

Evaluation of the Multi-funder Insect Pollinators Initiative (IPI)

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This document represents the views and conclusion of a panel of experts.

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Executive Summary

This document summarises the views of a specialist Review Panel which provided an independent evaluation of the effectiveness and impact of the multi-funder Insect Pollinators Initiative (IPI). The purpose of IPI was to promote innovative research into understanding and mitigating the biological and environmental factors that adversely affect insect pollinators. It was funded by five organisations¹, which invested a total of £9.65M in nine projects over five years.

The objectives of the evaluation were to:

- assess the quality and international standing of the research supported by IPI, the resulting outcomes and achievements, and its potential economic and societal impacts
- comment on the extent to which IPI fostered collaboration between researchers from different disciplines, fostered knowledge exchange between researchers and stakeholders, fostered engagement with the public, and built capacity and capability in UK pollinator research
- comment on the effectiveness of the management of IPI, including workshops and other networking activities, the coordinator's role, and the funders working together

Data for the evaluation were gathered from a number of sources including grant final reports, the researchfish® outcomes reporting system, and questionnaire responses from grant holders, funders and stakeholders.

Key Conclusions

1. IPI was very effective in delivering its objectives.

IPI supported innovative and high quality research aimed at understanding and mitigating the biological and environmental factors that adversely affect insect pollinators. It resulted in many high quality outputs and outcomes, including freely accessible data, tools and resources, and it promoted interactions between researchers and stakeholders. IPI was also successful in bringing together researchers already in the insect pollinator area with those from other areas of research, and in aiding the development of a UK insect pollinator research community. The involvement of five funders contributed to the success of the initiative, and the funders' active management approach was beneficial. The achievements that have been made through IPI are particularly impressive given the relatively limited scale of the investment made. IPI was successful in generating evidence that will inform the conservation of wild insect pollinators and improve the husbandry of managed species.

¹ The organisations that funded IPI were: Biotechnology and Biological Sciences Research Council (BBSRC), Department for Environment, Food & Rural Affairs (Defra), Natural Environment Research Council (NERC), the Scottish Government, and the Wellcome Trust.

There is significant potential for economic and societal impacts to arise from IPI research, and good progress has already been made towards realising these impacts. IPI has successfully influenced the development of policy, and it is expected that this influence on policy will continue in the future.

2. The standard of research supported by IPI was high.

The projects supported by IPI delivered high quality research outputs. Individually the projects were generally successful in meeting their own objectives, and the research findings generated by the projects were relevant to and helped achieve the initiative's aims. A large number of publications arose from the research, and a significant number of these were in highly prestigious journals. A substantial quantity of data was also produced, much of which has been (or is in the process of being) made freely available. However there is scope for data accessibility to be improved further.

3. The high standard of IPI projects was demonstrated through a wide variety of outcomes and achievements.

IPI research resulted in a good quantity of high quality outcomes including collaborations, further funding, and the building of capacity and capability. IPI researchers were successful in forming collaborations and partnerships with a variety of people and organisations; these included other IPI researchers, academics who were not funded through IPI (including some unsuccessful IPI applicants), and a variety of relevant stakeholders. The extent to which international and non-academic participants were involved in IPI research was encouraging, and is indicative of the relevance of IPI beyond the UK scientific research community. IPI was successful in increasing the overall capacity and capability in pollinator research in the UK. This was achieved in part through the provision of training and research experience to project staff, and in part by bringing established researchers from other disciplines into insect pollinator research. Some of these more established researchers have remained in this field of research after the end of their IPI projects. IPI grant holders were very successful in securing additional funding from a variety of sources. A majority of projects were awarded further funding to enable them to continue their insect pollinator research, and a significant proportion of the projects were awarded funding for training and/or translation activities.

4. IPI was effective in promoting engagement between researchers and stakeholders.

IPI was successful in fostering engagement with a good variety of strategically positioned stakeholders and with the public. These resulted in a high level of visibility of the initiative and helped to improve stakeholder and public understanding of the issues affecting insect pollinators. The proportion of grant holders' engagement activities that were aimed primarily at professional practitioners and policy makers was particularly impressive, and exceeded the levels normally expected for BBSRC grants. There was a high level of interaction between projects and stakeholders and many stakeholders took part in collaborations with

IPI researchers. Some were formal collaborations (e.g. joint research or applications for funding) while many others were informal (e.g. discussions, presentations, etc.). IPI was also effective in fostering engagement between grant holders and the public, with all projects taking part in engagement activities aimed primarily at a public audience. Grant holders used a good variety of approaches to public dissemination utilizing different media (radio, TV, social media) as well as making direct contact through talks and presentations, and attendance at public events. Public interest in and understanding of issues affecting pollinators was increased through these activities.

5. IPI has clear potential to deliver economic and societal impacts.

IPI was successful in delivering steps towards economic and societal impacts. These impacts include improving the health and size of pollinator populations, maintaining effective pollination of crops for agriculture, and increasing public knowledge of insect pollinators. The impact from IPI is likely to increase over time. IPI has been successful in influencing changes in government policy, and grant holders contributed to discussions with policy makers that may lead to further developments in policy in the future. IPI has also influenced practice, both indirectly through policy changes and directly through contact with professional practitioners. Opportunities for increasing impact (for example by strengthening the coordination of engagement activities across projects), and for improving the identification and tracking of impacts resulting from engagement activities could have been improved had funding for more coordinator time been available.

6. IPI grant holders were highly successful in engaging with the public.

IPI researchers engaged effectively with the public. They took part in an impressive number of public engagement activities, and used a range of media to promote the key messages and findings from their research. The visibility of IPI was significant, with many grant holders making contributions to numerous TV and radio productions. IPI has contributed to an increase in public awareness and understanding of issues affecting insect pollinators, and may lead to changes in behaviour that are beneficial to insect pollinators.

7. The active management of IPI was crucial in achieving its success.

The funders' active management of IPI included the establishment of a Programme Management Group (PMG, comprising representatives of each of the funders), supporting workshops and dissemination events, and funding a part-time coordinator. These activities made a key contribution to the successful delivery of IPI's aims. The PMG members worked together effectively to deliver the initiative's aims and provided clear and consistent information to grant holders, the coordinator and to stakeholders. The funders helped to create an 'IPI brand' that resulted in increased visibility of the initiative to stakeholders. The grant holders' workshops were successful in promoting dialogue among IPI researchers and led to greater knowledge exchange and cooperation between IPI projects. The stakeholder dissemination event was effective in raising the visibility of IPI with strategic stakeholders

and improving their awareness of IPI research and its potential impacts. The dissemination event was successful in providing an opportunity for stakeholders and grant holders to make contact and discuss potential future collaborative work.

8. The coordinator role was key in contributing to the overall success of IPI.

The coordinator role was instrumental in delivering the benefits of IPI for funders and the research community. The coordinator was a contact/liason point for everyone involved in or connected to IPI, including grant holders, stakeholders and funders. This creation of an 'IPI community' led to more effective information exchange and cooperation. The coordinator formed strong relationships with each of the projects, and gained a good understanding of their objectives and progress, through regular contact with grant holders. This helped ensure the projects remained focused on the initiative's aims as well as their individual project objectives. The coordinator role helped to maximise the outcomes of IPI research by identifying synergies between projects and encouraging cooperation, knowledge exchange and sharing of data. By representing IPI at external meetings, the coordinator raised the profile of IPI and acted as a point of contact for academics and stakeholders who wanted to engage more closely with IPI projects.

9. IPI was managed effectively and efficiently.

IPI brought together the major UK funders of insect pollinator research, and they worked together well to design and deliver an initiative which effectively addressed their policy and priority needs. The projects supported addressed a variety of questions around insect pollinators, and their results had broad applicability. The grant application and administration processes were managed to a high standard by BBSRC and the awarded grants were administered effectively. BBSRC also ran the Programme Management Group effectively.

10. There are opportunities to learn from IPI for future funding investments.

There are opportunities for funders to learn from the success of IPI in the design of future research initiatives, building on the aspects of IPI that were very effective while also addressing some of the lessons learned:

- **Active management of initiatives is beneficial.**
IPI demonstrated the value of active management. When future initiatives are planned, the potential benefits of actively managing them should be considered, as should the appointment of an expert coordinator with appropriate knowledge and skills.
- **Effective engagement between researchers and relevant stakeholders is key to maximising research impacts.**
Support for effective two-way knowledge exchange activities with appropriate audiences should be considered to improve delivery of impact from research

investments. Coordinating impact activities across projects can increase impact realised, but is likely to need additional investment in coordinator time.

- **Some research outputs and outcomes are not being recorded.**
Grant holders are expected to provide details of all outputs, outcomes and impacts arising from their research via the researchfish® system, but for some awards the information supplied is not complete. There may be value in funders providing additional guidance to grant holders and reiterating to them the importance of reporting all research outputs and outcomes. It may also be beneficial to track the impacts arising from research beyond the standard five year period (for example when impacts are dependent on the implementation of policy change arising from research) in order to capture fully the outcomes from the research.
- **Access to tools and resources could be improved.**
There is scope to improve the accessibility of tools and resources produced through research investments. Establishing robust structures for the management of data and tools generated at the outset could make it easier for data to be deposited and could facilitate easier access for others.
- **Increasing attendance at workshops and networking events should be considered.**
Encouraging all project staff to attend workshops and networking events should be considered. While practical and financial constraints may limit attendance at such events, ensuring the appropriate people attend can be effective in providing opportunities for networking and facilitating community building.

11. Insect pollinators remain an important area for continued research investment.

IPI was successful in increasing our understanding of the issues facing insect pollinators, and has been influential in the development of policy affecting them. Nevertheless, recent studies have shown that the populations of insect pollinators are continuing to decline. There is also uncertainty around the UK policy environment, particularly in relation to the UK's departure from the European Union. Insect pollinators, and the factors affecting them, therefore remain important areas for continued research investment.

1. Introduction

1.1 The Insect Pollinators Initiative

1. Insects contribute substantially to the pollination of a wide variety of cultivated and wild plants, and play important roles in both crop production and the maintenance of natural ecosystems. However, there is evidence that populations of managed and wild insect pollinators are declining in the UK and elsewhere, in the face of threats from rapid changes in the environment such as emerging pests and diseases, habitat loss, intensive agriculture and climate change. An evidence base is needed to inform the conservation of wild insect pollinators and to improve the husbandry of managed species, in order to avoid the potentially catastrophic loss of the ecosystem services and ecological processes they provide.
2. The Insect Pollinators Initiative (IPI) was conceived because of a common recognition by the five funders of the importance of bees and other insects for pollination, and in light of concerns about widespread declines in their abundance. IPI arose from discussions between funders instigated by Sir Mark Walport, then Director of the Wellcome Trust. These discussions followed a 'Frontiers Meeting' on 'Bee Populations: Health and the Environment' organised by the Trust in October 2008. Subsequently, a consortium of funders came together in this joint initiative to support research into the causes and consequences of threats to pollinators, and to inform the development of appropriate mitigation strategies.
3. The IPI consortium comprised five funding organisations: Biotechnology and Biological Sciences Research Council (BBSRC), the Department for Environment, Food and Rural Affairs (Defra), the Natural Environment Research Council (NERC), the Scottish Government and the Wellcome Trust. While each has a different mission and remit, all 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.
4. The initiative was launched in July 2009 with the purpose of promoting innovative research aimed at understanding and mitigating the biological and environmental factors that adversely affect insect pollinators. Its key aims were to:
 - provide an evidence base to inform the conservation of wild insect pollinators and to improve the husbandry of managed species, in order to avoid the potentially catastrophic loss of the ecosystem services and ecological functions they provide
 - provide a basis for reducing current declines and sustaining healthy and diverse populations of pollinating insects for the future
5. The funders agreed that the causes of pollinator declines were likely to be multifactorial, involving complex interactions between pollinators, their pests and pathogens, and the environment. To reflect this, the initiative encouraged multidisciplinary projects and systems-based approaches, in particular projects combining the expertise of the existing pollinator research community with relevant new skills such as state-of-the-art and

high-throughput 'post-genomic' technologies, and the latest techniques in epidemiological and ecological modelling.

6. Collectively, BBSRC, Defra, NERC, the Scottish Government and the Wellcome Trust agreed to commit up to £10M over five years to support multidisciplinary research in this area as part of the Living With Environmental Change (LWEC) partnership².
7. IPI was administered, and the assessment process managed, by BBSRC on behalf of all of the funders. Applications were sought for projects of three years' duration but, where appropriate and scientifically justified, shorter or longer projects were considered (up to five years' duration).
8. Overall, the funders invested a total of £9.65M in the initiative. Nine projects, made up of 29 grants, were funded. Details of the contributions of the funders to the initiative, and the grants that were funded are provided in Annex 1.

1.2 Introduction to Evaluation

9. Evaluation is an important tool for examining the relevance, performance, efficiency and impact of programmes and schemes in relation to their stated objectives and wider strategic aims. It provides the evidence required to assess the overall quality of research within a portfolio, providing assurance that the highest quality research is being funded. Evaluations are also used to examine the wider impacts and benefits arising from investments. This includes identifying the broader economic and societal impacts of the research.
10. Effective evaluation of investments helps funders to account to stakeholders for the funds that they allocate, informs specific decisions on future research funding, and helps to improve funders' policy and practice.

1.3 IPI Evaluation Methodology

11. An evaluation of the extent to which the initiative met its original objectives was undertaken by BBSRC on behalf of all the funders involved.
12. The aim of the evaluation was to provide an independent assessment of the effectiveness and impact of the initiative. Specifically, the objectives of the evaluation were to:

² LWEC was an interdisciplinary research and policy partnership to tackle environmental change and the societal challenges it poses, and so to provide a firmer basis for people to deal with the unprecedented changes that the world will face over the next century. All seven Research Councils, working with partners in at least nine Government departments, designed and contributed to the LWEC programme. LWEC became the RIDE Forum in 2016. For more information, see <https://nerc.ukri.org/research/partnerships/ride/>

- assess the quality and international standing of the research supported by IPI
- assess the outcomes and achievements of the research supported through IPI, including the accessibility of the data, tools and resources produced
- assess the potential economic and societal impacts of the research supported through IPI and the extent to which it is likely to inform the management and conservation of insect pollinators
- comment on the extent to which IPI fostered collaboration between researchers from different disciplines
- comment on the extent to which IPI built capacity and capability in UK pollinator research
- comment on the extent to which IPI fostered knowledge exchange between researchers and stakeholders, and engagement with the public
- comment on the coordination and management of IPI, including the effectiveness of:
 - workshops and other networking activities held as part of the initiative
 - the coordinator's role
- comment on the effectiveness of the funders working together to deliver IPI
- make recommendations on ways to build on successes and ways to address any identified gaps and issues present.

13. Information for the IPI evaluation was gathered from a number of sources:

- **Final reports from completed grants:** Final reports³ from all IPI projects were submitted to the funders and included in the evaluation.
- **Research outcomes:** All Research Council grant holders are asked to update the information on the outputs and outcomes from their grants in researchfish@⁴. The most recent data available, from the 2016 submission period (ending 10 March 2016) was used in this evaluation. Grant holders of four of the 29 grants did not provide a researchfish@ submission in 2016, although data were available from 2015. At least one grant holder from each of the nine projects submitted data in 2016.
- **Grant holder surveys:** In July 2015, BBSRC invited all IPI grant holders to complete a brief questionnaire which sought their views on the effectiveness of the IPI funding mechanism. This questionnaire was completed by all 29 IPI grant holders. A copy of the questionnaire is available on request.
- **Funder and coordinator surveys:** In July 2015, BBSRC invited representatives from each of the IPI funders, and the IPI coordinator, to complete a brief questionnaire which sought their perspectives on the effectiveness of the IPI

³ The research councils do not normally request final reports; this was a reporting condition required by Defra and the Scottish Government.

⁴ researchfish@ is an online facility that enables research funders and research organisations to track the impacts of their investments, and researchers to log the outputs, outcomes and impacts of their work.

funding mechanism. The questionnaire was completed by all five IPI funders and the IPI coordinator. Copies of the questionnaires are available on request.

- **Stakeholder surveys:** In August 2015, BBSRC invited representatives of organisations with interests in insect pollinators or pollination services to complete a brief questionnaire which sought their views on whether and how their organisation had benefitted from IPI. These organisations included: users of pollination services, nature conservation organisations, beekeeping organisations, government agencies/departments and industry. Organisations were selected to receive the questionnaire on the basis that the funders believed them to have an awareness of IPI or to have had some involvement with IPI. The questionnaire was completed by 22 of the 42 stakeholders to which it was sent (52%). A copy of the questionnaire is available on request.

14. In general, the data were considered with reference to projects (i.e. component grants are not considered separately). However, where appropriate, data were considered with reference to individual grants or grant holders.
15. The evidence collected for the evaluation was reviewed by a panel of experts who had not been directly involved in IPI but who were between them familiar with the insect pollinator research landscape and have expertise or awareness across the funders' remits. The review panel met in November 2016; the membership is listed at Annex 2.

2. Research Outcomes

2.1 Summary

- The research supported through IPI was of a high standard.
- The quantity and quality of publications arising out of IPI projects were very good.
- The amount of data generated by IPI projects was good.
- There was scope to improve the proportion of data that is publicly accessible, but this is expected to increase over time.
- IPI was successful in fostering the formation and maintenance of collaborations and partnerships both within and beyond academia.
- The IPI grant holders were very successful in attracting further funding.
- IPI helped to build capacity in pollinator research in the UK.

2.2 Overview of project performance

16. All of the nine projects made good progress overall and were successful in meeting all or most of their original objectives. The standard of research was high, and most projects resulted in the production of a good number of publications and other outputs. These other outputs included data, software and intellectual property, and the development of new (and maintenance of existing) collaborations.
17. Poor weather during the first season of fieldwork caused some delays and challenges for some projects, but did not significantly affect the overall performance of projects or the initiative as a whole.

2.3 Publications

18. Publications are an important output of scientific research and provide a means of disseminating the results to a wide audience. As well as reaching the academic research community, IPI publications could also be of use to other stakeholders including policy-makers, professional practitioners, conservation organisations and industry.
19. At the time of this evaluation, IPI projects had led to the publication of 91 original peer-reviewed research articles; this was a very impressive number of publications to have arisen from an initiative of this size. The median number of publications per project was 10, and the mean was 12.4. The 29 grants which made up the projects produced a mean of three original research articles in a peer-reviewed journal, and some grants produced many more. This was very good compared to the average for BBSRC funded grants, 82% of which give rise to at least one publication within five years of the grant start date. Additional publications continued to be produced by IPI projects after the evaluation took place.
20. The overall quality of publications resulting from IPI projects was high, and papers were published in a variety of high-profile and more specialist journals. Five of the projects

(56%) contributed to a total of six papers published in highly prestigious journals such as Nature and Science⁵; this was an excellent accomplishment. It was also noteworthy that many of the publications were highly relevant to policy development and were therefore likely to contribute to the strategic aims of IPI.

Examples of publications arising from IPI

IPI researchers demonstrated that bumblebees are becoming infected by honeybee diseases. There has been much research into the diseases of honeybees, and beekeepers try to ensure that these diseases are kept under control in their bees using various treatment and mitigation strategies. However, bumblebees and other wild pollinators are not able to receive treatment for diseases and populations of these species may therefore be more susceptible to these diseases. The IPI research highlighted the need to effectively control pathogens in managed bees in order to maintain wild pollinators.

Fürst (2014) Nature, doi: 10.1038/nature12977

Researchers at the Universities of Dundee and St Andrews studied the specificity and consequences of exposure to neonicotinoid pesticides on bees at field-relevant levels. Neonicotinoids have been shown to have sub-lethal effects on bees, and concerns about their use led to the UK Government issuing a moratorium on their use. The risks to bees from three neonicotinoid pesticides, imidacloprid, thiamethoxam and clothianidin, which have been used in the UK, were thought to be the same. However, the IPI research showed that these neonicotinoids have different effects on bumblebees, and that the risks from each need to be considered independently.

Moffat (2016). Scientific Reports, doi: 10.1038/srep24764

IPI researchers at Royal Holloway, University of London showed that colony-founding queen bumblebees exposed to thiamethoxam (a neonicotinoid pesticide) are less likely to lay eggs and thus give rise to new colonies. This could potentially lead to localised reductions of bumblebee populations or even local extinctions. These findings are relevant to the development of policies relating to the use of neonicotinoids.

Baron (2017) Nature Ecology & Evolution, doi: 10.1038/s41559-017-0260-1

Working at the Universities of Bristol, Leeds, Edinburgh, Reading and Cardiff, IPI researchers studied the importance of urban areas for flower-visiting insects. Urban areas contain a wide range of different flower resources which can sustain a lot of insect pollinators. They found that the abundance and species-richness of insect pollinators in urban areas was similar to that found in farmland and nature reserves. These results showed that urban areas can be an important component of any strategy to support and protect insect pollinators.

Baldock (2015). Proceedings of the Royal Society B, doi: 10.1098/rspb.2014.2849

⁵ A sixth project produced a paper in Nature after the panel meeting had taken place.

21. All of the IPI projects resulted in the publication of at least one paper with an international co-author. This was a remarkable accomplishment and indicates that IPI researchers were successful in establishing and maintaining collaborations with international academics. Overall, over half of the unique research publications produced included at least one international co-author.
22. Seven of the projects (78%) were involved in at least one publication with at least one non-academic co-author. The number of publications involving non-academic authors was small (3 out of 91), but included one publication with authors from six projects and over 30 representatives from industry (including growers and retail companies, as well as agribusiness), environmental NGOs, and conservation agencies. In addition to this publication, two projects each produced a paper with non-academic authors. These publications are evidence that IPI researchers successfully collaborated with a variety of stakeholders with interests in different aspects of pollinator research.

2.4 Generation of Data and Resources

23. Making research data readily available reinforces open scientific enquiry, promotes data quality, encourages diversity of analysis and opinion, and stimulates new investigations and analyses. This provides good value for funding investment. The Research Councils support the position stated in the Concordat on Open Research Data⁶ that research data gathered and generated by members of the UK research community should be, wherever possible, made openly available for use by others in a manner consistent with relevant legal, ethical and regulatory frameworks and disciplinary norms, and with due regard to the costs involved.
24. BBSRC expects research data generated as a result of its investments to be made available with as few restrictions as possible in a timely and responsible manner to the scientific community for subsequent research. Members of the scientific community are expected and encouraged to practise and promote data sharing, determine standards and best practice, and create a scientific culture in which data sharing is embedded. The funders agreed that IPI grants would need to comply with standard BBSRC policies, including submitting a data sharing plan and conforming to BBSRC's data sharing policy.
25. A specific objective of IPI was to encourage the generation of freely available data, tools and resources. A high proportion (78%) of projects resulted in data being submitted to databases. This data included: DNA sequence data, gene expression data, species records, and a variety of environmental and ecological information. Approximately 67% of the database submissions reported by grant holders are openly available. The proportion of the data generated that was publicly accessible was comparable with other programmes of research.
26. While approximately half of the grant holders reported no problems in making their data accessible, challenges were identified by other grant holders. It appeared that the ease of data deposition and accessibility was influenced by the type of data generated. The

⁶ <https://www.ukri.org/files/legacy/documents/concordatonopenresearchdata-pdf/>

variety of types of data also made organising metadata alongside datasets more difficult and time consuming for grant holders to achieve in a consistent and understandable way.

27. All IPI projects were required to nominate a 'data officer', to liaise with NERC's EIDC (Environmental Information Data Centre) regarding the deposition of data; a staff member from EIDC was nominated to work with IPI grant holders to facilitate this deposition. However, while the EIDC was established to store large environmental and ecological datasets, and there are established databases for sequence data, there is often no central publicly accessible storage available for other types of data. The absence of appropriate central data depositories may have made it more difficult for some grant holders to make their data openly accessible. Having a coherent structure for data and specimen management in place at the outset of IPI could have made it easier for grant holders to make their data available at the end of the initiative.
28. It was recognised that achieving a high level of publicly accessible data arising from IPI would benefit the long-term legacy of the initiative. One of the main challenges faced by the coordinator was that of working with the grant holders to ensure that data generated during the initiative was deposited where it could be freely accessed by other researchers. There is potential benefit in funders working with the academic community to ensure that focus on data capture and accessibility continues to improve.
29. One project reported that it had produced software which was available for others to use. The production of software and/or tools for others' use was not a high priority focus for IPI, and it is recognised that this requires much greater investment of resources than developing tools/software for use in-house. The development of publicly accessible software was a very positive outcome of the initiative. Other projects may have contributed to the development of tools and/or software but were unable to develop them sufficiently within their IPI project funding to enable them to be made publicly accessible.
30. Useful resources other than data and software can be generated in the course of research. Many insect specimens were collected during the course of the IPI research projects and advantage was taken of a timely offer from the Natural History Museum to store them in its Molecular Collections Facility. This resource, which will eventually house over 42,000 insect specimens at -80°C, provides a snapshot of pollinating insect abundance and diversity across the UK. The specimens will be able to yield information about these insects and the environment in which they were collected, including genetic diversity, presence/absence of pesticides and other chemicals, and disease markers. This resource is unique and will be available for any researcher wishing to make use of it.
31. It is expected that all data generated from future Research Council funded research using this specimen collection will be made openly accessible once the results have been published. Furthermore, all researchers who use the specimen collection, regardless of funder, should be encouraged to make their data openly accessible.

2.5 Intellectual Property

32. BBSRC has a responsibility to ensure that the research it funds is of the widest benefit to society and the economy both within and beyond the UK. The objectives of IPI were focused around producing scientific evidence, generating freely available data, tools and resources, and fostering engagement with stakeholders, the public and other academics. As such, the results of IPI were more likely to be of wider societal benefit than direct financial advantage, and it was unlikely they would lead to the generation of intellectual property (IP). However, it is recognised that there may be some cases, however, where it is appropriate for IP rights to be secured from IPI research, for example where this benefits the application of research outcomes.
33. Two IPI projects (22%) contributed to the development of IP. One project resulted in an application, relating to deformed wing virus (DWV) and the development of methods to prevent and/or treat DWV infection in honeybees, being submitted to secure IP rights. The outcome of this application was not known at the time of this evaluation. One other project generated results which the applicants anticipated may, following more research, lead to a patent application. It is encouraging that grant holders are considering how their research could be used and are exploring the possibility of securing IP rights.

2.6 Collaborations and Partnerships

34. Many of the questions addressed by scientific research are of international significance and are not limited by national or administrative boundaries. The formation and maintenance of collaborations and partnerships is therefore important to facilitate progress in, and maximise beneficial outcomes from, scientific research. Collaborations enable ideas and expertise to be shared more easily, and can facilitate access to data, facilities and equipment. Collaborative working also reduces duplication of effort, resulting in increased value for money.
35. The numbers and types of collaborations and partnerships developed through IPI were generally good. Collaborations were established and/or maintained between IPI projects through the initiative, with the publication co-author data indicating that the IPI grant holders successfully collaborated with researchers from other IPI projects. The publication co-author data also indicate additional collaborations and partnerships were developed beyond the IPI-funded community. Grant holders from all projects reported being involved in at least one collaboration with individuals or organisations not directly involved in IPI. These included collaborations with academics (both within the UK and international) and with non-academic organisations.
36. Furthermore, it is likely that more collaborations and partnerships occurred than were reported, since those without a formal basis (especially informal academic collaborations) are sometimes not perceived to be appropriate to report in grant holders' researchfish® submissions. Grant holders reported that IPI had fostered the development of collaborations, indicating that IPI funding had benefited the development

of wider interactions within the research community, as well as between the researchers it funded directly.

2.6.1 Academic collaborations

37. Eight projects (89%) involved researchers at more than one institution in the original application and there was also a high degree of interaction and collaboration between the IPI projects over the duration of the initiative. This contributed to the very good progress made in building an IPI community and in sharing knowledge, data and resources. There were still opportunities for further improvements, however, especially between projects where the research was more closely aligned.
38. Six of the IPI projects (67%) reported a total of 13 additional collaborations or partnerships with UK academics during the course of the initiative, and a very high proportion of projects (89%) reported developing or maintaining international academic collaborations. These were a mixture of formal collaborations (e.g. research collaboration, joint publication etc.) and less formal interactions (e.g. developing new and improved contacts).

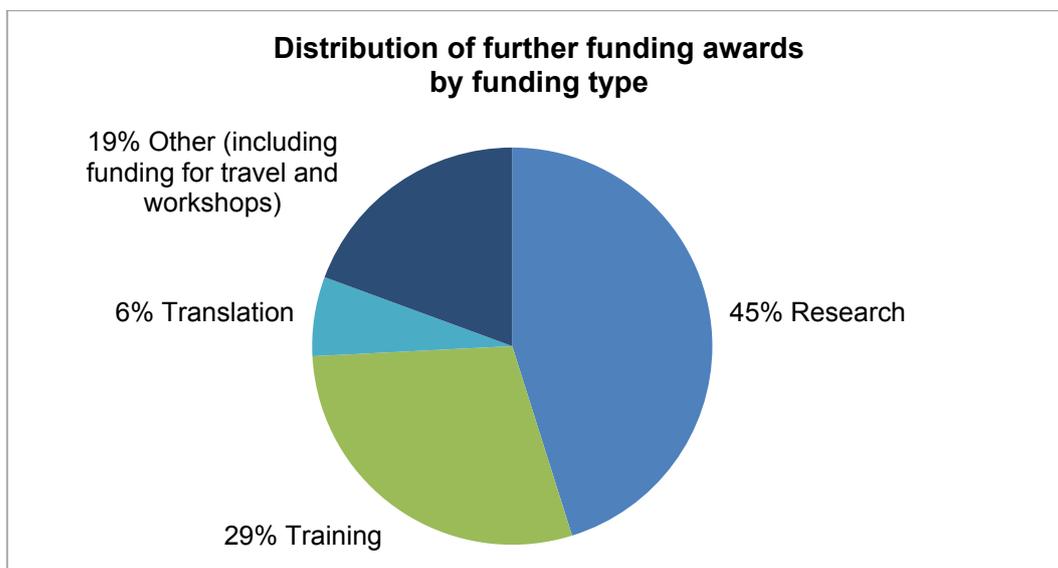
2.6.2 Non-academic collaborations

39. As well as encouraging collaborations within academia, IPI funding was also successful in fostering the development of wider interactions and collaborations beyond the academic research community. Collaborations with non-academics were reported by three projects (33%), and involved four organisations; three of these were with industry (Faccenda Farms, Norman Collett Ltd. and Syngenta), and one was with the Scottish Beekeepers' Association. These collaborations indicate that the impact of IPI extended beyond the scientific research community and into the stakeholder and research user communities. In addition, many engagement activities with non-academic stakeholders were undertaken; these are considered in section 3.

2.7 Further Funding

40. Success in obtaining further funding to continue or develop research can be an indicator of a project's success. It can indicate that the project produced exciting results that opened up new research directions, and/or that the research was of sufficiently high quality to support further competitive applications for funding.
41. The success of the IPI project teams in being awarded further funding was particularly notable, with most projects (89%) receiving funding for follow on research and/or translational work after the start of their IPI project. Seven projects (78%) received funding for further research, five (56%) for training (e.g. studentships) and four (44%) for work towards translation (including one BBSRC Enterprise Fellowships and one NERC Knowledge Exchange Fellowship). Many projects received more than one additional funding award, with a total of 31 awards for further funding reported for the IPI projects. The types of funding received may indicate that some researchers are seeking to

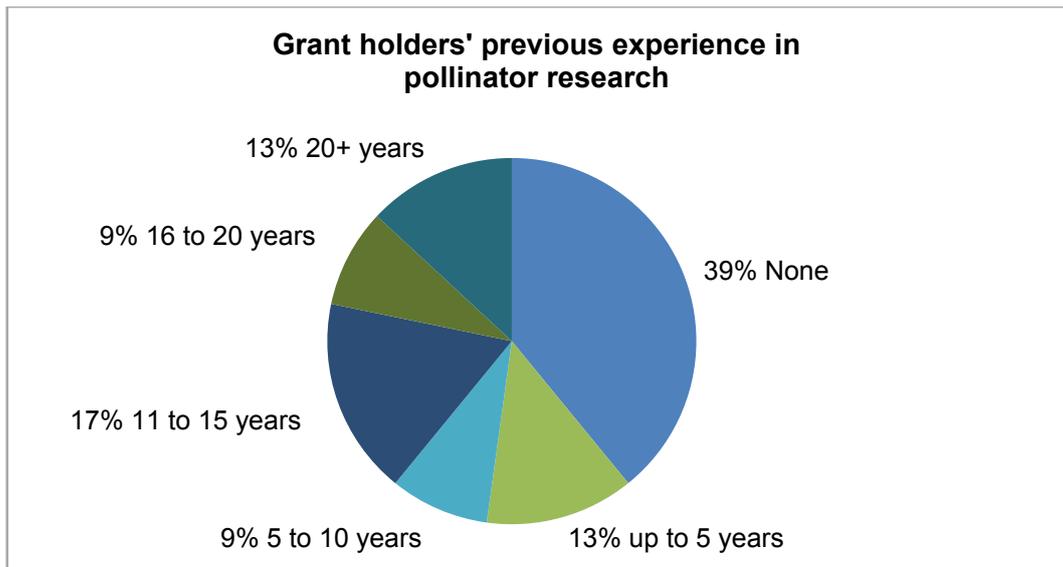
translate their research into more practical applications as well as securing funding to continue their research.



42. IPI grant holders reported that the further funding came from a variety of sources, including: Research Councils, UK and international governments, industry, charities, foundations and trusts, and learned societies. This range suggests that IPI grant holders were very successful in promoting the potential benefits of their research to a broad range of funders.
43. It was likely that some IPI grant holders had received further support from their own institution, but no internal university support was reported in researchfish® by any IPI grant holder. Having this data would have enabled a more complete picture to be drawn of grant holders' subsequent success in obtaining funding. If possible this information should be sought for future evaluations where appropriate; ways of encouraging inclusion in researchfish® submissions should be considered.

2.8 Capacity and Capability

44. One of the aims of IPI was to bring researchers who had useful expertise, but who had not previously worked on insect pollinators, into the insect pollinator community. IPI was highly successful in achieving this aim; nine out of the 23 IPI grant holders (39%) were new to this area, and had not received funding for pollinator-related research prior to receiving IPI funding. Overall, a good range of scientific disciplines were represented across the initiative, although most individual projects involved researchers from similar scientific backgrounds. It was very encouraging that so many of the successful applicants were drawn into IPI from other research areas.



45. A majority of staff employed on IPI projects remained in academia after the end of the project, and all staff employed in a research capacity on the projects remained in research positions in their next roles. Several individuals employed on IPI projects went on to study for PhDs after their IPI employment. One or more IPI PDRAs were subsequently appointed to lectureships, and PIs were also promoted. IPI has therefore resulted in an increase in the overall level of knowledge and expertise in pollinator research in the UK academic community.
46. The number of pollinator applications submitted to BBSRC's responsive mode has increased significantly since the start of IPI; from almost none prior to IPI to around three applications per round currently. Applications have been submitted both by IPI grant holders and by researchers who were not involved in the initiative. The increased number of applications to BBSRC responsive mode could be indicative of an overall increase in the size of research activity of the pollinator community, or could indicate that applications are now being directed to BBSRC that might previously have been submitted to other funders. This suggests that IPI has helped raise researchers' awareness of potential funders to whom they can submit applications for pollinator research funding.
47. IPI successfully consolidated a previously dispersed community in pollinator research. In addition to collaborations between IPI researchers and projects, other collaborations were developed between researchers who were unsuccessful in obtaining IPI funding and with those who were funded. This was a very positive outcome of the initiative, suggesting that IPI helped build the pollinator community beyond those it funded directly.

3. Economic and Societal Impacts

3.1 Summary

- The research supported through the Insect Pollinators Initiative has clear potential to deliver economic and societal impacts.
- IPI researchers engaged with a good number and variety of strategically positioned stakeholders.
- IPI was effective in working to address the needs of stakeholders.
- The visibility of IPI as a programme was significant, and researchers were highly successful in engaging with the public.
- IPI research influenced policy development and contributed to improving public and stakeholders' understanding of the issues around pollinators.
- There were opportunities to realise further impact from research supported through IPI.

3.2 Introduction

48. IPI was expected to generate research outputs, including publications and data, which would increase knowledge of the causes and consequences of insect pollinator decline. In addition to these shorter-term outputs, projects were expected to make progress towards broader and longer-term economic and societal impacts, which relate to the missions of the funders. Although it is difficult to measure and attribute economic and societal impacts, it is important to identify them where possible.

49. It was anticipated that the wider economic and societal impacts of IPI would include:

- an increase in understanding of the issues facing insect pollinators which informs how the problems can be addressed
- influencing the development of policy affecting pollinators
- promoting changes in practices (e.g. by farmers, beekeepers and those involved in landscape management)
- an increase in public awareness and understanding of the issues affecting insect pollinators

3.3 Engagement Activities

50. For impacts to be realised from research investments, researchers must engage with stakeholders, including practitioners, policymakers and industry. This enables researchers to gain an understanding of stakeholders' needs, and to share research findings. It is often useful for engagement activities to be tailored for different audiences, including practitioners, policymakers and the public.

51. IPI grant holders undertook a variety of engagement activities aimed at promoting the delivery of economic and societal impacts of IPI. These activities involved stakeholders

from different sectors including policymakers, NGOs, beekeepers, farmers and other organisations involved in land management, industry, and the public. All projects reported undertaking at least one engagement activity during the course of their award, which compares very well with the average for BBSRC grants⁷.

52. The total number of engagement activities reported by IPI projects was particularly high, with a total of 539 engagement activities reported across the nine projects. The majority of these activities (64%) were aimed at a public audience, but many others were aimed at academics (14%), professional practitioners (11%) and those involved in policy development (7%). This level of engagement is much higher than would normally be expected for BBSRC grants.

3.3.1 Engagement with Stakeholders

53. IPI grant holders were successful in engaging with a good variety of stakeholders, including beekeeping organisations, government departments, conservation organisations, NGOs, wildlife charities and farmers. High levels of engagement occurred during the projects, and further opportunities for engagement were created at the final dissemination event.

54. As part of the evaluation, relevant stakeholders were sent a questionnaire asking for information about their organisation's involvement with IPI and how beneficial this involvement had been. This provided information about the effectiveness of the engagement activities.

55. A high level of engagement occurred between the stakeholders and IPI; almost all stakeholders (95%) had either read information produced through IPI (such as research papers, policy briefings, and news articles) and/or attended an IPI workshop. 71% of the stakeholders had taken part in informal collaborations with IPI researchers (including discussions, meetings, presentations etc.) and 30% had been involved in formal interactions with IPI researchers (including collaborations, joint research, and joint applications for funding). Both funders and projects were successful in reaching out to and making contact with relevant stakeholders, with most stakeholders (80%) initially hearing about IPI research either directly from an IPI academic and/or from one of the funders.

56. Stakeholders found IPI to be useful and relevant to their concerns. For example, 76% stated that their understanding of issues relating to insect pollinators had changed as a result of IPI. All stakeholders indicated that the concerns of their sector, and of their organisation, had been addressed to at least some extent by the initiative. This is particularly impressive, and reflects the focus throughout the programme on research relevant to policy and practice.

⁷ Data from the 2016 researchfish® submission period indicate that an engagement activity is reported within five years of the start of the grant for 41% of BBSRC grants.

Examples of stakeholder engagement activities reported by IPI grant holders:

Representatives from all nine IPI projects participated in the 2015 British Beekeepers' Association Spring Convention. They presented their research findings, and contributed to the production of an information booklet for delegates. This booklet contained summaries of each research project, and was written to be accessible to beekeepers.

Researchers from all IPI projects also took part in various outreach activities with local and national beekeeping groups and commercial beekeepers throughout the course of their projects. Talks were given to beekeeping associations including: Hertfordshire Beekeepers, Leipzig and Taucha Beekeepers' Associations (Germany), Ulster Beekeepers' Association, North London Beekeepers' Association, British Beekeepers' Association, Ontario Beekeepers' Association, Fife Beekeepers' Association, Avon Beekeepers' Association and Reading and District Beekeepers' Association.

IPI researchers engaged with the Royal Horticultural Society to compile its "Perfect for Pollinators" planting list. This list was created to help gardeners and retailers identify garden plants that are beneficial to pollinators, with the aim of promoting the use of more pollinator-friendly plants in gardens.

IPI researchers worked with the Greater Bristol Pollinator Network partners⁸ to organise the Bristol Pollinator Summit, which was attended by a variety of stakeholders (including Defra, Natural England, local community groups, the Royal Horticultural Society, conservation charities including the Bumblebee Conservation Trust, the gardening industry and consultants). The discussions resulting from this meeting guided the development of the Greater Bristol Pollinator Strategy, and informed the development of pollinator-related activities subsequently developed in the Bristol area.

Researchers from one IPI project showcased best practice guides for managing crop pollination to the Waitrose agronomy group. The feedback they gained from the group helped them refine the guides ready for publication. The guides were intended be of use to farmers and land managers in ensuring their practices are beneficial to pollinator health.

IPI researchers contributed to a book, entitled "Habitat Creation and Management for Pollinators", which provided farmers and other land managers with the best available advice on creating and managing pollinator-friendly farmland habitats.

57. Two-way engagement with stakeholders is of key importance in realising impacts from research. It enables researchers to understand stakeholders' concerns and needs, and allows research to be responsive to these.

⁸The Greater Bristol Pollinator Network partners were: University of Bristol, University of the West of England, Avon Wildlife Trust, Buglife, Bristol City Council, South Gloucestershire Council, and Bristol Friends of the Earth. <https://www.ceh.ac.uk/book-habitat-creation-and-management-pollinators>

58. There is evidence of two-way knowledge exchange occurring through IPI, for example in the joint development of policy. However, many of the engagement activities that occurred during IPI were one-way transfer of knowledge where researchers informed others of their research findings, rather than two-way engagements. Both direct (via talks and presentations) and indirect (where intermediaries publicised or informed others of research findings) knowledge transfer activities were undertaken by IPI researchers. In general, IPI projects engaged in more knowledge exchange activities than normal BBSRC grants. However in common with most BBSRC grants, there was scope for increasing the delivery of impact from IPI research through increasing the number of effective two-way knowledge exchange activities undertaken.
59. Overall, greater impact could have been achieved from the engagement activities had projects with common themes undertaken more joint activities. There was potential for the coordinator role to have a greater involvement in identifying such opportunities and facilitating joint activities, although this would have required the funders to support more coordinator time to make it feasible, and additional coordination funding was not available.

3.3.2 Engagement with public

60. IPI grant holders were highly successful in engaging with the public, and all nine projects took part in at least one engagement activity aimed primarily at a public audience during the course of the initiative. The visibility of IPI as a programme was significant, especially as researchers used a variety of media to promote the key messages and findings from their projects. Effective media coverage from IPI is likely to have helped improve public understanding of the complex issues around pollinators, both within the UK and internationally. Grant holders reported that public engagement activities encouraged changes in behaviour that could benefit insect pollinators, and influenced public opinion.
61. The majority of grant holders (60%) stated that IPI had been effective in fostering engagement between researchers and the public. Of the engagement activities that were targeted primarily at a public audience, approximately 80% targeted the public directly and approximately 20% were instances of public engagement through media channels. A number of noteworthy contributions to public engagement were made (see box).

Examples of public engagement activities reported by IPI grant holders:

IPI researchers from all of the projects were involved in media productions about their work. Contributions were made to programmes for BBC TV and BBC Radio, local and national TV and radio, and articles in national and international newspapers and magazines. These activities raised the public profile of the importance of pollinators, increasing awareness of the challenges they face and what can be done by individuals and organisations to mitigate these challenges. For example, IPI researchers contributed to the BBC2 Horizon Special “What is killing our bees?” and associated radio interviews promoting the programme, and made contributions to articles in RHS Garden magazine, the New York Times and to an ebook (*The Importance of Ideas*) published by the Guardian newspaper.

Several IPI researchers took part in ‘Café Scientifique’ events at various locations around the UK, including Bath, Oxford, Leeds, Woking and Dunkeld. These events provided an opportunity for a public audience to hear talks about IPI research and to take part in discussions. Audiences at the IPI events noted that the events added to and questioned their knowledge about the challenges facing pollinators, and increased their interest in pollinators and what can be done to help them. Talk topics included: urban pollinators, modelling the spread of disease in honey bees, and pollinator declines.

IPI researchers engaged in discussions with Dundee City Council and the Britain in Bloom team there in the run up to the 2015 “Britain in Bloom” competition. Their aim was to promote the use of pollinator-friendly plants, and eliminate the use of pesticides by the Council. The team and Council committed to putting insect pollination as the key aim for their plantings, and were keen to establish a climate change garden and pollinator trails throughout the city to raise public awareness of pollinators and the problems they face.

IPI researchers spoke about their work at the 2014 Cheltenham Science Festival. This event gave audience members an opportunity to hear presentations about research being carried out through IPI, and to engage directly with the researchers involved.

Researchers from the University of Leeds were involved in a project to develop an exhibit focused on the ecosystem services provided by gardens, for the Royal Horticultural Society’s 2012 Chelsea Flower Show. The garden they designed showed how simple changes to urban gardens, including the use of pollinator-friendly plants, can make a positive difference to the environment. The garden was awarded a RHS Gold medal.

3.4 Influence on Policy and Practice

62. IPI was successful in influencing the development of policy and practice. It had more influence on policy and practice than would normally be expected from an initiative of this size, or from a similar scale investment in individual projects.
63. Grant holders from seven projects (78%) reported a total of 47 influences on policy or practice, which is a significantly higher proportion than the average for BBSRC grants⁹. These were mostly initial steps towards impact which may ultimately lead to policy developments; however examples of influencing the development of specific policies were reported by six projects (see box). There was scope to strengthen the evidence showing policy impact occurring from IPI funding.

Examples of policy influences reported by IPI grant holders:

Researchers from IPI projects were involved the development of *The National Pollinator Strategy: for bees and other pollinators in England*, which was published in 2014. This document set out a 10 year plan to protect pollinating insects which support food production and environmental diversity. IPI researchers participated in the Pollinators Expert Advisory Group, which oversaw a range of activities that contributed to the development of the strategy, and also took part in workshops and discussions. These not only led to the development of the plan, but also provided evidence to support the implementation of the strategy.

The Parliamentary Office of Science and Technology (POST), produces independent, balanced and accessible briefings on public policy issues related to science and technology. POSTnotes are summaries of public policy issues, written to inform politicians and others involved in the development of government policy. Two POSTnotes were produced with input from IPI researchers and funders. POSTnote 348 *Insect Pollination* examined the risks of insect pollination decline for the UK and explored strategies to provide stable pollination services for the future. POSTnote 442 *Reversing Insect Pollinator Decline* summarised the causes for the recent trends, gaps in knowledge and possible strategies for reversing pollinator decline.

Two IPI projects provided evidence to Natural England, which was influential in leading to changes in the English Countryside Stewardship Agri-environment Scheme. This scheme provides financial incentives for land managers to look after their environment, and includes a package to reward actions that benefit wild pollinators and other farm wildlife. Findings from IPI research relating to bumblebee foraging distances and the proportion of the landscape with flower-rich habitats required to maintain bee populations directly informed the minimum area thresholds for option coverage that are required under the Wild Pollinator and Farm Wildlife Package.

⁹ Data from the 2016 researchfish® submission period indicate that 6% of BBSRC grants reported having influenced policy and/or practice within five years of the start of the grant.

Policy and Practice Notes resulting from IPI

Policy and Practice Notes draw out conclusions from research and present key findings in non-technical language for public, private and third-sector audiences. Nine Policy and Practice notes were produced based on research funded through IPI:

Note 9: [What is causing the decline in pollinating insects?](#)

Note 13: [The benefits of managing pollinators for crop production](#)

Note 16: [Protecting insect pollinators from pesticide risk](#)

Note 17: [How are pests and diseases affecting bee pollinators?](#)

Note 19: [Crop pollination by wild and managed insects: why diversity matters](#)

Note 20: [Managing urban areas for insect pollinators](#)

Note 25: [Land use change: opportunities for pollinator conservation and disks for pollinator losses](#)

Note 26: [Managing the landscape to optimise pollinator nutrition](#)

Note 27: [Managing farmed landscapes for pollinating insects](#)

64. Impact through policy and practice often takes considerable time to achieve. Once changes in policy are agreed, relevant changes in practice need to be implemented and the effects then take time to become apparent. It is therefore to be expected that policy and practice impacts of IPI to date will be largely limited to initial steps towards policy influence and policy change, although these may lead to more substantial impacts being realised in future.
65. There is a need for practical, evidence-based, user-friendly advice which is aimed at, and tailored for, specific target audiences including different types of stakeholders and practitioners (farmers, gardeners, local councils etc.). Some advisory materials were produced by or with contributions from IPI researchers, including a best practice guide for managing crop pollination for growers, and a handbook for farmers and agri-environment advisors.
66. Given that the aims of IPI were to provide evidence on the causes and consequences of threats to insect pollinators, and to foster engagement with a wide variety of stakeholders, there was potential for the researchers to make the value of their research more readily apparent, especially to non-academics and stakeholders. Stakeholders' understanding of and use of IPI research could have been increased if more materials targeted to particular stakeholder groups had been made available by IPI projects. However, individual projects may not have had time and resources to produce such materials, and greater coordinator involvement would have been needed to prevent overlap and duplication of effort.

67. While the contribution of IPI research to the development of policy and practice is notable, the full impacts of the research will not be realised until after the policies are fully implemented. There may therefore be value in further exploring the impact of IPI research over time to determine the extent to which the initial steps achieved so far lead to eventual impacts.

3.5 Maximising Impact from the IPI Investment

68. IPI research was successful in influencing policy development and contributing to the improvement of public and stakeholder understanding of the issues around pollinators. The full extent of the impact of IPI, in terms of changes in policy and practice, and changes in public perceptions, attitudes and behaviours, will only become fully apparent over time.

69. Opportunities existed to realise further impact from IPI investment. Each IPI project was required to include an impact plan with their original application for funding. These plans were specific for each project and described what would be done to promote the realisation of the potential impacts of the research to those outside the academic research community. The focus of individual projects on their own impact activities meant there was scope to improve the impact realisation of IPI by coordinating the activities across projects. More emphasis could have been put on the role of the coordinator in creating and implementing a strong coordinated structure to maximise the impact of the projects. However, this would have required more funding for the coordinator than was available.

70. There are other areas where there may be scope to improve the tracking and realisation of impact:

- Better planning around impact, and a greater involvement of policy leads in impact aspects of the initiative's design stage, could result in policy impact being achieved more efficiently. The timescales on which IPI was launched made this difficult, but it should be considered for future initiatives in order to maximise the impact of the research.
- More direct interaction between scientists, those involved in policy development and implementation, and relevant stakeholders such as professional practitioners, could have helped the research findings be translated more quickly into policy developments and changes in practice.
- Having a clear impact tracking strategy for public engagement work could have facilitated the identification and measurement of impacts from the associated engagement activities.
- There is potential to improve awareness and skills in the IPI community around how to turn impact pathways into actual impacts. It may be worth considering the need for funders to support training in impact generation.

- The production of more materials offering practical, evidence-based and user friendly advice targeted at and tailored for specific stakeholders audiences could have further increased stakeholders' understanding of and use of IPI research.

4. Management and Administration of the Initiative

4.1 Summary

- The five funding organisations worked together effectively to deliver a well-managed initiative.
- The balance and coverage of research across the initiative was good.
- The management of IPI promoted engagement between funders, grant holders and stakeholders, and led to effective knowledge exchange.
- The coordinator provided a very valuable contribution, facilitating knowledge exchange and communication across the initiative.
- BBSRC provided effective and efficient administration of the initiative.
- The two grant holders' workshops were successful in promoting knowledge exchange and best practice around sharing data and resources.
- The dissemination event was successful in raising awareness of IPI research among stakeholders.

4.2 Overview of Initiative Management and Administration

71. The funders involved in IPI (BBSRC, NERC, Defra, Scottish Government and Wellcome Trust) included the major UK funders of this area of research. They worked together effectively to deliver a well-managed and coordinated initiative.
72. Successful delivery of the initiative was aided by the establishment of a Programme Management Group (PMG), comprising representatives of all the funders. Regular meetings of the PMG, and communications between PMG members, ensured that all funders were kept informed about progress of the initiative, and were involved in decision making where appropriate.
73. The balance and coverage of the initiative was good. The projects covered a range of scientific areas (including modelling the spread of honeybee diseases, understanding the sub-lethal effects of pesticides on bees, and understanding the relative importance of different habitats for pollinating insects), and focused on a variety of different species (including honeybees, bumblebees, solitary bees, hoverflies and other pollinating insects). Between them they gave good coverage of a wide range of issues affecting insect pollinators. Given that the overall scale of the investment in IPI was relatively small, it was particularly good that such a diversity of projects was supported.

4.3 Value of Being a Managed Programme

74. The IPI funders played a more active role in the management of the initiative compared with many other funding schemes. This was achieved through a combination of regular

PMG meetings, BBSRC staff involvement, and the employment of a part-time coordinator.

75. The key aim of actively managing the initiative was to achieve added value from the funding beyond the outcomes that would be expected from individual awards. Further aims were to improve knowledge exchange, both between projects and between project and stakeholders, and to promote the generation of useable outputs and publicity beyond scientific papers.

76. IPI was successful in delivering added value in a variety of ways. For example:

- By collaborating on research, and sharing ideas and data between projects, new outputs emerged that were beyond the scope of individual projects (for example, the specimen archive at the Natural History Museum).
- It was possible to engage with a greater number and wider range of stakeholders by working together as an initiative, e.g. at events involving multiple projects. This led to a greater awareness of IPI and its results among the public and other stakeholders.
- More publicity and greater visibility was generated by the initiative than the projects would have been likely to manage as a series of individual projects.

77. Engagement between funders and relevant stakeholders was promoted and facilitated by the active management of the initiative. During the design stages of IPI, the funders organised a meeting with stakeholders to discuss what areas of research would be of interest and/or use to them, and engagement was facilitated throughout the initiative by the coordinator and funders. This engagement was very beneficial in helping to ensure the initiative was relevant to stakeholders' concerns.

78. The active management of IPI was viewed positively by both funders and grant holders, and was effective in ensuring that the overall objectives of the initiative were met. It is likely that the active management of IPI contributed to the effective delivery of impact achieved by IPI. A high level of publicity was generated about the initiative and the research it supported, and the visibility of the initiative was increased by the coordination of publicity activities by the funders.

4.4 Value of the Coordinator Role

79. A distinctive aspect of the management of IPI was the role of a dedicated initiative coordinator, who was supported at 0.2 FTE throughout the initiative. The primary role of the coordinator was to facilitate knowledge exchange amongst grant holders and between grant holders and stakeholders.

80. The coordinator role was very effective and made a crucial contribution to the overall success of the initiative. The coordinator formed strong relationships with grant holders,

stakeholders and funders, and helped to build a community across IPI. Specific functions of the coordinator role that contributed to the added value of the initiative included identifying synergies between projects and maximising knowledge exchange opportunities, representing the initiative at external meetings and acting as a point of contact for stakeholders.

81. The grant holders noted that the frequent communications provided by the coordinator were helpful. 73% of grant holders rated the coordinator role as either 'very effective' or 'effective', particularly in terms of bringing people together and identifying and forging links between projects. All of the funders considered the coordinator role to have been highly beneficial to the initiative.
82. The coordinator facilitated effective knowledge exchange between IPI projects by identifying scientific synergies and opportunities to share ideas and data. The coordinator also contributed to the generation of outputs and publicity beyond scientific publications. This was achieved through organising meetings and activities to bring the wider insect pollinator community together and promoting IPI activities to stakeholders, policymakers and the public. The active management of the initiative by the funders and the activities of the coordinator role meant that greater impact was likely to have resulted from IPI than would have been achieved by the projects individually.
83. The coordinator had expert knowledge of the insect pollinator research field, and this was particularly helpful for successfully meeting the aims of the role. When initiatives are designed and funded in future, the deployment of an expert with appropriate knowledge and skills for the coordination role should be considered.
84. The achievements of the coordinator were particularly commendable considering that the role was only funded at 0.2 FTE. Significant benefit was gained from this funding and it is likely that providing support for more coordinator time would have resulted in greater benefit through enabling more engagement with projects and stakeholders.

4.5 Benefits of Multi-funder Involvement

85. In setting up the initiative, all funders agreed that there was an urgent need for an evidence base to inform the conservation of wild insect pollinators and to improve the husbandry of managed species. There was a common recognition of the importance of bees and other insects for pollination, in light of concerns about recent widespread declines in their abundance.
86. A number of benefits of being a multi-funder initiative contributed to the success of IPI. These included:
 - Several funders contributing towards the initiative meant that the overall funding envelope was larger, enabling more research to be supported. This helped create a critical mass of concurrent pollinator research, and lead to added value being generated from the initiative.

- Research was not limited to the remit of one funder, meaning that a broader range of research areas could be included in the scope.
- The participation of funders with both research and policy priorities, and the ongoing active engagement of the funders via the PMG, contributed to the high scientific quality and policy relevance of the initiative.
- The range of funders involved meant that the initiative benefited from the input of a variety of perspectives in its design and implementation. Having funders involved who had differing desired end-points and policy views made the initiative more broadly policy-relevant than if it had been focused on the interests of a single funder.

87. The involvement of five funders, with different priorities and drivers for investing in research, created some challenges, particularly in the initial phase of IPI. The funders had different requirements from the initiative, as well as different governance structures, funding regimes and reporting requirements. The funders worked well together to achieve this goal, by negotiating appropriate compromises in areas of difference and agreeing on the best mechanisms to support the initiative.

88. The funders communicated with each other regularly, and were involved in all parts of the initiative process; this led to a good degree of trust and respect between the funders. Decisions regarding the management of the initiative were made and agreed by the PMG. While this may have led to slower decision making than if only a single funder had been involved, it helped to ensure that the initiative was managed in a coordinated and consistent manner.

4.6 BBSRC's Role

89. The significant investment of BBSRC staff time and resource to this initiative was instrumental in delivering effective and efficient administration of the initiative. Feedback from the other funders about the administrative processes used and the individuals involved in managing the initiative was very positive.

90. Grant holders also provided very positive comments regarding BBSRC's management of the initiative. 91% of the grant holders rated the management of the initiative as either 'very effective' or 'effective'. Communication between BBSRC and grant holders was good, and grant holders appreciated the regular contact from BBSRC with information and instructions. The presence of an approachable and named contact in BBSRC, to whom questions and requests could be directed, was seen as a particularly advantageous by the grant holders.

91. Grant holders commented that BBSRC was pro-active in encouraging interaction between grant holders and stakeholders, and that researchers were motivated to actively participate in the initiative because of the encouragement from the initiative's

management. Grant holders commented that it would have been helpful to have the reporting requirements (including deadlines and detailed guidance) provided earlier, although this did not affect the progress or outcomes of the research.

4.7 Grant Holders' Workshops

92. Two grant holders' workshops were held during the initiative; one soon after the grants were awarded, and another approximately half way through the initiative. All grant holders and other staff who were involved in the research projects, were invited to attend the workshops. They were organised and managed by BBSRC, with input from the coordinator and PMG.

93. The aims of the workshops were to:

- encourage cross-project collaboration to build an 'IPI community',
- encourage grant holders to engage in knowledge exchange activities with stakeholders during their projects, and
- encourage best practice in the generation, use and storage of data and resources.

94. The workshops were successful in meeting these aims. All grant holders judged them to be useful, and a majority thought they were 'very useful'. The main benefit of the workshops as perceived by the grant holders was the opportunity to network and forge collaborations with other attendees. Providing more opportunity for post-doctoral researchers to showcase their work at the workshops was identified as one area where potential improvement could be made.

95. Both workshops were well attended by grant holders and other project staff. The timing of the initial workshop meant that some post-doctoral researchers had not yet started work on the projects (so could not attend the workshop), and overall attendance numbers were in some cases limited by meeting/venue logistics. However, a high proportion of grant holders and post-doctoral researchers, including at least one representative from each project, did attend each workshop. In order to maximise the opportunities for networking and community building in future managed programmes, the potential benefit of enabling more people from the funded projects to attend workshops should be considered.

4.8 Dissemination Event

96. A dissemination event was held at the end of the initiative, after the majority of the projects had been completed. The purpose of this event was to demonstrate the quality and breadth of research undertaken through IPI to an audience of stakeholders, and to highlight the research findings which could influence policy relating to insect pollinators and address problems associated with pollinator decline.

97. The audience included a good number and range of stakeholders, including representatives from beekeeping organisations, national organisations and statutory bodies, those involved in farming and food production, and wildlife and environmental organisations. The overall feedback from stakeholders was very positive, with the event viewed as being particularly valuable in raising awareness of IPI research.
98. The innovative format of the dissemination event, which included poster displays and demonstrations from each of the projects as well as presentations and discussions, facilitated interaction and knowledge exchange. Stakeholders who attended commented that the 'speed-networking' style approach was particularly useful as it ensured that all projects had an opportunity to talk about their research with all of the stakeholders who attended.
99. The projects were represented at the dissemination event by a majority of grant holders and many research staff, although some post-doctoral researchers could not attend because they had already moved on to their next posts. The event was viewed by grant holders as being useful, as it provided them with an opportunity to engage with and cement relationships with stakeholders at the end of their IPI projects, and to present their findings to a wider audience than would have been possible through their project's activities.

Annex 1. Financial Contributions of the Funders

The financial contribution of each of the funders was as follows:

- BBSRC £2.5M
- Defra £2.55M
- NERC £1.55M
- Scottish Government £0.55M
- Wellcome Trust £2.5M

Table 1.1 Projects funded by IPI

Reference ^{1,2}	Grant Holder (Research Organisation)	Project title
BB/1000100/1 BB/1000151/1 BB/1000097/1	Paxton Robert (Queens University Belfast) <i>Mark Brown (Royal Holloway, University of London)</i> <i>Juliet Osborne (Rothamsted Research)</i>	Impact and mitigation of emergent diseases on major UK insect pollinators
BB/1000275/1 BB/1000348/1 BB/1000429/1	Jacobus Biesmeijer (University of Leeds) <i>Simon Potts (University of Reading)</i> <i>Giles Budge (Fera Science Limited)</i>	Sustainable pollination services for UK crops
BB/1000313/1 BB/1000178/1 BB/1000143/1 BB/1000259/1	Chris Connolly (University of Dundee) <i>Nigel Raine (Royal Holloway, University of London)</i> <i>Geraldine Wright (Newcastle University)</i> <i>Neil Millar (University College London)</i>	An investigation into the synergistic impact of sublethal exposure to industrial chemicals on the learning capacity and performance of bees
BB/1000364/1 BB/1000216/1 BB/1000437/1 BB/1000119/1 BB/1000577/1	William Kunin (University of Leeds) <i>Simon Potts (University of Reading)</i> <i>Jane Memmott (University of Bristol)</i> <i>Nigel Boatman (Fera Science Limited)</i> <i>Richard Morton (NERC Centre for Ecology and Hydrology)</i>	Linking agriculture and land use change to pollinator populations
BB/100047X/1 BB/1000267/1 BB/1000305/1 BB/1000208/1	Jane Memmott (University of Bristol) <i>Jacobus Biesmeijer (University of Leeds)</i> <i>Graham Stone (University of Edinburgh)</i> <i>Simon Potts (University of Reading)</i>	Urban pollinators: their ecology and conservation
BB/1000801/1 BB/1000615/1 BB/1000836/1 BB/1000518/1	Giles Budge (Fera Science Limited) <i>Matthew Keeling (University of Warwick)</i> <i>Edward Feil (University of Bath)</i> <i>Steven Rushton (Newcastle University)</i>	Modelling systems for managing bee disease: the epidemiology of European Foulbrood

Reference ^{1,2}	Grant Holder (Research Organisation)	Project title
BB/1000828/1	David Evans (University of Warwick)	Unravelling the impact of the mite <i>Varroa destructor</i> on the interaction between the honeybee and its viruses
BB/1000925/1 <i>BB/1000720/1</i> <i>BB/1001069/1</i>	Claire Carvell (NERC Centre for Ecology and Hydrology) <i>Seirian Sumner (Zoological Society of London Institute of Zoology)</i> <i>Andrew Bourke (University of East Anglia)</i>	Investigating the impact of habitat structure on queen and worker bumblebees in the field
BB/1000968/1 <i>BB/1000445/1</i>	Geraldine Wright (Newcastle University) <i>Philip Stevenson (Royal Botanic Gardens Kew)</i>	Can bees meet their nutritional needs in the current UK landscape?

¹ For joint projects, the lead grant reference and Principal Investigator (PI) are listed first. Other component grant references and PIs are shown in italics. Co-Investigators (Co-Is) on individual grants are not listed.

² Grant references are provided as hyperlinks to the associated record on the UK Research and Innovation Gateway to Research (GtR) portal. The GtR record contains a description of the grant, alongside details of any reported outputs and outcomes.

Annex 2. Membership of the IPI Evaluation Panel

Name	Affiliation
Professor Alison Smith (Chair)	John Innes Centre
Professor Lin Field	Rothamsted Research
Professor Jeff Ollerton	University of Northampton
Professor Robert Pickard	Independent
Professor Mark Reed	Newcastle University
Professor Piran White	University of York

Annex 3: Published Research Articles Arising from IPI Projects

This list is complete up to the 2017 researchfish® submission period ending 10 March 2017.

2011

1. Moore J, Jironkin A, Chandler D, Burroughs N, Evans D, Ryabov E (2011). Recombinants between Deformed wing virus and *Varroa destructor* virus-1 may prevail in *Varroa destructor*-infested honeybee colonies. *Journal of General Virology* 92(Pt1): 156-161. doi: 10.1099/vir.0.025965-0

2012

2. Gill R, Ramos-Rodriguez O, Raine N (2012). Combined pesticide exposure severely affects individual- and colony-level traits in bees. *Nature* 491(7422): 105-8. doi: 10.1038/nature11585
3. Köhler A, Pirk C, Nicolson S (2012). Honeybees and nectar nicotine: deterrence and reduced survival versus potential health benefits. *J Insect Physiol* 58(2): 286-92. doi: 10.1016/j.jinsphys.2011.12.002
4. Köhler A, Pirk C, Nicolson S (2012). Simultaneous stressors: interactive effects of an immune challenge and dietary toxin can be detrimental to honeybees. *J Insect Physiol* 58(7): 918-23. doi: 10.1016/j.jinsphys.2012.04.007
5. Ruiz-González M, Bryden J, Moret Y, Reber-Funk C, Schmid-Hempel P, Brown M (2012). Dynamic transmission, host quality, and population structure in a multihost parasite of bumblebees. *Evolution* 66(10): 3053-66. doi: 10.1111/j.1558-5646.2012.01655.x
6. Vásquez A, Forsgren E, Fries I, Paxton R, Flaberg E, Szekely L, Olofsson T (2012). Symbionts as major modulators of insect health: Lactic Acid Bacteria and honeybees. *PLOS ONE* 7 (3): e33188. doi: 10.1371/journal.pone.0033188
7. Wolf S, Toev T, Moritz R, Moritz R (2012). Spatial and temporal dynamics of the male effective population size in bumblebees (Hymenoptera: Apidae). *Popul Ecol* 54(1): 115-24. doi: 10.1007/s10144-011-0285-2
8. Wright G, Lillvis J, Bray H, Mustard J (2012). Physiological state influences the social interactions of two honeybee nest mates. *PLOS ONE* 7(3): e32677. doi: 10.1371/journal.pone.0032677

2013

9. Aguirre-Gutiérrez J, Carvalheiro L, Polce C, van Loon E, Raes N, Reemer M, Biesmeijer J (2013). Fit-for-purpose: species distribution model performance depends on evaluation criteria - Dutch Hoverflies as a case study. *PLOS ONE* 2013 8(5): e63708. doi: 10.1371/journal.pone.0063708
10. Bolland K, Hothersall J, Moffat C, Durkacz J, Saranzewa N, Wright G, Raine N, Highet F, Connolly C (2013). The microsporidian parasites *Nosema ceranae* and *Nosema apis* are widespread in honeybee (*Apis mellifera*) colonies across Scotland. *Parasitol Res* 112(2): 751-9. doi: 10.1007/s00436-012-3195-0

11. Bryden J, Gill R, Mitton R, Raine N, Jansen V (2013) Chronic sublethal stress causes bee colony failure. *Ecol Lett* 16(12): 1463-1469. doi: 10.1111/ele.12188
12. Butler E, Alsterfjord M, Olofsson T, Karlsson C, Malmstrom J, Vasquez A (2013) Proteins of novel lactic acid bacteria from *Apis mellifera mellifera*: an insight into the production of known extra-cellular proteins during microbial stress. *BMC Microbiology* 13: 235. doi: 10.1186/1471-2180-13-235
13. Carvalheiro L, Kunin W, Keil P, Aguirre-Gutiérrez J, Ellis W, Fox R, Groom Q, Hennekens S, Van Landuyt W, Maes D, Van de Meutter F, Michez D, Rasmont P, Ode B, Potts S, Reemer M, Roberts S, Schaminée J, WallisDeVries M, Biesmeijer J (2013). Species richness declines and biotic homogenisation have slowed down for NW-European pollinators and plants. *Ecol Lett* 16(17): 870-8. doi: 10.1111/ele.12121
14. Datta S, Bull J, Budge G, Keeling M (2013). Modelling the spread of American Foulbrood in honey bees. *J R Soc Interface* 10: 20130650. doi: 10.1098/rsif.2013.0650
15. Haynes E, Helgason T, Young J, Thwaites R, Budge G (2013). A typing scheme for the honeybee pathogen *Melissococcus plutonius* allows detection of disease transmission events and a study of the distribution of variants. *Environ Microbiol Rep* 5(4): 525-9. doi: 10.1111/1758-2229.12057
16. Kohler A, Nicolson S, Pirk C (2013). A new design for honey bee hoarding cages for laboratory experiments. *J Apicult Res* 52(2): 12-4. doi: 10.3896/IBRA.1.52.2.03
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19. Nicolson S, de Veer L, Köhler A, Pirk C (2013). Honeybees prefer warmer nectar and less viscous nectar, regardless of sugar concentration. *Proc Biol Sci* 280(1767): 20131597. doi: 10.1098/rspb.2013.1597
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21. Palmer M, Connolly C (2013). Patch-clamp recording from Kenyon Cells in acutely-isolated bee brain. *Protocol Exchange* doi: 10.1038/protex.2013.038
22. Palmer M, Moffat C, Saranzewa N, Harvey J, Wright G, Connolly C (2013). Cholinergic pesticides cause mushroom body neuronal inactivation in honeybees. *Nat Commun* 4: 1634. doi: 10.1038/ncomms2648
23. Polce C, Termansen M, Aguirre-Gutierrez J, Boatman N, Budge G, Crowe A, Garratt M, Pietravalle S, Potts S, Ramirez J, Somerwill, Biesmeijer J (2013). Species distribution models for crop pollination: A modelling framework applied to Great Britain. *PLOS ONE* 8 (10): e76308. doi: 10.1371/journal.pone.0076308

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25. Williamson S, Baker D, Wright G (2013). Acute exposure to a sublethal dose of imidacloprid and coumaphos enhances olfactory learning and memory in the honeybee *Apis mellifera*. *Invert Neurosci* 13(1): 63-70. doi: 10.1007/s10158-012-0144-7
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- Batáry P, Benjamin F, Biesmeijer J, Blitzler E, Bommarco R, Brand M, Bretagnolle V, Button L, Cariveau D, Chifflet R, Colville J, Danforth B, Elle E, Garratt M, Herzog F, Holzschuh A, Howlett B, Jauker F, Jha S, Knop E, Krewenka K, Le Féon V, Mandelik Y, May E, Park M, Pisanty G, Reemer M, Riedinger V, Rollin O, Rundlöf M, Sardiñas H, Scheper J, Sciligo A, Smith H, Steffan-Dewenter I, Thorp R, Tschardt T, Verhulst J, Viana B, Vaissière B, Veldtman R, Westphal C, Potts S (2015). Delivery of crop pollination services is an insufficient argument for wild pollinator conservation. *Nat Commun* 6: 7414. doi: 10.1038/ncomms8414
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