

Summary of results from consultation on research gaps and priorities

The consultation survey was sent to wide stakeholder group including members of Defra's Pollinator Strategy Advisory Group (PASG), the Welsh Task Force - Action Plan for Pollinators, Scottish Natural Heritage and organisations involved in pollinator conservation.

We received 22 responses in total with several individuals answering on behalf of the organisations they work for. The specific questions asked, the responses obtained including summaries and the additional comments are provided below.

Q1. Which pollinator groups should be a priority for monitoring?

Respondents were asked to rank the top three where 1 was the most important. For analyses, the most important (rank 1) were given a score of 3, the second most important (rank 2) a score of 2, and so on and all the non-scored columns given a score of zero. Where replies had extra ranks beyond 3, a score of 0.5 was given

	Wild bees	Honey bees	Wasps	Hover-flies	Butter-flies	All the above taxa	Other (please state)
	0	0	0	0	0	3	
	3	1	0	2	0	0	
	0	3	0	0	1	0	
	3	0.5	1	2	2	3	
	2	3	0	0	1	0	
	3	0.5	0.5	2	1	0	
	3	0	0	2	1	0	
	3	0	0	1	2	0	
	2	3	0	0	1	0	
	2	0	0	3	0	0	All Lepidoptera incl. moths
	3	0	0	0	2	1	
	3	1	0	2	0	0	
	3	0	0	2	0	1	
	3	0	0	2	0	0	Other flies
	2	0	0	0	0	3	Under recorded groups / flower visiting Diptera
	3	2	0	1	0	0	
	3	0	0	1	2	0	
	3	1	0	2	0	0	
	3	2	0	1	0	0	
	3	0	0	2	1	0	
	3	0	0	0	2	0	Non syrphid Diptera
	3	0	0	2	0	1	
MEAN	2.50	0.75	0.06	1.23	0.73	0.55	
RANK	1	4	6	2	3	5	

Overview: Our stakeholders ranked (from high to low) the priority taxa for monitoring as: wild bees, hoverflies, butterflies, honeybees, all taxa, wasps

Q2. What should be the focus of a monitoring scheme?

Respondents were asked to rank the top five by adding 1, 2, 3, 4 and 5 to the table below, where 1 is the most important. For analyses, the most important (rank 1) were given a score of 5, the second most important (rank 2) a score of 4, and so on and all the non-scored columns given a score of zero. Where replies had extra ranks beyond 5, a score of 0.5 was given

	Common species	Rare species	Endemic species	Invasive species	Crop pollinators	Wild plant pollinators	Managed pollinators	Threats stressors	Effective-ness of interventions
	3	2	0	0	0	1	0	5	5
	5	0	0	0	4	3	2	0	0
	3	0	2	0	4	1	5	0	0
	4	5	3	0.5	0	2	0	1	0.5
	4	0	3	0	0	1	0	2	5
	3	0.5	2	0.5	0.5	1	0.5	5	4
	3	0	0	0	0	4	0	5	5
	5	0	4	0	0	3	0	2	1
	5	0	0	0	0	4	2	3	1
	2	1	0	0	0	0	0	4	5
	4	5	0	0	2	3	0	0	1
	4	3	0	0	1	2	0	5	0
	4	5	0	0	2	3	0	0	1
	5	4	0	0	0	3	2	0	1
	4	1	0	0	0	0	0	5	3
	0	0	0	0	3	2	1	5	4
	5	3	0	0	0	4	0	1	2
	0	1	0	0	5	4	0	2	3
	4	0	0	0	5	1	2	0	3
	3	0	0	0	0	4	0	0	5
	4	0	0	0	0	5	2	3	0
	0	0	0	0	5	5	0	4	4
MEAN	3.36	1.39	0.64	0.05	1.43	2.55	0.75	2.36	2.43
RANK	1	5	8	9	6	2	7	4	3

Comments in the ‘other’ section included requests to consider the following: contribution of non-floral resources, pollinators in gardens, functionally important species (e.g. long tongue v short tongue bumblebees).

Overview: Our stakeholders ranked (from high to low) the priority focus for monitoring as: common species, wild plant pollinators, effectiveness of interventions, threats/stressors, rare species, crop pollinators, managed pollinators, endemic species, invasive species.

Q3. Please tell us in your own words what other research gaps or needs you think should be addressed through additional research specific to pollinator monitoring.

Below are the free text responses provided by 16 individuals/groups:

1. Many resources are expended in creating crop only fields through the use of herbicides. **What is the value of arable 'weeds'** for wild pollinators and if crops are 'infested' with arable plants what is the effect on production? If arable plants do support significant populations of wild pollinators should future agri-environment schemes compensate farmers for loss of production through the cessation of herbicide use?
2. The main gap is in follow-up looking at **the impact of HLS and now CS** (before and after and matched pairs of farms), compared to changes in whole farm systems to organic farming. There is a huge gap in assessing the **impact of fungicides** (fastest growing pesticide use) directly on pollinators and indirectly through enhancing impact of insecticides like neonicotinoids.
3. **Larval food plants** available in pollinator strips on farmland, **nesting substrates** available for ground nesting wild bees, importance of private and **public gardens** for pollinators
4. What is required is assessment of the **habitat requirements of native pollinators** in terms of improving our knowledge of plant-pollinator interactions, including the relationship between wild pollinators and habitat size, quality, type and connectedness to other areas of habitat. This is a major inadequacy of the current work to reverse the decline of pollinators, specifically for floristically rich semi natural habitats, and not just sown pollinator crops in arable situations. Research on the causal relationship between habitat provision and native pollinator populations has to be better understood, in order for it to be valued in terms of the natural capital that floristically rich semi natural habitats provide.
5. **Effects of agricultural and garden pesticide sprays**, including neonicotinoids.
What are the most effective agricultural subsidy schemes to stop habitat loss and promote habitat restoration, with a view to going it alone post Brexit.
6. Assessment of the **habitat requirements of native pollinators** - this is a major inadequacy of the current work to reverse the decline of pollinators, specifically floristically rich semi natural habitats. Research on the causal relationship between habitat provision and native pollinator populations should be better understood, valued (in terms of the natural capital floristically rich semi natural habitats provide) and remedied. This goes beyond any requirements for greater abundance of flowering plants; it also encompasses improved knowledge of plant-pollinator interactions, including the relationship between wild pollinators and habitat size, quality, type and connectedness to other areas of habitat.
7. This is submitted on behalf of the Wildlife Gardening Forum, (www.wlgf.org) a charity whose aim is to promote the management of private and public gardens and greenspace in way that will support and enhance their wildlife conservation value. One of our aims is the encouragement of a scientific evidence base for conservation practices in gardening. There is now solid evidence that urban areas, especially gardens and allotments, have the potential to support a range of pollinating insects. We believe that there is further scope to **involve gardeners in pollinator monitoring**, to complement the work already being done by organisations such as BBCT, Butterfly Conservation, and so on. A couple of years ago we ran our

own pilot survey of garden plants and their association with pollinating insects. This produced interesting results, clearly showing the difference in garden flower preference between different insect groups, and showing a bias in their preference towards flower species originating in the Western Palearctic. This was a very small pilot among our members and we do not have the resources to expand our survey among the wider gardening public at present. We suggest that a similar sort of survey, scoring and ranking garden plants in accordance with their attractiveness to insects, and discriminating between the insect groups that visit them, if properly resourced and managed using clear protocols, would be of great value if it could be rolled out among a large sample of gardeners. While the results might have to be viewed as indicative rather than conclusive, they could prompt various questions deserving of more detailed research. The horticultural industry potentially has a major role to play in helping gardeners to grow pollinator-friendly varieties of ornamental plants. At present this barely manifests itself in practice, due to the low level of knowledge and motivation in the horticultural industry, and the patchy and inconsistent nature of the advice available to its members. They would benefit from more and better scientific research in this field, to give clearer and more definitive guidance as to what constitutes 'pollinator friendly planting' in a horticultural setting. Completed by Marc Carlton on behalf of WLGf. Contact: info@wlgf.org

8. I still believe that the turning point to incentivise greater uptake of interventions to benefit pollinator populations within the farm setting will be when you can **demonstrate clearly that the cost of those interventions (e.g. a wildflower strip) outweighs the benefit delivered** (e.g. uplift in crop quality or yield as a result of improved pollination). Better demonstrating this for a range of different crops is a specific research gap. I am increasingly concerned that there are two distinct strands to work on pollinators, which often get blended to suit particular arguments or agendas. To some extent the questions above reflect this. If the driver for action is to safeguard £690 million worth of agricultural pollination and the 1 in 3 mouthfuls of food we eat – then the focus needs to be clearly on the pollinators that deliver this. And the indicators are that we would be talking about a handful of common abundant species of wild bees and hoverflies, and honeybees. If the driver for action is to conserve biodiversity, then the focus of the monitoring is very different. Clearly stable biodiverse wider pollinator population will help underpin and add to the resilience and sustainability of the handful of crop pollinators – but fundamentally these are two separate issues that should be kept clear and separate. For example - to generate interest in the issue by talking about the importance of crop pollinators and pollination to the food we eat, but then to start measuring butterflies and rare species would be a misleading approach and in our view a waste of these limited precious resources being put into pollinator monitoring.
9. Focus on the **pollination service to assess level and extent of pollination deficits in crops** and possibly also wild plants. Develop an **early warning indicator of pollination deficits**
10. Ultimately understanding threats/stressors and the **effectiveness of interventions** is critical and should be a 'priority' for a monitoring scheme to deliver – but at this stage the 'focus' should be on monitoring the pollinators because only then can we address the drivers and solutions. This should always be kept in mind when developing this scheme. Linking changes in the abundance and distribution of both rare and common pollinators is likely to impact the pollination of wild plants and crops. There are still research gaps that need filling to better understand the **consequences for pollination of changing pollinator populations**. We have an understanding for a few crops but I do not know how well we understand the implication for many wild plants.

11. **Cumulative effects of stressors on bee and other pollinators.** The responsiveness of species to provision of better conditions.
12. It is important to understand more clearly the **threats / stressors**. From our point of view the threats posed by pesticide use. Not just the obvious such as neonicotinoids but **in particular fungicides**. Also it would be useful to look at the effects of combinations of pesticides being used. Marrying monitoring data with up to date pesticide usage data should be a priority across all areas. One thing I also think missing is monitoring of moth populations.
13. **Identifying threats/stressors** - it would be good to clarify what you mean by this – for example proximity to monoculture cereal crops, loss of hedges/ditches etc.? Ideally we would like to see monitoring of both common and rare species of pollinators. Also some proxy measures such as **habitat function** - some measure of diversity of flowering resource, temporal and spatial availability of flowering resource, availability of other life cycle needs - nesting resource. The study that was part of the last Countryside Survey (no longer funded?) which looked at the availability of nectar plants (<https://www.nature.com/articles/nature16532>) provided some very useful information and could be extended/repeated. Regarding our prioritisation above – Effectiveness of Interventions - is this looking at impact of reducing pesticides, increasing habitat connectivity, increased habitat quality/diversity? We will probably need regional level trend resolution for this Other - Contribution of non-floral habitat resources (i.e. breeding/ nesting habitat in banks, ditches, wetlands etc.) Note the following are not in any prioritised order.
- Identifying which **habitat/landscape features** contribute most to increasing pollinator biodiversity e.g. semi-natural habitats, 'permanent' features vs 'temporary' features, hedgerows or ditches, annual weed communities etc.
 - How does management of landscape features correlate with pollinator abundance e.g. what are impacts of ditch clearance, intensity of hedge or verge management, grazing regimes on pastures
 - Impacts of **fertilisers** and herbicides on pollinator abundance and diversity
 - More applied research to ground-truth existing recommended agri-environment/voluntary measures so that we are providing best possible recommendations. For example more research into value of Pollen & Nectar mixes (similarly seeded wildflower margin mixes) for all groups of pollinators, not just a limited suite.
 - More research on prevalence of **neonicotinoids** in other landscape habitats/features e.g. hedgerows, field margins, arable weed communities, ruderal plant communities, grasslands.
 - The value of **woodlands** in the farmed landscape, and the impacts of woodland management on pollinator biodiversity
 - Identifying the **key plant species** and how much floral diversity is enough to ensure good pollinator biodiversity (see Countryside Survey and research above)
 - **Linking yields to pollinator prevalence** for various crops
 - Basic trend analysis **linking pollinator data to other data** e.g. decrease in pollinator diversity and decreases in plant diversity and change in community composition. I.e. Linking wildflower decline to pollinator populations
 - Does increased **habitat connectivity** correlate with increased pollinator biodiversity. And also how does it correlate with increased crop yields

14. Fundamentally we need an understanding of **long-term trends in the resources available for pollinators**. Whilst agri-environment impacts are good to know, we also need to know what is going on in the wider countryside. In effect we need to integrate pollinator monitoring with monitoring of potential drivers – resources in the landscape, pesticides, & diseases. Specific examples: The effectiveness of agri-environment schemes is usually measured at a small scale and over a relatively short timeframe. However, it is crucial that we learn whether these measures are effective over a longer timeframe, and if not, why not? A wildflower buffer strip may promote bee abundance and diversity at a field scale, but does it have an impact on a farm scale? We also need to know whether nesting sites are a limiting factor in the ability of agri-environment schemes to contribute to pollinator conservation and if so, what management interventions might redress this. There are still knowledge gaps in our understanding of **disease associations** – between imported bumblebees and native pollinators, and between honeybees and native bees. Distribution of pathogens, routes of transmission, biological and ecological effects, and control mechanisms all require further investigation particularly in the context of emerging diseases. **Gardens and allotments** are often promoted as important habitats for pollinators. Whilst we are starting to understand some of the effects of insecticides and herbicides on pollinators in an agricultural context, there is little known about the relative contribution of chemicals used in domestic gardens. This requires an interdisciplinary approach to investigate the extent of use, potential effects on pollinators, as well as gardeners' attitudes and awareness. This information would provide a sound basis to develop education policies and/or regulation to reduce chemical use in a domestic setting.
15. "Is the term 'endemic' being used to mean native? (I think I'd normally interpret endemic as 'only occurring in a particular country/region'). Do invasive species mean invasives that are potentially pollinators? Or invasive species that affect native pollinators? I also think there is some overlap between the species focus (common, rare, endemic) and the plant focus (crops, wild plants). I feel like a monitoring scheme should be able to inform in both cases? Lastly, the policy emphasis on pollinators is partly a consequence of potential risks to pollination services. But all the above options focus on monitoring pollinators rather than pollination – the latter would potentially also be valuable. In addition to the above, and with the caveat that there may be research that I'm not aware of: I think it would be useful to have a better understanding of the **relationships between pollinator abundance/richness, visitation rates, and seed/fruit set**, as well as the extent to which plants are in pollination deficit. Also, I'm not sure how much research there is on if/how changes in pollinator composition affect plant communities (particularly for plant species of conservation importance). A related question would be trying to predict the consequences if pollinators were to decline further. Paul Woodcock on behalf of JNCC"
16. Research into the **value of plant species/types** for different groups of pollinators, cultivated and non-cultivated. Also availability of suitable nest sites.