bees' Needs messages[4]. Over the last two years of the plan, BBKA – with support and input from the NBU – has worked to coordinate Asian Hornet Action Teams (AHATs – recently renamed Asian Hornet Teams [AHTs]) across the UK to create a network of informed beekeepers able to identify and report sightings of Asian hornet, a significant risk to beekeeping which has increased during the course of the Healthy Bees Plan because of its continued spread in various European countries

[4] https://www.gov.uk/government/news/bees-needs-food-and-a-home

including France, and its persistence on Jersey. WBKA also works with the NBU and shares procedures with BBKA to raise awareness of the Asian hornet threat and actions to be taken in the case of a suspected sighting. This contingency work is discussed in detail under Outcome 3 of the Healthy Bees Plan Review.

BBKA and WBKA are very concerned about the level of imports of bees into the UK, and so consider the development of queen rearing skills among UK beekeepers to be very important. Local associations are encouraged to rear their own locally adapted queens.

Partly in the interests of improved biosecurity, WBKA has been supported by both the NBU and the Welsh Government in encouraging beekeepers to buy and breed from locally adapted bees rather than importing or even moving bees any great distance, with the attendant risk that such movements present. The Healthy Bees Plan has increased awareness of the need for good beekeeping practice and enabled a more cohesive approach amongst the main stakeholders in beekeeping in Wales. Despite some difficulties, the support provided and involvement both by the Welsh Government and the NBU has increased in recent years.

BFA report that their figures for the twenty-year period spanning approximately 1990 - 2010 show that in the UK there was an average loss of 10,000 hives every year, and that the number of hives per bee farmer in the UK declined by 54%. BFA report that this was a much higher decline than in Europe where, over the same period, hive numbers reportedly declined by 20%.

In 2019, the UK was the fourth largest importer of honey in the world, importing around 50,000 tonnes per annum, with a value of around $130m[5]. BFA is clear that there remains a huge opportunity to sell honey and other apiary products within the UK market and there is a growing market for apiculture products because of their health benefits. BFA estimate that UK bee farmers supply only 13% of the honey consumed in the UK. Over two-thirds of the honey which comes to market is produced by bee farmers. Each European country on average produces 60% of its total consumed honey, although in some countries, for example Spain, the figure has been as high as 90% in some years. BFA suggest that the UK needs more well-managed and sustainable bee hives and beekeepers to run them. BFA believe that the UK needs 15,000 more honey bee colonies in the UK within five years, producing 500 tonnes of honey to satisfy growing British consumer demand and agricultural needs.

Over the ten years of the Healthy Bees Plan, BFA has done much to promote the bee farming industry and lobby for positive change. BFA plays an active part in the EU Honey Working Party and had particular success in contributing to the development of the current honey labelling rules.

[5] Figures obtained from the Bee Farmers' Association.

Varroa continues to have a costly impact on beekeeping and bee farming. It is almost impossible to find completely Varroa-free colonies in the UK and without the application of appropriate Varroa controls many of the honey bee colonies in temperate climates are believed to be at risk of collapse within two-three years. Regular Varroa treatment has increased beekeeping costs and BFA strongly advocates government-funded treatment to encourage registration, improve honey bee health and reduce the burden of treatment.

BFA feels that it has struggled over the course of the Healthy Bees Plan to ensure that the needs of bee farmers are heard. Most bee farmers are microbusinesses, often producing highly artisan products, with limited resources to invest in growing their business. Although only 1% of UK beekeepers are considered to be professional, the high numbers of hives managed by each one means that bee farmers collectively manage an estimated 35-40% of UK hives. At the start of the plan more than half of BFA members were over sixty-five years old, but BFA has worked hard to attract young bee farmers: its Apprenticeship scheme and other new entrants have reduced the average age, but there is still progress to be made.

BFA observes that, for many people, bee farming continues to be a second career and appears to be particularly suited to those leaving the Forces. BFA sees this as a funding and/or liaison opportunity with other government agencies such as the Ministry of Defence. This drives a need for appropriate bee farming education material to be made available for adults not eligible for the Apprenticeship scheme, which the Healthy Bees Plan has supported.

Photo: BFA Apprentices on the Millennium Bridge. Photo credit: BFA

During the course of the Healthy Bees Plan, Defra and the Welsh Government have applied for apiculture funding from the EU to underpin funding to the NBU's inspectorate activities including preparing for outbreaks of bee pests and diseases. BFA believe that more could be done to support commercial beekeeping interests using this apiculture funding.

Efforts to encourage younger beekeepers

In 2015, at the midpoint of the Healthy Bees Plan, the BBKA conducted a member survey aiming to obtain information on a number of points related to beekeeping. The majority of respondents were aged fifty-five years or above. Whilst this was a small survey, with the number of respondents corresponding to <5% of BBKA membership, it produced similar data to that seen in other surveys. The NBU's annual husbandry survey has found that 80-85% of respondents are aged 51 or over, and fewer than 5% are aged forty or under. These findings are typically considered representative of the sector.

BBKA has found, however, that there has been increased demand recently from junior beekeepers to undertake assessments, which are offered free of charge. Around thirty to fifty applications per year are being received, compared with hardly any at the outset of the Healthy Bees Plan. BBKA has links with around 300 schools and has recently begun a "Beacon Schools" initiative, whereby schools maintain links with a local beekeepers' association. BBKA also funds trips abroad for young beekeepers: in 2019 BBKA sent a full team of three to represent England at the International Meeting of Young Beekeepers (IMYB) in Slovakia.

No figures are available for the average age of beekeepers in Wales, but WBKA is conscious that beekeeping tends to be a hobby undertaken by the older citizen, and has been encouraging the recruitment of younger beekeepers, particularly by involving schools directly. The development of younger beekeepers is undertaken by local beekeepers' associations but WBKA has provided encouragement and guidance and in 2019 managed to fund a visit by two young beekeepers and chaperones to Slovakia to compete at the IMYB. Following the recent appointment of a Schools Officer and an IMYB Officer, WBKA hope to support a full team of three young beekeepers to attend future meetings.

Photo: Young beekeepers training in preparation for representing Wales at the 2019 International Meeting of Young Beekeepers in Slovakia. Photo credit: WBKA

BFA's Apprenticeship scheme has provided 30 new jobs and careers for young people in both rural and urban areas. Healthy Bees Plan funding contributed 7% of the total cost of

this scheme. The scheme has proved to be very successful, with a very low drop-out rate and high proportion of those completing the programme remaining within the industry. BFA note that it is the first time in generations that bee farming has had so many young people entering the industry. The scheme is discussed in more detail in Chapter 5.2.

Photo: Trainers, assessors and verifiers celebrate the first BFA apprentices to qualify in 2014. Photo credit: BFA

Other efforts to engage with existing and potential beekeepers, particularly from younger generations, have involved adapting to use new methods of communication. This area has undergone radical change in the past ten years, with much more emphasis now on the internet and social media. Beekeepers' associations have moved with the times, with well-developed websites and Twitter feeds.

BFA has been very effective in publicising its highly successful Apprenticeship scheme, for example through photos such as the one on page 90 above, showing apprentices on the Millennium Bridge. This photo has been shared globally and has become an iconic image. The online platform OneFile provides a very effective way for apprentices to share information and keep records of their work. Apprentices themselves have often proved very effective in identifying media opportunities to publicise bee farming.

BBKA had approximately 13,500 Twitter followers by the end of November 2019. There was huge public engagement with their 2019 tweet about wildflower verges in Rotherham, with over 400,000 impressions and 47,000 reactions. Other messages which prompted a large response concerned Bees' Needs Week and Asian hornet. BBKA created a Facebook page in August 2018 and had 6,600 followers by the end of 2019. BBKA also has around 2,500 followers on Instagram.

Photo: Some of the images of wildflower verges tweeted by BBKA.

A market remains for traditional publications, but these have also undergone substantial changes. Ten years ago, for example, BBKA News magazine ran to twenty-four pages and there were six editions per year. The magazine was printed in black and white with one spot colour and was distributed to members via their local association. Now twelve issues of BBKA News are produced per year, and it is mailed directly to all members. The magazine is now full colour and has grown to thirty-six pages per issue.

Working with Government

In addition to working together to achieve Healthy Bees Plan outcomes, BBKA, WBKA and BFA have worked on other Defra and Welsh Government initiatives such as the implementation of the collaborative National Pollinator Strategy, to inspire action to support pollinators at all levels by both organisations and individuals.

WBKA recognises that the NBU and Welsh Government have long shared its aim of ensuring that the welfare of honey bees and their keepers is paramount. WBKA is also clear that more has been done cohesively by all three organisations under the Healthy Bees Plan.

At the start of the plan, relationships between BFA, government and the NBU Inspectorate could be difficult at times and there were frustrations regarding the lack of funding opportunities and limited scope for development and education.

BFA and BBKA have engaged with each successive Defra minister responsible for Bee Health. BFA's relationship with government was strained following the high colony losses experienced in 2012 and the organisation found this especially frustrating when support available across the UK was inconsistent because of different policy approaches. At this point, the BFA considered leaving the HBP completely. The BFA did, however, receive seed funding and a visit from the Defra minister Lord de Mauley, which helped secure commercial sponsors.

The BFA share the knowledge and course material developed in connection with their apprenticeship scheme among the wider membership. BFA continue to observe tensions between the amateur and professional beekeeping sectors and consider that this was exacerbated by the Healthy Bees Plan's initial focus on the education of amateurs.

BFA Knowledge Transfer Project

The BFA secured substantial funding from The Waterloo Foundation for a Knowledge Transfer pilot project. The BFA felt that the project fulfilled Healthy Bees Plan outcomes and Defra Bee Health Policy were invited to contribute to the pilot but chose not to do so at that time. The goals of the project were to increase performance and productivity by improving understanding of best practice husbandry techniques. The project ran for eighteen months during 2016 and 2017 once third-party funding had been secured. A small group of bee farmers selected from across the country, representing different types of business, met regularly to openly discuss operational performance. The BFA modelled the pilot on a similar project in the dairy industry and a professional facilitator was employed to guide discussions and analyse outcomes.

Results showed that most bee farms start as a one-person enterprise with the owner trying to do everything. An individual could operate 200 hives, generating £60,000 in sales, against costs of £20,000, leaving a gross profit of £40,000 to cover expansion, premises and personal drawings. The programme observed that taking on the first employee is a major barrier to growth and after this has successfully occurred, businesses comfortably pass the financial break-even point and expansion becomes easier. Information was shared with all BFA members through the association's Bee Farmer magazine[6], allowing all subscribers to benefit.

All businesses taking part in the project reported measurable performance improvement. By the end of the project the total number of colonies managed by the six group members had increased by 1,000 – this represented a 20% increase. The results have encouraged BFA to plan to make Knowledge Transfer Projects available to all members. The initiative has been identified as an effective way for all participants to benefit, whether they are already highly experienced or relative newcomers to the profession. BFA has found knowledge exchange to have had a positive effect on the honey bee industry and to provide huge benefits to agriculture in general.

Conclusion

Beekeeping and bee farming have experienced many changes over the period of the Healthy Bees Plan, and the key national associations have played a vital role in helping beekeepers and bee farmers respond to those changes. Providing training and mentoring; supporting scientific research and knowledge exchange; embracing new forms of communication; working with government to contribute to the development of bee health policy; attracting new beekeepers and bee farmers and supporting them to remain committed to the craft. All these and other activities besides, ensure that the sector is in a considerably healthier state than it might otherwise have been.

[6] Bee Farmer magazine Vol. 4, Issue 1 (February 2018), pp. 9-12

There are many ongoing challenges, such as disease and the risks posed by exotic pests, and new challenges will doubtless emerge over the next several years. As such, the range of services that national associations are so well placed to provide will continue to be of crucial importance as we move into a new decade and embark upon a new Healthy Bees Plan.

BBKA and WBKA remain committed to continue working to address pest and disease risks to honey bees whilst further improving beekeepers' husbandry and management practices to strengthen the resilience of bee colonies.

BFA agree that the objectives of the National Pollinator Strategy are crucial to the overall health of bees and that it is important to maintain links to the Healthy Bees Plan. Over the course of the plan all those involved have worked hard to listen and have built good working relationships.

BFA believe that the situation regarding bee health in the UK continues to be summarised well by Sarah Newton's remark in the House of Commons debate on 26th March 2013:

We need a holistic approach, looking at the many contributing factors in a joined-up strategy, led by Defra and involving other Departments. I am asking the Minister to ask the Secretary of State to consider implementing a British bee strategy that would work across Departments and with stakeholders to develop a holistic action plan, with identifiable outcomes and budget allocations.

5.4 – Education and advisory material provided by the National Bee Unit

Rebekah Clarkson and Kate Wilson, National Bee Unit

Objective

This chapter aims to review the provision of both the education and advisory material provided by the National Bee Unit (NBU) to beekeepers throughout England and Wales over the life of the 'Healthy Bees Plan 2009 – 2019. The educational talks, online courses and educational material; both online and printed support all outcomes of the plan.

The NBU has been committed to providing advice and guidance for beekeepers and produced a variety of bilingual information in English and Welsh. During the Healthy Bees Plan the NBU produced a wide range of beekeeping advisory material which was delivered to stakeholders in three ways;

- Online: using BeeBase the National Bee Unit's website.
- Print; hard copies of advisory leaflets and identification guides.
- In person; over the phone, email, at inspections and events.

Each method of dissemination is looked at in turn and available information reviewed.

Background

The plan in 2009 outlined how the NBU and national associations were to develop a common set of husbandry principles including monitoring colonies and apiary health planning. Honey bee health is affected by many interrelated factors including diseases, parasites, pesticides and the environment including nutritional forage and many of these factors can be managed using husbandry techniques.

Insights from 'A study of Beekeeping Practices, influences and information sources',[7] a report commissioned by Defra in 2009, made a number of recommendations including:

- the dissemination of information about good practice should be promoted, and
- messages should be tailored to different types of beekeeper clarifying what is 'good husbandry practice'.

[7] People, Science & Policy and East Malling Research, *A Study of Beekeeping Practices: Influences and Information Sources, 11th May 2010,* *http://sciencesearch.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&ProjectID=17049&FromSearch=Y&Publisher=1&SearchText=beekeeper&SortString=ProjectCode&SortOrder=Asc&Paging=10#Description*

Evidence

BeeBase data, recording inspection types and events, is used.

A 'snapshot' beekeeper APHA Satisfaction Survey was conducted in 2015. The survey was commissioned predominantly to understand both what was working well with the National Bee Unit and to provide a steer for what may be improved. 1083 beekeepers were randomly selected from a total of 5,250 inspections conducted in 2015. A total of 305 respondents completed the survey accounting for 28% of inspections that year; feedback and data from this survey is used within this report.

Since 2009 Defra have commissioned an annual husbandry survey to understand beekeeping practices in England and Wales. The survey is distributed in different ways to try and reach as many people as possible and to remove bias from response type. The survey receives over 1000 responses. Although every care is taken to select a random sample from registered beekeepers, its results should not be assumed to reflect the beekeeping community's experiences as a whole. Data from Defra's husbandry survey is also used within this report.

BeeBase

BeeBase http://www.nationalbeeunit.com has been the National Bee Unit's website since 2005. It is recognised by beekeepers and the government as a valuable resource and is used throughout England, Wales and Scotland to record beekeepers' data, manage apiary inspections, diagnosis, research, development and training. The site also provides guidance and educational material including online courses which have been produced in collaboration with scientists and experienced bee inspectors to ensure that the advice is based on sound science. Much of the information provided on the site is accessible without logging in and is free to download.

A National Audit Office report published in 2009 titled 'The Health of Livestock and Honeybees in England' highlighted the importance of BeeBase as a major communication channel with beekeepers, and described issues found at the time. The website was not fully compatible with the minimum accessibility standards required for government websites, meaning that not all web-users were able to view it properly. Search engine ranking for beekeeping education phrases did not find BeeBase on the first page of a search, so beekeepers unaware of BeeBase were unlikely to find the site. The audit also found an out of date leaflet on the management of Varroa which incorrectly stated that it was notifiable, when it had ceased to be notifiable in 2006. At the start of the Healthy Bees Plan, resource was increased, leaflets were updated, and improvements made in the BeeBase listing on key search engines. Six months later, in November 2009, BeeBase won a prestigious Whitehall and Westminster World Civil Service Award recognising the innovative live on-line database used by Beekeepers to manage honey bee health across England and Wales.

The number of unique visitors to BeeBase has increased each year.

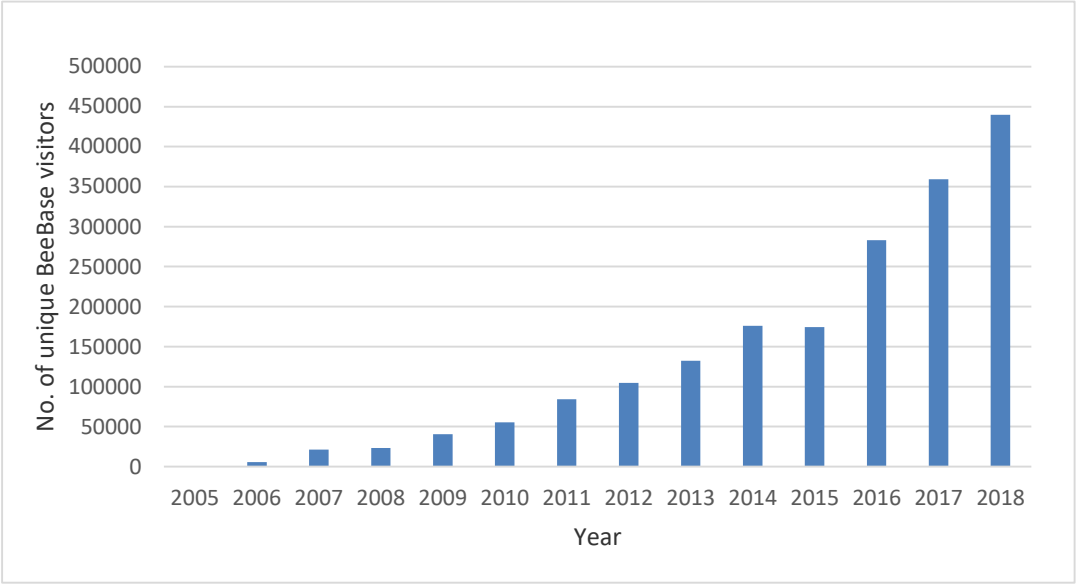


Figure 1: Number of unique visitors to BeeBase per year, 2005-2018

Two thirds of Beekeepers in the APHA customer satisfaction survey used BeeBase – 205 of 306 respondents. The survey found there were differences in the uptake of BeeBase across the regions and also minimal differences in satisfaction ratings. Beekeepers were given the opportunity to provide open feedback and this suggested that approaches were not consistent across the regions, which may account for both the difference in uptake and different levels of satisfaction.

Once visitors had found BeeBase, the average number of page views (page views divided by the number of visits), was consistently above fifteen, except for 2005 and 2012. A higher number of page views indicates a higher level of user engagement with the material.

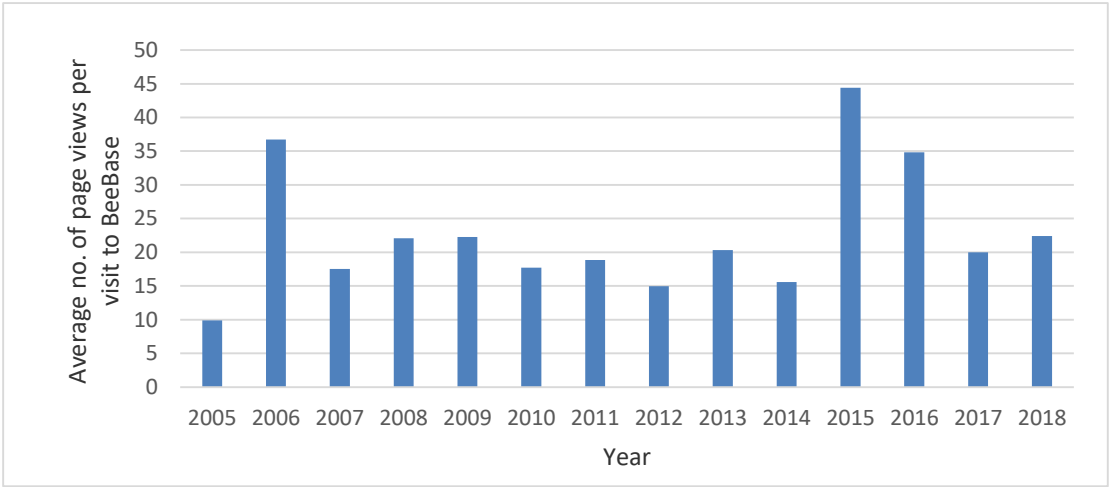


Figure 2: Average number of page views per visit to BeeBase, 2005-2018

In 2015 a range of E-Learning courses were launched on BeeBase covering topics including: Exotic Threats, Foulbrood, Varroa, Adult Bee Diseases and Viruses, Other Brood Disorders and Other Pests. BeeBase page view numbers peaked sharply after the launch of E-learning which received positive feedback e.g. “I have used the eLearning facility and found it excellent”. Module development did not occur due to limited resources and technological advancement since 2015 has meant some key features have not been maintained.

The page view peak the following year in 2016 is likely to be because of the first sighting of the Asian hornet in the UK, Gloucestershire, when National media ran stories informing the general public of the threat to honey bees. A number of web pages ran pictures of another insect called the Asian giant hornet (*Vespa mandarinia*). The National Bee Unit worked with the Non-Native Species Secretariat (NNSS) to aid identification and developed a variety of content including an Asian Hornet webpage, identification leaflet and poster.

BeeBase was used as a news platform for bee health issues and to disseminate local updates. Since 2009 Regional Bee Inspectors have produced annual reports summarising their region’s beekeeping year. These were emailed to registered Beekeepers and made available on BeeBase.

Beekeepers who used BeeBase in the 2015 survey were asked “Would you like to comment further on BeeBase?” A summarised list of the themes emerging from the answers includes:

- BeeBase was considered to be a useful, valuable tool by many;
- Some problems with navigation of the online tool were being, or had been, experienced;
- Practical issues (in addition to navigation) of usability of the tool were noted;
- Beekeepers may benefit from a mobile friendly version (iPad etc) for use in the field;
- Issue of timeliness of information and updates;
- Some beekeepers thought that registration on BeeBase ought to be compulsory.

Advisory Material available on BeeBase

The National Bee Unit produces a wide range of material, all available online via its website BeeBase. Two Beekeeping Essentials leaflets and ten Best Practice Guidelines were developed in 2010 after the appointment of two training and extension officers as part of the Healthy Bees Plan; these documents were jointly developed by Governments, beekeepers, their associations and other stakeholders. Literature was reviewed and tailored to suit different audiences. The guidelines designed for beginner beekeepers are shorter than the more detailed leaflets and cover the essentials of the craft of beekeeping:

- No. 1 – The Essence of Beekeeping
- No. 2 – Handling and Examining a colony of bees
- No. 3 – Apiary and hive hygiene
- No. 4 – Disease recognition

- No. 5 – Advice for obtaining honey bees
- No. 6 – Spring Checks
- No. 7 a) – Feeding Bees - sugar
- No. 7 b) – Feeding Bees - water
- No. 7 c) – Feeding Bees - pollen and substitutes
- No. 8 – Sale of Honeybee Nuclei – initially a beekeeping essential leaflet
- No. 9 – Small hive beetle - What you need to know
- No. 10 – Bee Improvement
- No. 11 – Varroa

A wide range of factsheets have been made available on BeeBase covering a multitude of topics from how to make a simple Asian Hornet Monitoring Trap to Wax moths and cover the most frequently asked beekeeping questions.

Throughout the plan, National Bee Unit staff collaborated with scientists and beekeeping journal editors to ensure Healthy Bees Plan messages reached the wide range of beekeeping stakeholders. Published, peer reviewed scientific literature produced by the National Bee Unit and grey literature printed in beekeeping journals have been made available on BeeBase.

All National Bee Unit printed material is available on BeeBase. Two detailed leaflets including Statutory Procedures Advisory and Contingency Planning Procedures are only available online.

Printed material

Detailed leaflets, developed with scientists and experts, are available covering key topics including:

- Starting Right with Bees
- Common Pests, Diseases and Disorders of the Adult Honey Bee
- Managing *Varroa*
- Foulbrood Disease of Honey Bees
- Small Hive Beetle
- *Tropilaelaps*: Parasitic Mites of Honey Bees

BeeBase pages and the leaflet on 'Common Pests, Diseases and Disorders of the Adult Honey Bee' cover the topics of both the *Nosema* parasite and the phenomenon of Colony Collapse Disorder (CCD) reported in the USA, both of concern at the start of the Healthy Bees Plan.

Throughout most of the Healthy Bees Plan, leaflets have been available in hard copy by request and available at NBU events. These leaflets often formed the body of recommended literature provided to new beekeepers attending association beginner beekeeping courses at their local Beekeeping Association.

Number of leaflets recorded on BeeBase sent to Stakeholders per year*										
Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Leaflets	4275**	9609	7518	9826	5553	9363	4735	5037	6733	6790

** BeeBase does not record all leaflet utilisation. The total number is higher.*

***data only available for six months from June.*

Figure 3: Each spring, prior to the beekeeping season, thousands of leaflets are sent to associations to supply beginners' courses

In 2017 postcards featuring the Small hive beetle, Tropilaelaps mite and Asian Hornet were produced to handout at stakeholder events, designed to aid identification and highlight preferred reporting methods. In 2019 analysis of misidentified sightings highlighted the high numbers of native hornets being reported. The Asian hornet post card was updated with life-size illustrations of both native and non-native hornets and made available in both English and Welsh.

1175 beekeepers in the 2018 husbandry survey provided information on whether they had read NBU literature for training and education. 75.1% of beekeepers (882) reported they had read NBU literature. 24.9% (293) of beekeepers had not read any NBU literature. Of the 882 beekeepers that had read NBU literature, 877 then provided breakdown information on the literature they had read (Figure 4). Beekeepers overwhelmingly found the NBU literature to be useful, as each piece of literature received a 'useful' rating at least 94% of the time.

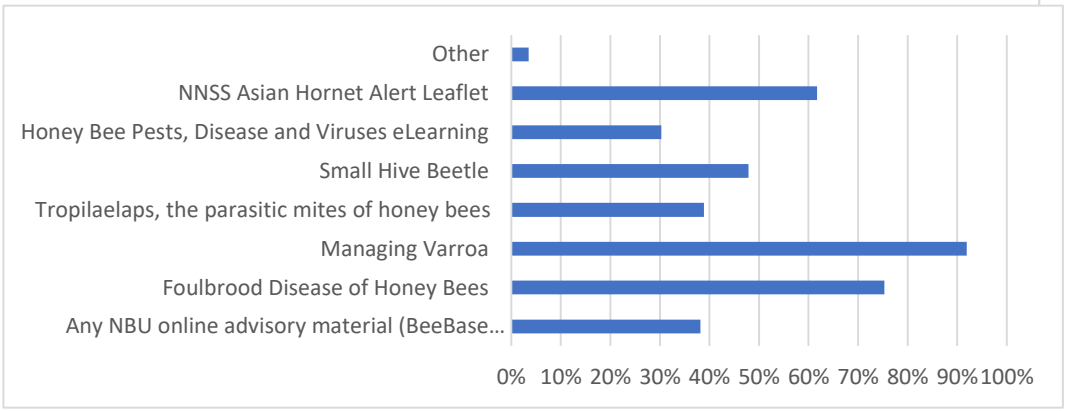


Figure 4: Percentage of beekeepers using different NBU literature. 877 beekeepers provided information on the NBU literature they had read. Multiple responses were permitted.

Delivering messages in person

During the beekeeping season from April to September beekeepers could contact their local Seasonal Inspectors directly to ask for guidance and request help. Out of season Regional Bee Inspectors are available. Bee Inspectors dealt with local queries either over the phone or by email. Beekeepers sometimes requested an inspection if disease was suspected. Whenever appropriate, beekeepers were directed to published material such as Frequently Asked Questions on BeeBase.

Inspections were an important part of disseminating Healthy Bees Plan material and messages. Whilst on inspections, Inspectors referred to published material and directed beekeepers to BeeBase. Beekeepers had the opportunity to ask questions and see biosecurity best practice techniques and other beekeeping procedures first hand.

The percentage of requested visits where a beekeeper calls the National Bee Unit and statutory disease was found has remained relatively constant throughout the course of the plan – between three percentile points (4.9-7.7%).

Year	Number of Beekeeper Requested visits	% of requested visits as total of all inspections	Number of requested visits where statutory disease found	% of requested inspections were statutory disease found
2009	1389	14.2%	97	7.0%
2010	1331	15.5%	65	4.9%
2011	1698	19.0%	115	6.8%
2012	1627	19.5%	125	7.7%
2013	1315	17.1%	77	5.9%
2014	1133	15.3%	79	7.0%
2015	961	15.6%	68	7.1%
2016	987	16.2%	62	6.3%
2017	1114	17.3%	74	6.6%

2018	951	15.6%	69	7.3%
2019	1206	19.6%	89	7.4%

Figure 5: The number of National Bee Unit requested visits and in England and Wales 2009-2019

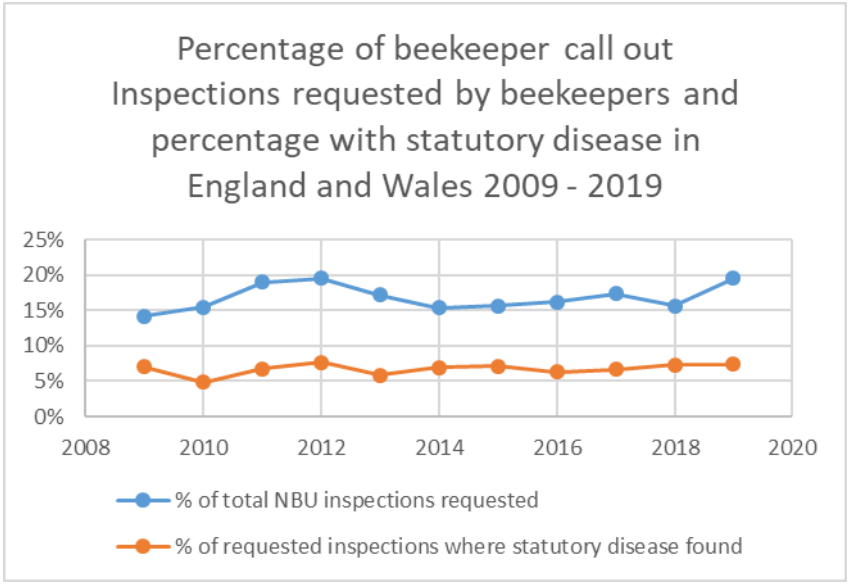


Figure 6: Percentage of National Bee Unit visits requested by beekeepers and percentage where statutory disease was found in England and Wales, 2009-2019

The lowest number of requested visits was 62 in 2016 and the highest number, 125 in 2012.

NBU Events

The NBU prepared presentations for hundreds of targeted regional events every season. Over the course of the Healthy Bees Plan NBU Inspectors delivered 4556 events and reached 161,781 beekeeping stakeholders.

Region	Total number of training events	Estimated* attendance at events
Cross Region*	495	21153
Eastern England	426	12223
North East England	399	17905

Northern England	653	28035
South East England	437	18826
South West England	674	18632
Southern England	311	9102
Western England	470	16614
Wales	691	19291
Total	**4556**	**161781**

**Attendance numbers recorded may sometimes be different*

***Cross Region events are where events were held jointly with more than one region.*

Figure 7: Total number of training events and total estimated attendance at NBU events per region

Bee Inspectors worked with local associations, county associations and national stakeholders to support events and deliver education relevant to their area's needs. National Bee Unit event locations are managed and rotated across regions to maximise coverage and ensure events are accessible to beekeepers. Some inspectors and bee scientists attended association meetings and gave presentations on pests and diseases. Healthy Bees days was attended by large numbers of beekeepers – typically around fifty – and a range of educational material was presented. Visual training aids, including *the* Asian hornet and Small Hive Beetles in resin, were used to improve identification of non-native species of concern. Attention grabbing pull-up banners were used to create professional backdrops in venues organised by stakeholders.

The NBU saved frames exhibiting disease from destruction and showed these at educational events. Due to the biosecurity risk of spreading statutory disease, anyone wishing to hold diseased material for any purpose including educational events, must apply for a licence. For many beekeepers, even those that may have kept bees for several years, seeing diseased frames at an NBU event is often the first time they saw statutory disease such as foulbrood and event feedback often focussed on how valuable beekeepers found the experience of seeing real examples:

- *"It was magical to see the frames. Photos and books are not as good as seeing the actual thing."*
- *"It was lovely to have the chance to inspect infected frames with experienced Inspectors - I feel much more confident that I would identify infection earlier."*
- *"Thank you so much for organising this day an excellent opportunity to see diseases first hand."*

National Bee Unit Healthy Bees Day Case study

The National Bee Unit ran hundreds of events each year throughout the plan, often using licenced diseased frames to enable beekeepers to see statutory diseases first hand.

Photo: Paul Day and Jane Richmond, new beekeepers who correctly recognised and reported statutory disease after attending a Healthy Bees Day.

Prior to getting their first bees, Paul Day and Jane Richmond from Warwick and Leamington Beekeepers attended a Healthy Bees Day on 19th May 2018. The event was run at the BBKA headquarters at Stoneleigh by the National Bee Unit's Western Region team and included workshop sessions on inspecting bee colonies for diseases; this gave beekeepers the chance to examine diseased combs. Later in the summer, after receiving their first bees, the beekeepers observed that something was wrong with one of their new

colonies. They recognised the symptoms of statutory disease and knew what to do. They requested an inspection from their local inspector, Gordon Bull. They also sent an email with a photo of the diseased comb. An inspection three days later confirmed their diagnosis of the statutory disease, European Foulbrood. Paul and Jane are certain that the training that they received at the Healthy Bees Day gave them the skills to recognise the disease they found.

Over the course of the ten-year plan, the NBU has collected reams of completed feedback forms from events and the majority of comments are positive e.g. Buckinghamshire in 2018:

- *"Recommend that this type of session is run more frequently for new beekeepers and as a refresher for more experienced beekeepers."*
- *"Thanks to the volunteers, grateful it was all free."*
- *"Thank you. Please do this annually*."

Feedback gathered was used on a local level to improve future events. All of the most recent husbandry survey respondents who had attended NBU events found the NBU training courses useful.

Conclusions

The NBU is well respected for delivering clear information to beekeepers. Since 2013, the NBU has updated the majority of BeeBase pages, reviewed specific literature, updated educational material and written many articles on pests and diseases.

The NBU produced a variety of guidance reflecting the range of issues and management techniques available to beekeepers; this guidance was delivered in a variety of ways. Different stakeholders have different needs during their beekeeping education as well as experience, and the information developed by the NBU was tailored in a variety of formats. Detailed technical information was presented on BeeBase with clear concise husbandry best practice guidelines. Articles were written for beekeeping stakeholder magazines and journals, and tailored events at a local, regional and national level equipped beekeepers with identification skills to recognise pests and diseases and the knowledge to ensure the health of their bees.

BeeBase is a useful tool to beekeepers but its functionality, presentation and content require continued investment to remain relevant and functional in the future. The wide range of tailored material means that updating BeeBase is a continuous task, requiring both specialist knowledge together with an understanding of realistic practical applications for beekeeping stakeholders. Over the course of the plan, beekeeper behaviours have changed, and more people are able to access information and training online. Future BeeBase strategy needs to ensure its facilities, information and training continue to be accessible.

Appendix 1:

Timeline and governance of the Healthy Bees Plan

Timeline of key events during the Healthy Bees Plan

Key events that occurred before and during the Healthy Bees Plan were numerous and perhaps too vast to list, but a timeline of some events provides an insight into the broad range of work carried out. As stated in the review, these events were not always directly under the banner of the Healthy Bees Plan; they may, however, be events enacted by participants that met the aims of the plan, and in some cases shaped the course of the plan and the policies enacted under it.

- October 2007 – Meeting of the Bee Health Advisory Panel to discuss a draft strategy on the health of managed bees.
- April 2008 – Public consultation on the new draft bee health strategy – consultation closed August 2008.
- January 2009 – Government funding of an additional £2.3million announced for implementation of the initial phase of a new bee health strategy.
- March 2009 – National Audit Office report published: *The health of livestock and honeybees in England.*
- March 2009 – *The Healthy Bees Plan* launched at an event in Ergon House, London, attended by then Minister of State Jane Kennedy.
- July 2009 – First meeting of the Healthy Bees Plan Project Management Board, responsible for successful implementation of the Healthy Bees Plan by identifying priorities and by steering and guiding the workstreams, activities and deliverables.
- 2009-2010 – National Bee Unit Survey to assess health status of apiaries in England and Wales ('The Random Apiary Survey').
- September 2010 – Defra funding for stakeholder education courses began.
- 2010-2015 – £10m Insect Pollinators Initiative begun – £2.5million provided by Defra. Of the nine projects, two focused on honey bee health issues while six of the other projects covered both honey and bumble bees.

- July 2011 – Review of policies on honey bee pests and diseases undertaken on behalf of Defra and Welsh Government (WG) (formed the basis of the Consultation on Improving Honey Bee Health, launched January 2013).

- April 2012 – Defra's *Asian Hornet 'Response Plan* published – this was replaced in January 2016 by the Pest Specific Contingency Plan for Asian Hornet (revised September 2017).

- October 2012 – Meeting of the first Bee Health Advisory Forum, merging the Husbandry and Education Group, the Communications Group, and the Science and Evidence Advisory Group.

- January 2013 – Government consultation on *Improving Honey Bee Health*. Results published on gov.uk July 2013.

- April 2013 – The Disease Assurance Scheme ('DASH') for Honeybees developed and launched in collaboration with the Bee Farmers' Association.

- July 2013 – *The Action Plan for Pollinators in Wales* launched by the Welsh Government, with foreword by Alun Davies, Welsh Minister for Natural Resources and Food.

- April 2014 – The Bee Farmers' Association (BFA) Apprenticeship Scheme launched.

- September 2014 – Detection of Small hive beetle in Gioia Tauro, Calabria, Italy.

- November 2014 – *The National Pollinator Strategy* launched by Defra, with foreword by Lord Gardiner, Secretary of State for Environment, Food and Rural Affairs.

- June 2016 – Defra's updated Pest Specific Contingency Plan published for Small hive beetle and Tropilaelaps mite (revised September 2017).

- September 2016 – Asian hornet sighting confirmed in Tetbury, Gloucestershire.

- January 2017 – Defra's Generic Contingency Plan for Plant and Bee Health in England published.

- September 2018 – The Action Plan for Pollinators Review 2013-18 and Future Actions published. Carried out by members of the Pollinator Taskforce and updates the Welsh Action Plan for Pollinators in Wales.

- September 2020 – Healthy Bees Plan Review published.

Governance

The Bee Health Advisory Forum (BHAF) provided governance and project management for the Healthy Bees Plan. The forum was first convened in October 2012 and during the course of the plan met for a total of 27 quarterly meetings. Minutes are available on BeeBase.

BHAF was the principal means by which government officials and stakeholders could consider pest and disease control policies. The Forum enabled active engagement at the start of the policy-making process ahead of the formation of proposals/options. The aim was for those most affected by policy decisions to have increased opportunities to play a full role in influencing the decisions which would, as now, be made by Ministers.

The BHAF was preceded by 19 Healthy Bees Plan Project Boards that provided governance for the initial phase of the work. Three working groups provided expert advice on specific aspects of the plan.

- Husbandry and Education Working Group (HEG) provided input and challenge to the work of Fera's Education and Extension Officers.

- Science and Evidence Advisory Group (SEAG) provided scientific challenge and input to work on three of the outcomes of Healthy Bees - pests and diseases, biosecurity and evidence base.

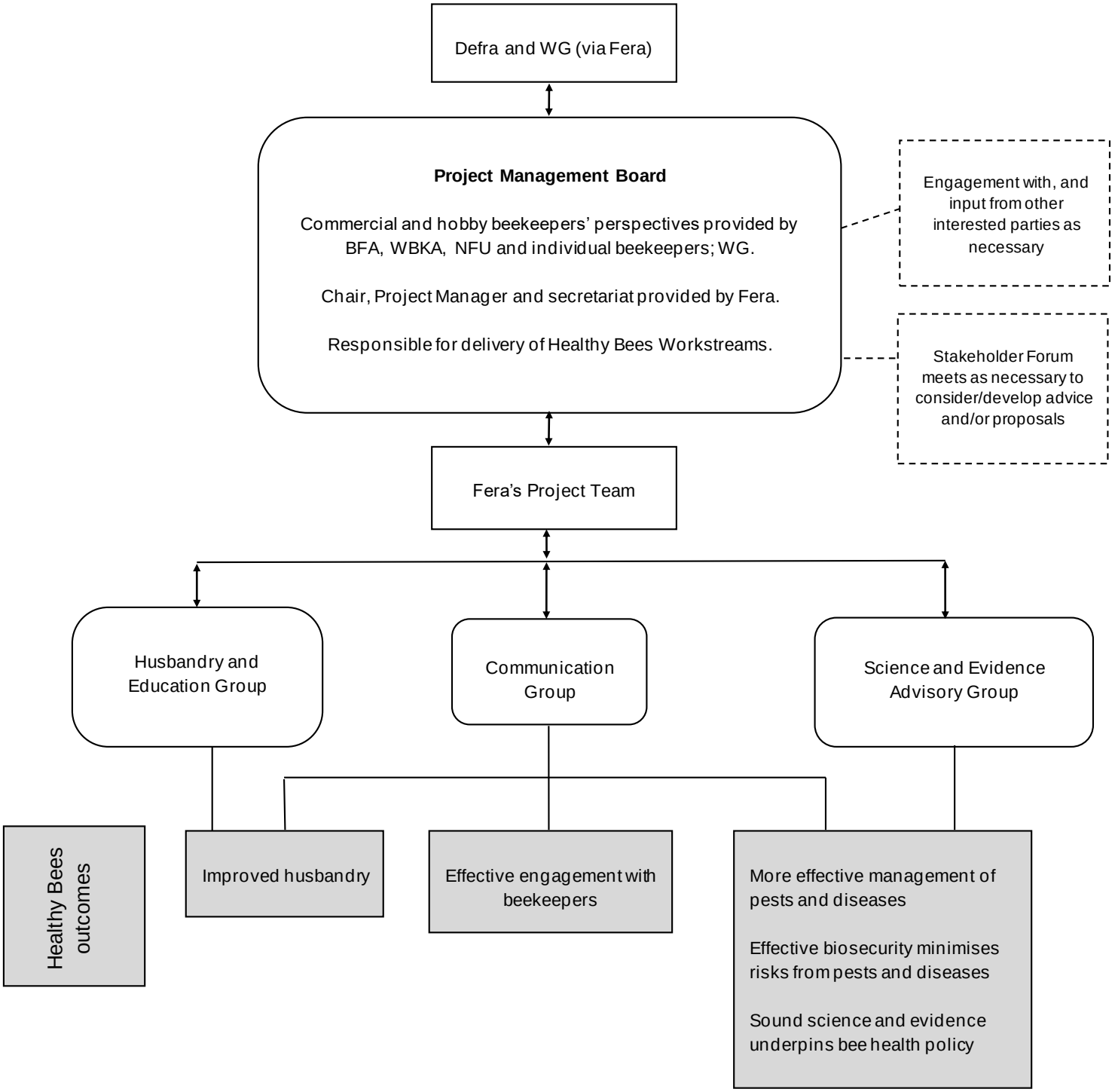
- Communications Working Group (CWG) provided input and challenge to coordinated communications activities.

SEAG met six times between February 2010 and September 2011. CWG met nine times between October 2009 to March 2012. HEG met six times between February 2010 and October 2011. Minutes are available on BeeBase.

The Role of HEG was to provide input and challenge to the work to achieve the outcomes of the HBP. In particular: improvements in standards of husbandry and in biosecurity to manage and minimise pest and disease risks. The role of SEAG was to ensure that a sound science and evidence base underpinned bee health policy and operations. The role of CWG was to develop and implement a jointly owned and coordinated communications strategy to help deliver the policy objectives of the HBP.

All three working groups and the project management board were merged to form the BHAF in 2012.

Governance organogram, 2009-2012



Changes to Defra, the National Bee Unit and Fera Science Ltd during the Healthy Bees Plan

'Fera' is referenced several times throughout this review. It should be noted that this organisation has held different titles and worked under different management throughout the Healthy Bees Plan. It has similarly carried out different functions and been made up of different teams since 2009. These changes and the relevant dates are detailed here.

- The Central Science Laboratory (CSL) merged with several other divisions to become the Food and Environment Research Agency (Fera), an executive agency of Defra, on 1st April 2009. At this juncture, the National Bee Unit became part of Fera.

- The Bee Health Policy team left Fera and joined Defra on 31st December 2012. The National Bee Unit remained part of Fera, still an executive agency of Defra at this time.

- The National Bee Unit (NBU) inspectorate left Fera and joined the Animal and Plant Health Agency (APHA) on 1st October 2014. The research arm of the National Bee Unit stayed as part of Fera.

- On 1 April 2015 the business and operations (including bee research and laboratory diagnostics) of Fera became Fera Science Limited (FSL), a Joint Venture (JV) between Defra and Capita. At the time of writing, this remains the case.

Appendix 2:

Summary of the bee health husbandry survey 2009-2018 – tables and figures

Contents

Please note that questions included have varied over the course of the plan – where no information is available for a particular year because it was not included in the survey it is not included within the table.

Number of responses

Table 1: Number of survey responses per year

Year	Number of responses
2009	1658
2010	1915
2011	1226
2012	958
2013	1248
2014	1572
2015	1254
2016	1166
2017	1054
2018	1201

Number of colonies

Table 2: Number of colonies reported by each responder

Date	Mean	Standard error of mean	Median
Apr-10	10.59	1.28	2
Oct-10	12.62	1.53	2
Apr-11	4.81	0.56	2

Oct-11	5.98	0.62	3
Apr-12	4.16	0.24	2
Oct-12	4.77	0.26	3
Apr-13	4.54	0.31	2
Oct-13	5.13	0.34	3
Apr-14	4.65	0.32	2
Oct-14	10.57	5.14	3
Apr-15	4.94	0.34	3
Oct-15	5.57	0.35	3
Apr-16	4.50	0.19	3
Oct-16	4.75	0.21	3
Apr-17	4.15	0.20	3
Oct-17	4.63	0.23	3
Apr-18	4.78	0.30	3
Oct-18	5.41	0.34	3

The mean is the total number of hives divided by the number of respondents.

The standard error of the mean is an indication of how accurate the mean is compared to the true population.

The median is the middle number between the highest and lowest responses (so for 2017 it will be the 527th highest response).

Association membership

Table 3: Of those reporting memberships of an association, proportion (%) that were members of which association

Year	BBKA and other	BBKA only	Other only	None reported
2010	1.7	78.1	9.3	10.8
2011	8.2	62.2	11.5	18
2012	9.8	60.6	11.1	18.5
2013	9.9	65.6	11	13.5
2014	11.7	62.7	11.3	14.4
2015	11	62.9	11.4	14.7
2016	9.8	63.5	10.8	16
2017	10.6	63.3	9.8	16.3
2018	10	64.9	11.2	14

Qualifications

Table 4: Proportion (%) reporting holding a qualification

Year	Yes	No	Not reported
2010	30.9	53.6	15.5
2011	26.3	70.1	3.7
2012	25.8	68.9	5.3
2013	29.2	67.7	3.1

2014	32.1	63.9	3.9
2015	34.3	59.6	6.1
2016	36.2	60	3.8
2017	36.5	61.3	2.2
2018	36.3	60.1	3.6

Table 5: Of those reporting a qualification in Table 4, the proportion (%) with more than one qualification

Year	2 or more	3 or more	4 or more	5 or more	6 or more	7 or more	8 or more	9 or more
2012	12.35	4.94	2.06	1.23	0.41	0.41	0	0
2013	12.98	4.97	2.76	1.66	1.38	0.83	0.55	0.28
2014	9	2.6	0.8	0.2	0	0	0	0
2015	7.51	2.35	1.17	0.47	0.23	0	0	0
2016	11.46	4.3	1.91	1.19	0.95	0.48	0	0
2017	14.89	6.38	3.19	2.66	1.6	1.33	0.27	0
2018	11.09	5.31	3.93	2.77	1.85	0.69	0	0

Table 6: Of those reporting a qualification in Table 4, proportion (%) holding which qualification

Qualification held	2012	2013	2014	2015	2016	2017	2018
BBKA Basic Assessment	90.12	92.54	94.4	91.55	91.17	89.1	91.45

BBKA Intermediate Theory Certificate	8.23	9.12	0	0	6.21	8.24	5.54
BBKA General Husbandry Certificate	4.94	7.18	4.6	4.69	5.73	6.38	6.7
Other	7	4.14	6	7.51	5.25	9.84	6.7
BBKA Advanced Theory Certificate	2.47	3.87	0	0	2.39	4.52	4.62
BBKA Microscopy Certificate	2.47	2.76	3.2	2.82	2.86	3.46	3.46
BBKA Advanced Husbandry Certificate	1.23	1.66	1.2	1.17	1.19	2.39	2.31
BBKA Master Beekeeper	2.47	1.66	1.6	1.88	1.91	2.66	2.31
National Diploma in Beekeeping	1.23	1.38	0.6	0.94	0.24	0.8	0.46
BBKA Show Judge Certificate	1.23	1.1	0.6	0	0.48	0.27	0
BBKA Junior Certificate	0	0	0.4	1.17	1.19	0.53	0.23
WBKA Basic Assessment	0	0	0	0	1.67	2.13	1.85

Literature used

Table 7: Proportion (%) of respondents using literature

Year*	Yes	No	None reported
2011	63.8	32.5	3.7
2012	63.8	32.2	4.1
2013	70.4	28	1.6

2014	68.6	28.6	2.8
2015	68.9	27.4	3.7
2016	68.7	29.1	2.2
2017	69.7	28.6	1.7
2018	73.4	24.4	2.2

* Not asked as Yes/No question in 2010

Table 8: Of those reporting use of literature in Table 7, proportion (%) using which literature

Literature used	2010	2011	2012	2013	2014	2015	2016	2017	2018
Managing Varroa	95.6	98.5	97.8	98.4	96	94.7	92.7	95.1	91.9
Foulbrood	82.8	81.7	77.0	82.7	80.4	76.4	75.4	75.8	75.3
Parasitic Mites, Tropilaelaps	49.2	52.3	40.8	43.8	43.5	39.6	38.8	41.7	38.9
Small Hive Beetle	56.1	61.8	48.1	52.6	51.3	51.1	48.1	50	47.9
Honey Bee Pest, Disease and Viruses eLearning	0	0	0	0	0	0	28.1	30.7	30.3
* Common pests, diseases and disorders of the adult honey bee	0	0	0	0	53.6	52.1	0	0	0
NBU online advisory material	0	0	0	0	42.3	38	40.1	39.5	38.2

NNSS Asian Hornet	0	0	0	0	0	0	37.8	57.8	61.7
Other	15.8	1.9	0	2.7	1.9	2.7	3.4	2.9	3.5

* Replaced by e-learning course Honey Bee Pest, Disease and Viruses

Table 9: Proportion (%) of literature users reported in Table 7 that found literature useful

Literature used	2010	2011	2012	2013	2014	2015	2016	2017	2018
Managing Varroa	99.3	99.2	99.4	99.2	99.5	99.1	99	98.8	98.8
Foulbrood	NA	99	99.7	99	99.2	98.5	100	98.9	99.4
Parasitic Mites, Tropilaelaps	93.4	95.4	95.1	94.2	93.1	93.8	97.3	94.1	94.4
Small hive Beetle	93.5	94	96.2	93	93.4	95.5	97.5	95.1	96
Honey Bee Pest, Disease and Viruses eLearning	NA	NA	NA	NA	NA	NA	97.9	94.1	96.9
Common pests, diseases and disorders of the adult honey bee	NA	NA	NA	NA	99.6	98.4	NA	NA	NA
NBU online advisory material	NA	NA	NA	NA	98.8	97.8	99.6	97.6	98.9
Other	0	NA	NA	NA	88.9	100	100	94.7	95.5
NNSS Asian hornet	NA	NA	NA	NA	NA	NA	98	98.1	98.9

Training

Table 10: Proportion (%) of respondents that attended training

Year	Yes	No	None reported
2011	52.8	43.3	3.9
2012	50.3	46	3.7
2013	57.8	39.9	2.3
2014	54.4	42.4	3.2
2015	54.2	42.3	3.5
2016	53.3	42.9	3.8
2017	52.9	43.6	3.4
2018	53.1	42.7	4.2

Table 11: Of those attending training in Table 10, proportion (%) attending which training

Training events	2011	2012	2013	2014	2015	2016	2017	2018
Train the trainer	11.4	9.2	6.4	9.3	9.8	5.8	8.3	5.9
NBU Disease Recognition	27.7	37.2	33.2	19.2	21.1	25.7	25.3	25.2
NBU Good Husbandry	12.6	17	11.7	15.4	13.8	16.1	12.5	16.3
*Healthy Bees Plan Road Show	4.8	2.9	3.9	0	0	0	0	0
Bee Health Advisor course	0	0	0	8.9	12.4	14	15.9	11.2

‡Other	64.4	58.7	63.4	64.7	60.5	58.4	58.5	59.9

* Only held in 2011, 2012 & 2013

‡ For example, local association courses

Table 12: Of those attending training in Table 10, proportion (%) that found the training useful

Training events	2011	2012	2013	2014	2015	2016	2017	2018
NBU Disease Recognition	99.2	100	97.3	97.7	98.3	99.2	100	100
Healthy Bees Plan Road Show	NA	85.7	95	NA	NA	NA	NA	NA
NBU Good Husbandry	100	100	98.2	100	97.3	100	100	100
Train the trainer	86.4	95	92.7	98.4	88.5	89.7	94.9	88.9
Bee Health Advisor course	NA	NA	NA	98.4	98.5	97.2	100	100
Other	98.6	99.3	99.1	98.8	99.7	97.1	99.2	98.9

Race of bees

Table 13: Proportion (%) reporting race

Year	Proportion Reported
2011	96.1
2012	96.9

2013	97.1
2014	96.6
2015	97.1
2016	94.6
2017	98.2
2018	98.6

Table 14: Of those reporting race in Table 13, proportion (%) reporting which race

Race of bee	2011	2012	2013	2014	2015	2016	2017	2018
A. m. carnica	2.6	1.4	2.4	2.7	1.6	1.6	2	1.6
A. m. ligustica	0.5	0.3	0.7	0.7	0.2	0.5	0.8	0.4
A. m. mellifera	17.6	15.4	17.2	21.3	17.2	16.2	15.2	17.8
A.m. macedonica	0.2	0.2	0.1	0.1	0.2	0	0	0
Buckfast	6.5	7.8	10.4	8.8	9.6	12.5	13.1	14.3
Hybrid	20.6	19.8	18.9	22.5	21.8	23.6	23.7	23.8
Other	3.7	2	2.9	2.4	3.6	2.7	3.6	3.7
Don’t know	48.3	53	47.4	42.1	45.9	42.9	41.6	38.3

Origin of queens

Table 15: Proportion (%) reporting queen origin

Year	Proportion Reported
2009	95.5
2010	92.8
2011	93.9
2012	93
2013	95.1
2014	94.5
2015	96.3
2016	92.6
2017	96.2
2018	94.3

Table 16: Of those reporting queen origin in Table 15, proportion (%) reporting what origin of queen

Origin of Queen	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
UK- Reared by colony itself	86.4	84.2	73.8	74.4	70.4	71.4	76.3	74.4	70.5	72.2
*UK- Reared from selected queens	NA	NA	12.8	9.7	9.9	10.6	10.2	9.6	10.9	11.5
Purchased from UK queen breeder	21.5	26.1	15.6	14	17.4	16.3	11.3	14.4	15.9	15.1

Purchased from EU queen breeder	7.3	5.5	1.5	1.1	1.9	1.8	1.3	1.3	1.1	1.2
Purchased from Third Country	4.7	4.8	1.1	0.8	0.5	0.4	0.8	0.2	1.6	0

* only included from 2011, previously reported under reared by colony itself

Origin of colonies

Table 17: Proportion (%) reporting origin of colonies

Year	Proportion Reported
2010	43.7
2011	39
2012	43.6
2013	45.8
2014	39.9
2015	40.8
2016	35.6
2017	36.2
2018	35.6

Table 18: Of those reporting the origin of colonies in Table 17, proportion (%) reporting what origin of colonies

Origin	2010	2011	2012	2013	2014	2015	2016	2017	2018
UK	98.6	96.2	96.7	97.5	97.8	98.2	97.6	96.3	96.5

Europe	1.9	2.7	1.7	1.8	2.2	1.6	2.4	2.9	3.5
Other	0.1	2.5	2.2	0.9	1	1	1	1.6	1.2

Collecting swarms

Table 19: Proportion (%) of respondents reporting collecting swarms

Year	Yes	No	None reported
2012	65.2	30.8	4
2013	61	37.1	1.9
2014	63.4	33.8	2.7
2015	68.3	29.7	2
2016	69	28.4	2.6
2017	63.7	34.7	1.6
2018	64.6	34.5	0.9

Varroa treatment applied

Table 20: Proportion (%) of respondents reporting treating for Varroa

Year	Yes	No	*Colonies kept in a Varroa free area	None reported
2009	94.6	5.1	NA	0.2
2010	90.2	9.2	NA	0.6

‡2011	NA	NA	NA	100
2012	92.2	5.8	NA	2
2013	92.8	6.2	NA	1
2014	89.6	9	NA	1.4
2015	92	7.3	0.5	0.2
2016	88.7	9.1	0.8	1.5
2017	86.6	12	0.5	0.9
2018	87.8	10.6	0.4	1.2

Not included prior to 2015

‡ Not included as a yes/no answer

Beekeeping problems

Table 21: Proportion (%) of respondents reporting a problem with their bees

Year	Proportion Reported
2009	98.7
2010	91.1
2011	81.8
2012	81.5
2013	79.3

2014	78.3
2015	91.9
2016	91.9
2017	92.5
2018	93.6

Table 22: Of those reporting a problem with their bees in Table 21, proportion (%) of respondents reporting a specific problem

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Acarapisosis	1.87	0.65	0.6	1.34	0.1	0.04	0.11	0.06	0.26	0
AFB	N/A	N/A	0.7	1.92	0.1	0	0	0	0	0
Ants	N/A	N/A	8.77	6.4	9.39	8.29	8.76	10.06	8.63	8.69
Chalkbrood	82.03	48.28	33.2	43.53	34.34	32.17	31.82	27.9	29.02	28.04
Deformed wings	N/A	26.42	29.41	35.72	23.33	20.31	34.04	29.94	28.37	33.95
EFB	N/A	N/A0	2.09	6.4	1.72	1.38	1.22	1.08	0.65	0.58
Failing queen	N/A	34.34	26.72	29.19	38.28	24.45	32.04	39.88	37.91	36.96
Mice	N/A	N/A	11.67	21.64	11.82	7.72	12.2	9.46	8.24	12.17
Nosemosis	17.09	11.45	14.36	19.72	10.71	6.82	9.65	8.5	7.45	8.23
Paralysis	N/A	3.1	1.4	1.66	1.52	0.81	1.11	2.63	3.53	2.9
Rats	N/A	N/A	1.6	1.28	1.41	0.65	0.89	1.56	1.31	1.04
Sacbrood	3.33	2.88	1.6	1.92	1.92	1.42	2.38	3.53	3.2	3.07

Vandalism theft	N/A	N/A	4.59	6.79	3.23	2.11	2.55	2.04	1.57	2.09
Varroosis	N/A	39.16	50.55	49.55	37.07	35.58	43.46	32.93	30.98	36.73
Wasps	N/A	35.63	43.07	46.61	22.63	41.27	26.72	42.99	33.33	28.85
Woodpeckers	N/A	N/A	19.44	19.85	10.3	6.66	5.76	4.55	5.49	5.68
Other	N/A	N/A	10.07	7.17	10.3	8.61	7.21	7.54	8.37	6.6

Diagnosis of pests and diseases

Table 23: Proportion (%) of respondents reporting on diagnostic testing

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Acarapisosis	48.19	44.99	33.81	27.61	38.94	37.6	35.65	34.65	32.92	34.76
American Foulbrood	96.68	90.65	68.27	55.32	78.04	75.45	70.57	69.47	65.56	68.86
Chronic bee paralysis virus	N/A	86.79	65.5	52.51	76.12	74.24	69.38	68.01	65.28	68.19
Chalkbrood	N/A	N/A	71.37	62.32	81.73	77.93	73.21	71.44	68.03	71.86
Deformed wing virus	N/A	87.05	68.11	55.95	77.96	76.34	72.49	70.15	67.08	70.61
European Foulbrood	97.41	90.81	68.52	56.37	78.61	76.53	71.37	69.73	66.22	69.19
Nosemosis	97.53	91.7	70.8	59.39	79.89	77.42	73.21	70.84	66.98	70.86
SacBrood	N/A	N/A	67.37	54.28	77.16	75.19	70.26	69.47	65.46	69.03
Varroosis	N/A	N/A	73.9	64.61	81.41	78.31	75.12	71.87	68.12	73.02

Other	N/A	N/A	39.31	15.24	41.11	40.52	37.8	41.77	42.22	41.13

Table 24: Of those reporting on diagnostic testing, proportion (%) of respondents undertaking test

Problems	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Acarpisosis	12.58	12.71	9.05	9.45	6.28	6.6	5.93	4.08	4.03	5.39
American Foulbrood	19.21	17.97	14.46	16.42	12.42	11.64	8.7	8.89	8.54	7.38
Chronic bee paralysis virus	NA	9.81	8.22	10.54	8.53	7.11	6.44	6.43	5.96	7.69
Chalkbrood	NA	NA	26.86	31.83	24.61	22.12	16.78	15.85	15.34	15.41
Deformed wing virus	NA	12.24	17.72	18.66	14.39	15.25	14.52	14.79	11.46	14.62
European Foulbrood	22.11	20.7	17.5	19.81	16.11	14.3	10.73	11.69	9.6	8.54
Nosemosis	23.13	20.05	20.05	23.2	16.25	16.27	13.94	12.11	10.91	11.16
SacBrood	NA	NA	12.71	12.5	12.25	8.97	8.63	9.26	7.83	9.77
Varroosis	NA	NA	40.84	47.82	34.15	37.61	33.12	30.79	27.58	30.56
Other	NA	NA	5.81	8.22	3.9	2.83	3.38	3.29	3.6	2.23

Table 25: Proportion (%) of respondents' tests that reported positive

Problems	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Acarpisosis	4.98	3.2	2.67	4	1.64	6.41	3.77	9.09	14.29	2.22

American Foulbrood	1.62	2.56	2.48	1.15	0.83	1.45	6.49	1.39	10.17	3.28
Chronic bee paralysis virus	NA	4.91	6.06	5.66	17.28	15.66	14.29	23.53	41.46	22.22
Chalkbrood	NA	NA	67.23	74.21	66.53	68.27	72.08	65.15	70	57.89
Deformed wing virus	NA	19.12	55.41	58	40	48.63	57.58	57.02	62.96	53.23
European Foulbrood	9.52	5.28	5.44	8.41	10.13	8.72	12.5	10.53	10.45	7.04
Nosemosis	37.97	29.83	43.68	41.67	41.98	30.3	33.59	42	36.36	29.47
SacBrood	NA	NA	20	21.54	22.88	21.7	26.32	41.33	37.04	29.63
Varroosis	NA	NA	83.24	81.76	76.37	77.54	82.37	79.84	80.3	79.1
Other	NA	NA	39.29	41.67	20	22.22	43.75	31.25	37.5	27.27

Honey production

This question was added to the survey to provide information for the market sector analysis to support the apiculture programme in 2016.

Table 26: proportion (%) of respondents reporting honey production

Year	proportion reporting	proportion of reports		
		heather	multifloral	other
2016	18.52	3.59	87.15	15.74
2017	18.83	4.41	88.54	13.85
2018	16.49	7.2	98.74	0

Selling honey

This question was added to the survey to provide information for the market sector analysis to support the apiculture programme in 2017.

Table 27: Proportion (%) of respondents reporting selling honey

Year	Yes	No	None reported
2017	39.47	52.47	8.06
2018	42.63	50.29	7.08

Feeding

Table 28: Proportion (%) of respondents reporting bee feeding

Year	Proportion Reported
2009	88.3
2010	78.2
2011	79.9
2012	87.8
2013	94.6
2014	88.6
2015	84.5
2016	87.4

2017	87.5
2018	89.8

Table 29: Proportion (%) of respondents reporting bee feeds

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Ambrosia	7.86	10.88	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Candy / fondant	52.39	51.6	50.46	57.43	70.45	68.27	60.66	60.16	62.36	70.25
Feed supplement	3.89	2.54	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
HFC syrup	N/A	N/A	0.51	0.83	0.51	1.22	1.13	1.08	0.65	0.28
Honey	8.27	6.88	6.54	10.34	11.01	7.04	11.32	7.56	7.38	6.86
Inverted sugar syrup	N/A	N/A	7.15	7.49	10.5	12.35	12.64	12.56	12.15	17.05
Pollen / patty	3.48	5.74	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Sugar syrup	65.44	72.63	62.72	63.85	53.68	75.95	66.98	73.8	71.69	71.08
Vitafeed	3.89	2.54	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Other	1.71	1.74	3.27	4.76	6.94	3.3	4.06	4.81	4.56	4.26

Comb replacement

Table 30: Proportion (%) of respondents reporting on whether comb replacement is of importance

Year	Yes	No	None reported
2014	83.08	12.53	4.39
2015	82.14	13.96	3.91
2016	79.85	14.84	5.32
2017	81.5	13.28	5.22
2018	82.43	12.24	5.33

Table 31: Proportion (%) respondents reporting on the quantity of comb replaced

Year	Proportion
2011	32.63
2012	83.3
2013	91.51
2014	92.43
2015	93.7
2016	93.05
2017	93.55
2018	93.67

Table 32: Of those reporting on comb replacement, proportion (%) respondents reporting changing proportion (%) of comb annually

Year	>0%	>10%	>20%	>30%	>40%	>50%	>70%	>90%
2012	71.43	49.25	33.83	18.8	15.79	6.64	5.39	4.14
2013	71.28	52.89	40.11	24.43	19.09	8.49	6.74	5.43
2014	76.46	58.29	43.36	25.33	20.1	9.84	6.47	4.54
2015	79.83	57.87	40.17	23.49	17.96	7.57	5.87	4.09
2016	79.54	62.12	46.18	28.02	21.75	10.78	7.19	4.7
2017	79.92	60.85	42.6	24.65	19.57	8.92	6.29	4.06
2018	80.18	63.64	44.8	26.58	21.07	10.58	6.49	3.82