UK Pollinator Monitoring Scheme

Establishing a UK Pollinator Monitoring and Research Partnership (PMRP)

Progress Report January 2018

Claire Carvell and PMRP partners (January 2018)

A collaborative project funded by Defra, JNCC, the Welsh and Scottish Governments and project partners

UK Pollinator Monitoring Scheme

Objectives

To provide a hierarchical approach to monitoring combining expert and non-expert volunteer and professional recording while building capacity through existing partnerships to ensure long-term sustainability (Tasks 1 – 3);

To provide metrics and/or indicators to show how pollinator populations are changing in Great Britain (Tasks 1 and 4);

To establish how pollinator populations are changing in the cropped and non-cropped environment (Task 4-5);

To provide access to monitoring data at full resolution and engage with external research groups and wider stakeholders to facilitate use of the data in research, conservation & survey planning (Tasks 4-5).

These objectives will be delivered under the following Tasks:

Task 1) Improving robustness and our understanding of population trend estimates for bees and hoverflies from opportunistic records across England, Wales and Scotland, and increasing capacity for data flow and record verification.

Task 2) Promoting simple systematic surveys to engage a wide range of volunteers collecting data on abundance and flower visitation rates of pollinators, initially through targeted promotion with project partners.

Task 3) Undertaking new intensive systematic surveys of pollinators and floral resources with a core set of stratified sites across England, Wales and Scotland.

Task 4) Data management, integration and modelling to create metrics or indicators at GB and country level.

Task 5) Establishing a Pollinator Monitoring Research Advisory Group to help support externally-funded research applications and use project data in research, conservation and survey planning (Specification Part B)

Summary of Progress (July 2017 – January 2018)

This report summarises progress on the PMRP project since the last report (dated 20th July 2017). Highlights have included further development of models to estimate trends in species distribution (Task 1); the design and launch of a new survey to gather widespread data on pollinator abundance and flower visitation (the FIT Count, Task 2); set-up and initial sampling from a new survey site network of 1km squares (Task 3) and communication about the Pollinator Monitoring Scheme (PoMS) to a variety of audiences (see Figure 1). A summary of activities and preliminary results is given in the text below, with Figures and Tables presented with the Annex.

Task 1: Strengthening existing opportunistic recording of bees and hoverflies

Task 1.1: Improving robustness and understanding of population trend estimates from opportunistic records

Opportunistic records of bee and hoverfly species are collated by the Bees, Wasps and Ants Recording Society (BWARS) and the Hoverfly Recording Scheme (HRS) and used to estimate trends in the status and occupancy of species over time. Occupancy refers here to the area (number of 1km grid cells across the UK) over which each species was found, hence measures changes in species' distributions.

The UK Status of Pollinating Insects Indicator is produced alongside other UK Biodiversity Indicators and funded directly by JNCC[1]. The first Indicator published in 2015 was based on modelled trends for 213 pollinator species. The new UK Status of Pollinating Insects Indicator[2] was published on 3rd August 2017, reporting changes in the distribution or 'occupancy index' of 389 pollinator species across the UK. The

[1] http://www.jncc.gov.uk/page-1824
[2] http://jncc.defra.gov.uk/page-6851

increase in species for which robust trends could be generated was made possible by an increase in verified records and improvements to the modelling approach developed under this project. Between 1980 and 2014, 16% of species became more widespread and 32% of species became less widespread (Fig. 2). While, as expected, species show considerable interspecific variation through time, these patterns translated to an overall relative decline in the indicator (average trend across all species) by 2014, to 87% of the value in 1980. The indicator is presented separately for bees (147 species) and hoverflies (242 species) and shows a particularly sharp decline in bee species occupancy between 2007 and 2010. Various drivers (e.g. a run of wet summers and intensive agricultural practices) have been implicated, but more systematically collected data on bee abundance (see PMRP Tasks 2 and 3) are required to better understand these patterns of change.

Understanding of these trends has been aided by PMRP discussions with scheme organisers where the species-by-species model outputs have been examined in detail (we have developed an online app to communicate model outputs to the schemes, and to share their views on the outputs). A parallel exercise to produce a "Red List for the aculeate Hymenoptera", supported by Natural England, has also furthered our understanding of the species-specific trend estimates. The UK Indicators are presented at UK level, however under this Task we will use latest updated versions of the BWARS and HRS databases (i.e. with maximum potential number of records) to explore the potential to derive country-level trends for England, Wales and Scotland.

Task 1.2: Increasing capacity for data flow and record verification

The current capacity for verifying species records within BWARS and HRS is limited by the small number of dedicated volunteer scheme organisers with sufficient taxonomic expertise, and the lack of a clear route by which potential new verifiers can be identified and mentored.

BWARS have identified the lack of suitable online tools for training and assessing verifiers as one of the barriers to recruiting more volunteers into the system, especially for building the capacity to verify photographic records. Through Hymettus (project partners and expert entomological consultants), we are developing a detailed specification for online tools that will make use of existing verified photographic records alongside new records, so that potential new verifiers can gain experience of verifying photographic records and a quantitative assessment can be made of their level of taxonomic experience. New recruits could then be matched on the basis of their levels of taxonomic expertise to verification tasks for recording schemes (BWARS in the first instance). PMRP funds will be used initially to produce the detailed specification and design for this tool, which will require further resourcing (depending on outcomes) to complete the programming and testing stage.

By increasing the pool of available verifiers with known taxonomic expertise we will ultimately improve the flow of data available for modelling trends. This system will also provide a clear and more quantitative route for people who wish to increase their identification skills and so contribute to verification at levels that will increase the capacity of recording schemes such as BWARS.

Task 2: Simple systematic survey collecting data on abundance and flower visitation of pollinators

The name **Pollinator Monitoring Scheme – PoMS** is an overarching term to describe the various activities taking place under Tasks 2 and 3 of the Pollinator Monitoring and Research Partnership.

Flower-Insect Timed Counts - **FIT Counts** - are simple systematic surveys collecting data on abundance of flower visitors across a variety of habitats, and have been developed with the aim of encouraging a wide range of people to get involved in pollinator monitoring. To take part, recorders are asked to spend ten minutes counting all the insects that land on a particular flower species within a 50cm square, recording these to a broad species group (e.g. honey bees; bumblebees; hoverflies; other flies; etc).

The FIT Count protocol and associated supporting resources (survey guidance, survey form, insect and flower guides) were designed by the project team and made available through the CEH pollinator monitoring project webpage[3] in time for Defra's Bees Needs Week in July 2017. The activity was signposted on social media (primarily Twitter) and trialled with several volunteer groups by CEH and partner NGOs throughout the summer (see Publications and other Outputs section). Infrastructure and forms for online data capture (including photographs) were developed in iRecord, storing the data securely on the Indicia system.

As well as FIT Counts submitted by the wider public (here 'public' FIT Counts), FIT Counts were carried out as part of the 1km square protocol (Task 3) in order to help calibrate the data and increase sample sizes ('1km' FIT Counts). Surveyors of 1km squares carried out a minimum of two counts per survey visit, average = 2.7 across all 127 survey visits. Here we present preliminary results from both FIT Count datasets together.

Preliminary Results

The public entered 37 FIT Counts onto iRecord during 2017 (see map in Figure 3, and Table 1), containing a total of 401 insect visits to flowers. Target flowers were mostly selected from the garden plants on the 'target list' of 12 species, reflecting the fact that 65% of counts were carried out in gardens (Figure 5), but a variety of other plant species and habitats were represented. A total of 336 FIT Counts were entered from 72 1km survey squares across the wider countryside, containing 4,818 insect visits and covering the full range of target flowers (except dandelion, due to surveys starting in June). Most were conducted in 'stands of tall herbs' or grassland habitats with a variety of other habitats, including heathland and woodlands represented (Figure 6).

Counts of the different insect groups are presented in Figure 7 and Table 1. Numbers were variable but the majority of FIT Counts returned positive values, with only ca. 20 counts within 1km squares observing no insect visitors during the 10-minute observation period. Bumblebees, honey bees, hoverflies, 'other' flies and small insects (categorised as any insect less than 3mm long) were the dominant flower visitors recorded, but there were differences between the public and 1km FIT Counts in the relative proportions of groups represented, likely due to the contrasting habitat types and target flowers selected. Public counts contained a higher proportion of bee visits (GB mean = 4.4 bees per FIT Count vs 1.8 per count from 1km squares) comprising bumblebees and honey bees, but numbers of solitary bees were very low in both datasets (mean = 0.2 per FIT Count). These preliminary results match relatively well with the counts and patterns achieved from the same 10-minute protocol during the 2015 pilot survey across 14 squares in England and Scotland[4] (e.g. GB mean = 1.8 bees per count, with similarly low numbers of solitary bees).

The 1km square FIT Counts allow for some comparisons between countries (Table 1). While counts of bees and hoverflies were similar in England (mean for each group = approx. 3 per FIT Count), counts were lower from squares in Scotland and Wales as expected from previous surveys (e.g. Scotland means = 0.6 and 1.3 per FIT Count for bees and hoverflies respectively). Other flower visitors should not be overlooked, with for example a mean of 4.4 'other flies' per count being recorded in Wales (Table 1).

For 34 of the 37 public FIT Counts, surveyors uploaded at least one photo of their target flower, and for 16 at least one photo of an insect for verification of their group-level identification. Encouragingly, all flowers and insects were found to have been correctly identified. Overall, 19 participants said they were "familiar with recognising the main groups of pollinating insect" and 17 said they were "confident in identifying the commonly-occurring pollinating insects to species level"; however, it should be noted that several CEH staff took part in the 'public' FIT Count. Finally, of those who provided feedback 23 said they found the activity "really fun" or "fun" and 8 found it "okay", with the majority reporting it to have been "easy" or "very easy".

Further plans

We will develop a simple ID quiz within the iRecord framework to better assess accuracy of group-level identifications received in 2018 and in future potentially allow the incorporation of observations of easily

[3] www.ceh.ac.uk/our-science/projects/pollinator-monitoring

[4] Carvell et al (2016) Design & Testing of a National Pollinator & Pollination Monitoring Framework. Summary report.

recognised species for those with proven 'skill' levels. This may link with the verification tools being developed under Task 1.2 depending on timing. Other elements of the FIT Count protocol will be modified in response to reviews of the 2017 data in order to maximise the quality and coverage of data generated from public counts in particular during 2018. This will include adding 2-3 species to the target flower list, targeting FIT Counts between April and September and encouraging volunteers to record more frequently at fewer sites (with monthly reminders) rather than only once over many sites.

Many opportunities to promote the FIT Count activity and increase uptake in 2018 have been identified, including articles in online and printed newsletters, volunteer 'citizen science' events and recorder meetings (see below).

Task 3: Intensive systematic survey of pollinators and floral resources from a network of 1km squares

Task 3.1: Site selection and stratification

A target of 75 squares, stratified to represent the relative land areas and coverage of agricultural and semi-natural land in each of the three countries, was set – see scoping paper presented to the project Steering Group in April 2017 "Pollinator Monitoring_Task3.1_Site stratification Scoping paper_310317_final.docx". Squares were co-located with randomly allocated squares within the National Plant Monitoring Scheme in England and Scotland and within the GMEP Welsh monitoring framework in Wales. Tranches of squares fitting the required mix of agricultural and semi-natural land use were randomly drawn from these survey networks and access permission was sought from landowners within each square in turn (see July 2017 progress report).

Securing access to survey 36 squares in England alone involved around 160 letters sent by post to landowners (with freepost return forms), over 80 emails and almost 50 telephone conversations as well as many more attempted 'phone calls. Of these, around 130 responses were received, of which most landowners granted permission. In rare cases where access to survey part of a square was refused, or there was a lack of information about or lack of response from landowners, that square was rejected in favour of the next square on the random list. Overall, across GB, only around 20 squares were rejected and access was obtained for the full target of 75 1km squares (36 in England, 22 in Scotland and 17 in Wales, see Figure 3). Letters were sent to all landowners within the final 75-square network in September to thank them for allowing access for PoMS surveys on their land, and to confirm that they were happy for these to continue in 2018.

Task 3.2: Field sampling

The PoMS 1km square protocol involves a set of five pan trap stations (each hosting 3 coloured bowls filled with water) being set out along a diagonal of each 1km square and left for 6 hours, during which time the surveyor collects data on floral resources and habitats surrounding the pan traps and undertakes at least two 10-minute FIT Counts (see example site map Figure 3). The protocol is intended to be repeated on 4 survey visits to each square between late April and September.

CEH surveyors visited 72 of the 75 squares to 'set up' and map sampling locations (e.g. Figure 3), and conduced at least one, and in most cases two surveys on each square between June and early September 2017 (mean = 1.76 survey visits per square). Three squares in Scotland were not surveyed this season, mainly due to unsuitable weather conditions. The total of 127 survey visits achieved fell short of the potential total of 300 visits due to the later start, time required for obtaining access permissions, staffing challenges and variable weather at remote sites, often exceeding 2 hours' drive from CEH sites.

Task 3.3: Links with crop pollination

This Task aims to investigate the potential of data on abundance and diversity of pollinators collected using the PoMS 1km survey protocol to act as a proxy for important crop flower visitors. Having established the network of 75 survey sites, we aim to carry out additional surveys of crop visitors on a selected focal crop, during bloom, at a subset of squares. Preliminary analysis by CEH of the new 'Land Cover Plus: Crops' data show that of our 75 survey squares, 14 contained oilseed rape in 2015 and 2016, and 13 included oilseed rape in 2017. In 2018 we will implement pollinator surveys (via transects or crop watches TBC) in flowering oilseed rape fields located in 10 of the PoMS sample squares. These will be carried out on the

same day as the PoMS survey. Relationships between pollinator abundance and diversity during the PoMS survey and the crop pollinator survey will then be compared. We are awaiting a finalised agreement for use of the Crop map data on the PoMS before the Reading University team finalise protocols and select PoMS sampling squares for this Task.

Task 3.4: Sample processing and identification

A total of 631 pan trap samples (all the insects captured at one pan trap station over a 6 hour period), comprising over 50,000 individual specimens, was returned to the CEH lab in 70% ethanol for sorting and archiving. All bees and hoverflies (2,115 specimens) were removed from the samples and individually tubed in 100% ethanol with unique identifier codes. Where these could not be easily identified to species level by CEH staff, they were sent to taxonomic experts for determination (along with 20% of those identified by CEH for checking). All other captured specimens were identified to group level (e.g. all non-hoverfly flies as 'other flies'; solitary, social and parasitic wasps; butterflies; moths; sawflies; a group for very small insects <3mm; and 'other insects') and archived in 100% ethanol in their original sample tubes at -20degC for potential downstream analysis.

We summarise the pan trap catches at the level of 1km square survey visits (all five trap stations per square summed) and distinguish these by country, rather than presenting any detailed analyses comparing land use types or time periods at this stage. Bee and hoverfly species identifications are still underway (approx. 60% complete); we therefore present counts at insect group level which allow comparison with the FIT Count results and with pan trap catches from the 2015 pilot survey.

Preliminary Results from PoMS pan trap surveys across 1km squares

Pan trap stations were set out across a wide range of habitat types in the three countries (Figure 8). Improved grassland was the dominant local habitat type in all three countries, followed by arable crops, neutral and rough grassland habitats in England. Heathland, wet or acid grassland/ bog and arable crops were well represented in Scotland and Wales, with the exception of pan traps not being sited in arable crops in Wales. Surveyors did not find some of these habitat categories intuitive in the field (they were based on the EUNIS pan-European classifications adopted by the Bumblebee Conservation Trust (BBCT) BeeWalks), hence we are reviewing alternatives for the 2018 survey. Analyses of the flower count data from a 2m radius surrounding each trap station (on each survey visit) will provide additional explanatory variables in this context.

Mean counts of bees and hoverflies captured on each 1km square survey visit were 6.4 and 10.2 respectively (see Table 2 including standard errors). This GB mean of 16.6 bees and hoverflies per visit is very close to our predicted mean of 18 (or 3 – 4 bees and hoverflies per individual pan trap station over 6 hours) based on the 2015 pilot survey of 14 squares. Similarly, differences between countries were as predicted with more bees sampled per visit in England than in Scotland or (less so) Wales, and hoverfly counts relatively similar across countries (Figure 9). These counts should be sufficient at the bee / hoverfly group level to detect GB trends in abundance over time, but will only represent insect activity during the mid-late summer months. It is hoped that 2018 will act as a more complete baseline year with surveys across all 75 squares commencing in late April/ early May.

Mean counts of other insects captured in the pan traps were high (GB mean of all other groups = 380 per visit) (Table 2). These were dominated by non-hoverfly flies in all countries (Figure 9) which are known to be regular flower visitors and some of which could be effective pollinators. Many, however, were very small flies and the archived samples will allow downstream analysis of any impact these may have on sample sizes across the site network (given additional resources).

Task 3.5: Volunteer recruitment and training

Initial 'set up' and surveys were undertaken by CEH surveyors, but they are working with project partners to engage a group of volunteers to match with squares local to their area and receive training and mentoring on the PoMS 1km sampling protocol during 2018. Survey activities will also be promoted and demonstrated at planned BBCT training days across a range of counties. To date, potential volunteers have been matched with 20 squares in England, 3 squares in Scotland and 2 squares in Wales. Interest has been received via personal contact (e.g. at meetings or via email with the BBCT BeeWalk network) and from enquiries to the poms@ceh.ac.uk email account.

Task 4: Data management, integration and modelling

Data from the public FIT Counts and all data from the 1km square surveys is being stored in a CEH data warehouse. Data is entered via forms developed within the iRecord online recording system. These have been set up to match the paper field recording forms, and allow all relevant data and any associated species photographs to be stored securely.

Insect specimen data from the pan trap samples has also been added to the iRecord forms, at species level for the bees and hoverflies and at species-group level for the other insects. The specimen data is linked to the 1km square data that has already been entered, avoiding the need to re-enter basic date and location details and thus reducing the chance of data transcription errors. Procedures have been set up to export all data from the data warehouse in a form that is suitable for checking and further analysis. The queries used to carry out the data export have been documented so that they can be used consistently in future years.

Species data is not being made publicly visible within iRecord, so as to respect agreements with landowners. It will be shared via the relevant recording schemes at a later stage to enable formal verification and contribution to the wider pool of pollinator occurrence data. Verified species data will be shared at the 1km square resolution with the relevant landowners as a means of providing feedback, and published on the NBN Atlas following the appropriate data security restrictions.

Task 5: Pollinator Monitoring Research Advisory Group (PMRAG)

A Pollinator Monitoring Research Advisory Group (PMRAG) has been established to help identify opportunities to maximise the value of data generated by the PMRP and PoMS surveys; to highlight knowledge gaps and aim to secure external resources to address these needs. A total of 13 academic experts have accepted our invitation to join the PMRAG, and will work alongside representatives of the project team to achieve its goals.

Terms of Reference for the PMRAG have been agreed by the Funders and will be reviewed by the full PMRAG at the planned workshop meeting at CEH Wallingford on 20th February 2018. Prior to the workshop, a stocktake of ongoing relevant pollinator monitoring activities, and online consultation with stakeholders to identify key research gaps, is underway to provide resources for the PMRAG to consider. The PMRAG intends to link with the Advisory Groups of each country pollinator Strategy (e.g. the Welsh Task Force and Defra's PASG) offering members an opportunity to contribute to the stocktake and research gap consultation.

Publications and other outputs

The PMRP and PoMS have been presented or communicated through various channels since the July 2017 progress report including:

- 14 talks at external meetings or seminars
- 3 volunteer activity days
- 4 articles in print
- 6 articles or newsletter items online
- 4 bouts of social media activity including 31 tweets on Twitter using the #PoMScheme hashtag, each receiving up to 24 retweets.

Key meetings attended include:

Public Policy Exchange symposium, London: “Tackling the Decline in Pollinating Insects”; 12th October 2017 (Invited talk by Claire Carvell, wide range of stakeholder groups represented)

Bees, Wasps and Ants Recording Society AGM, Liverpool; 22nd October (talk by Claire Carvell and Catherine Jones)

EC Workshop, Brussels, on understanding the knowledge on pollinators and pollination in the EU; 23rd October 2017 (Invited talk by Adam Vanbergen: "A potential EU monitoring framework for pollinators")

Central Association of Beekeepers (CABK) Autumn conference, Kenilworth; 18th November 2017 (Invited talk by Claire Carvell)

Defra Seminar on "Pollinator monitoring and potential for DNA barcoding", London; 17th January 2017 (Presentation by Claire Carvell, joint with Hannah Norman (NHM placement student))

A full project end-of-year team meeting was held at CEH Wallingford on 20th November 2017.

The next full project Steering Group meeting is scheduled for 15th March 2018.

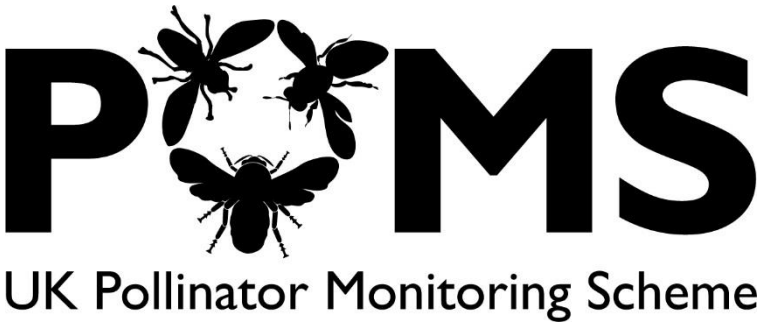
Other communications activity:

The PoMS webpage is consistently among the most viewed project pages on the CEH website (it has generally been in the top 3 with 2744 views since the launch on 17th July 2017). Page view numbers have held up fairly well even during months of low communication activity. More than 1500 downloads of the FIT-Count resources have been made, weighted towards activity in August and September, although it is clear that only a small proportion of these followed through to submit FIT Count data.

A PoMS logo has been designed (see below) and will soon be available for use across the partner organisations.

Further plans for PoMS communications

A detailed communications 'calendar' for 2018 is being compiled, along with a "Q&A" document for consistent messaging across the PMRP which will likely be made available via the CEH webpage along with further resources connected with the PoMS (e.g. we are producing short 'how-to' video guides to accompany the FIT Count and 1km square survey materials). These will be shared with Defra and other Funders as soon as possible before publication and/or before the 2018 field season commences.



ANNEX - Figures and Tables to accompany progress report text.

Figure 1. PoMS 2017 highlights in numbers.

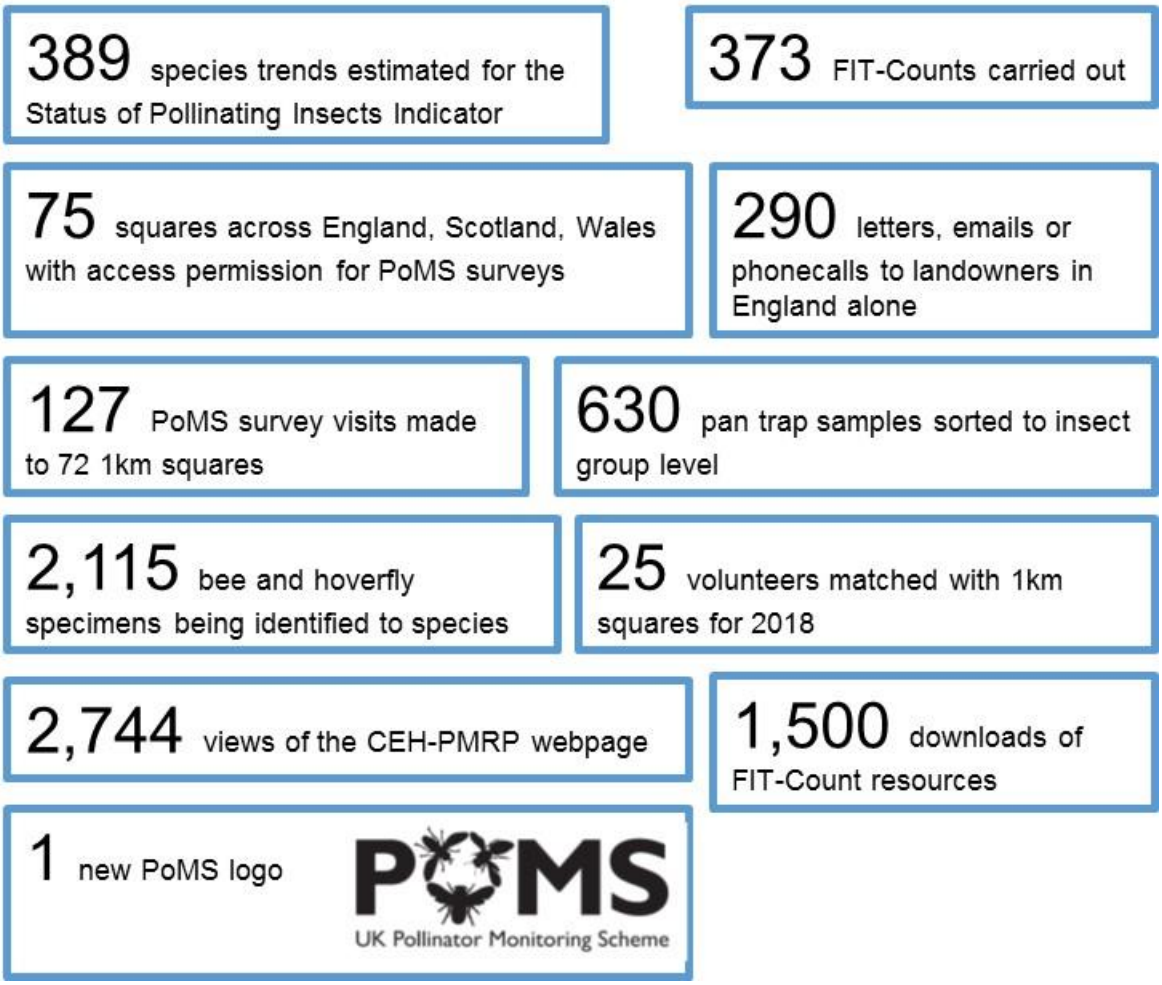


Figure 2. Change in the distribution of pollinators in the UK between 1980 and 2014 (average across all n= 389 species of bee and hoverfly included in model estimates). The shaded region is the 90% credible intervals of the annual occupancy estimates and represents the uncertainty surrounding the annual estimates. The solid line illustrates the rescaled indicator value.
The proportion of pollinator species in each trend category (bars to the right; green = increasing; red = declining) is based on mean change in occupancy over both a) the long-term (1980-2014) and b) the short-term (2009-2014).
Figure taken from Powney et al (2017) Technical background document: D1c. Status of pollinating Insects. http://jncc.defra.gov.uk/page-6851

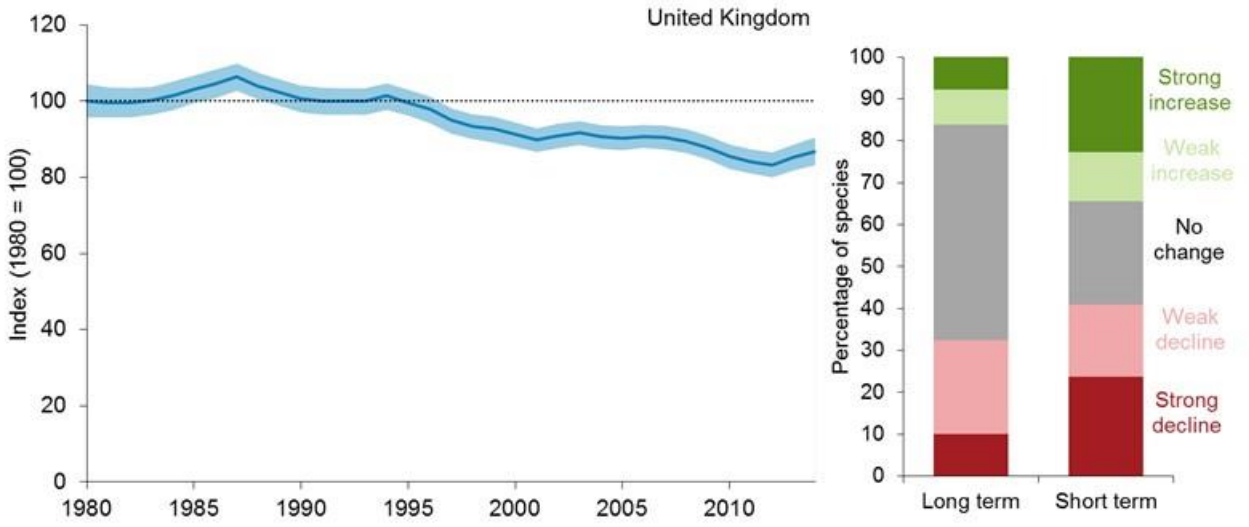


Figure 3. Map (left) showing locations of Flower-Insect Timed Counts (FIT Counts) carried out by members of the public (red squares) and by CEH surveyors within 1km survey squares (blue squares).
Example of a PoMS 1km survey square map (right) on agricultural land. Target notes are used along with GPS locations to help volunteers re-locate sampling points.

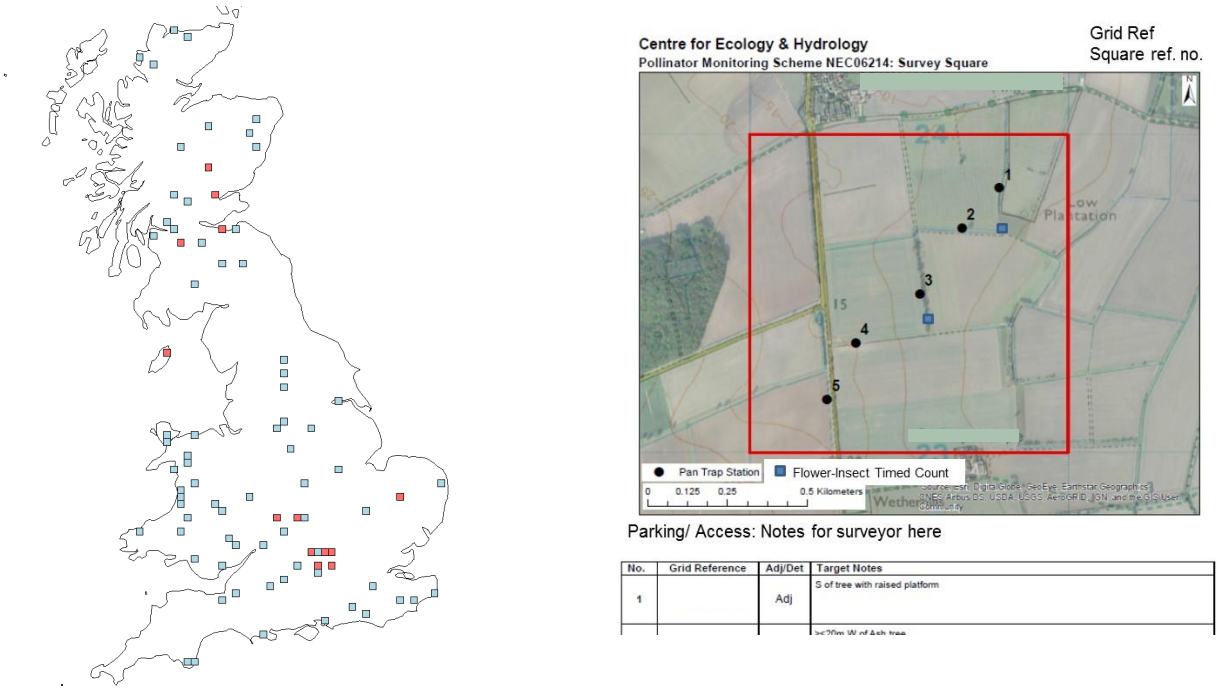


Figure 4. Target flowers used for 2017 FIT Counts. Flowers in the 'other' category represented a variety of species but most commonly included buttercups, marjoram and (mis-classified) thistle family.

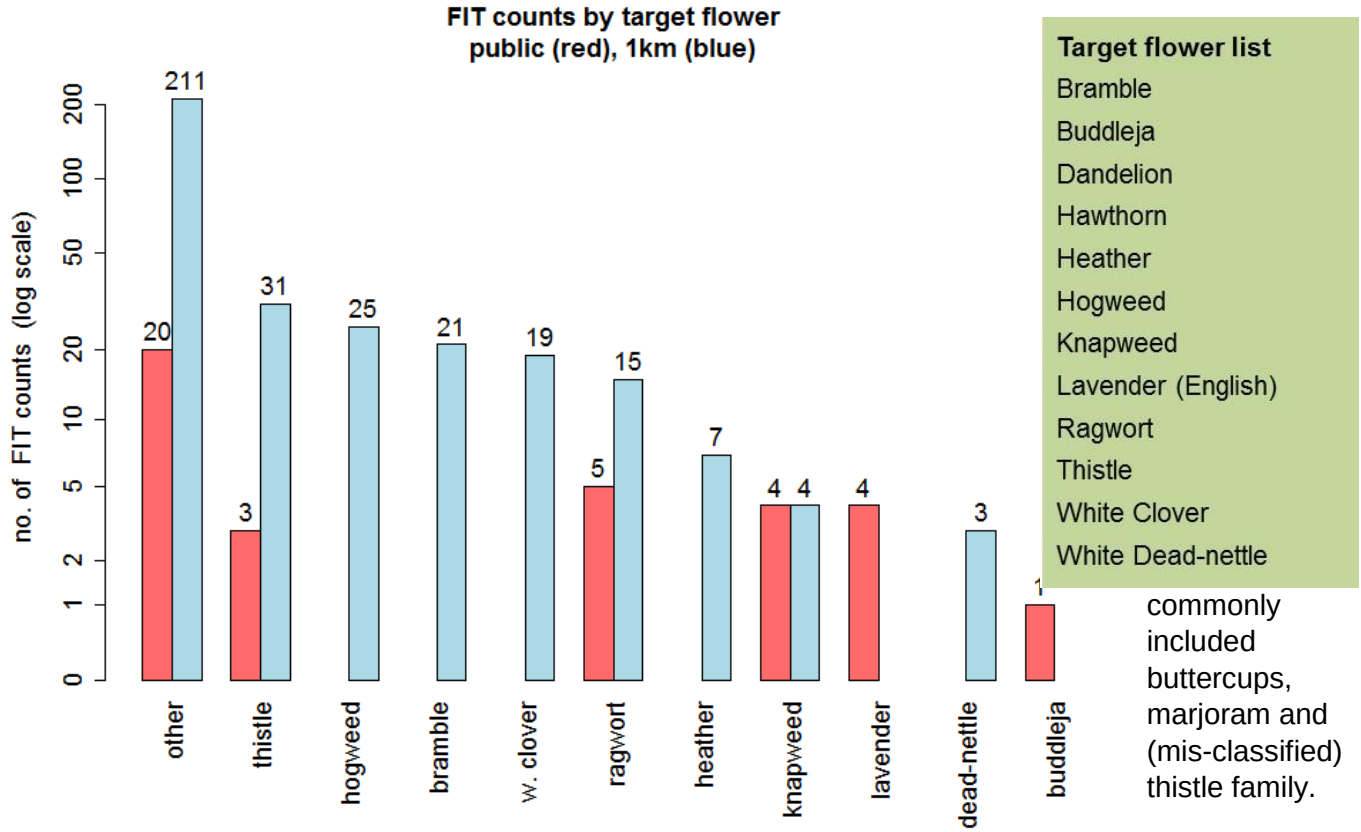


Figure 5. Habitat types in which public FIT Counts were conducted in 2017.

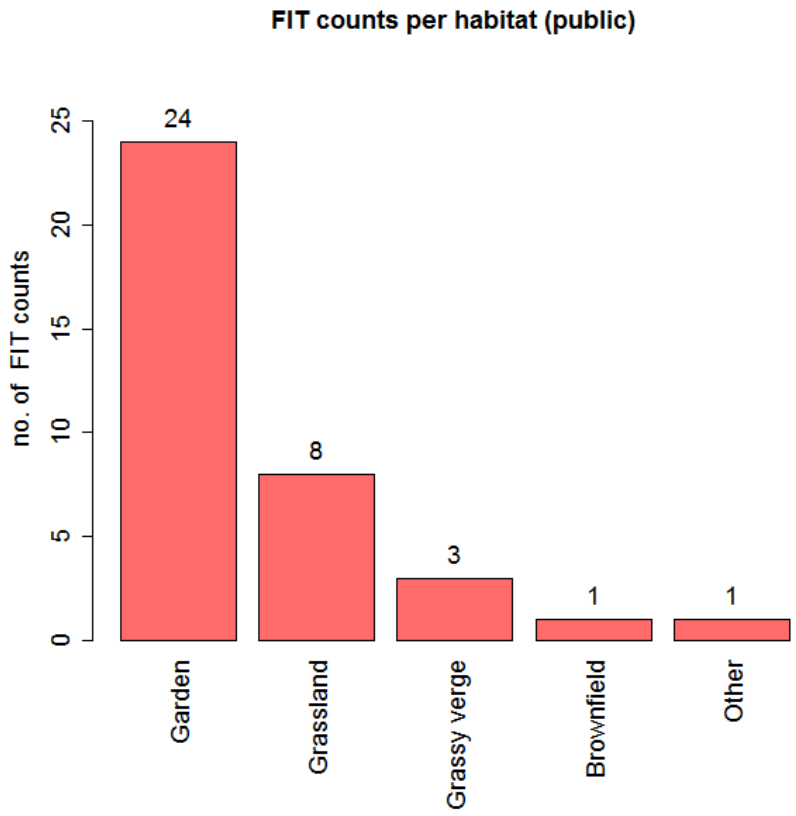


Figure 6. Habitat types in which FIT Counts were conducted within 1km survey squares in 2017.

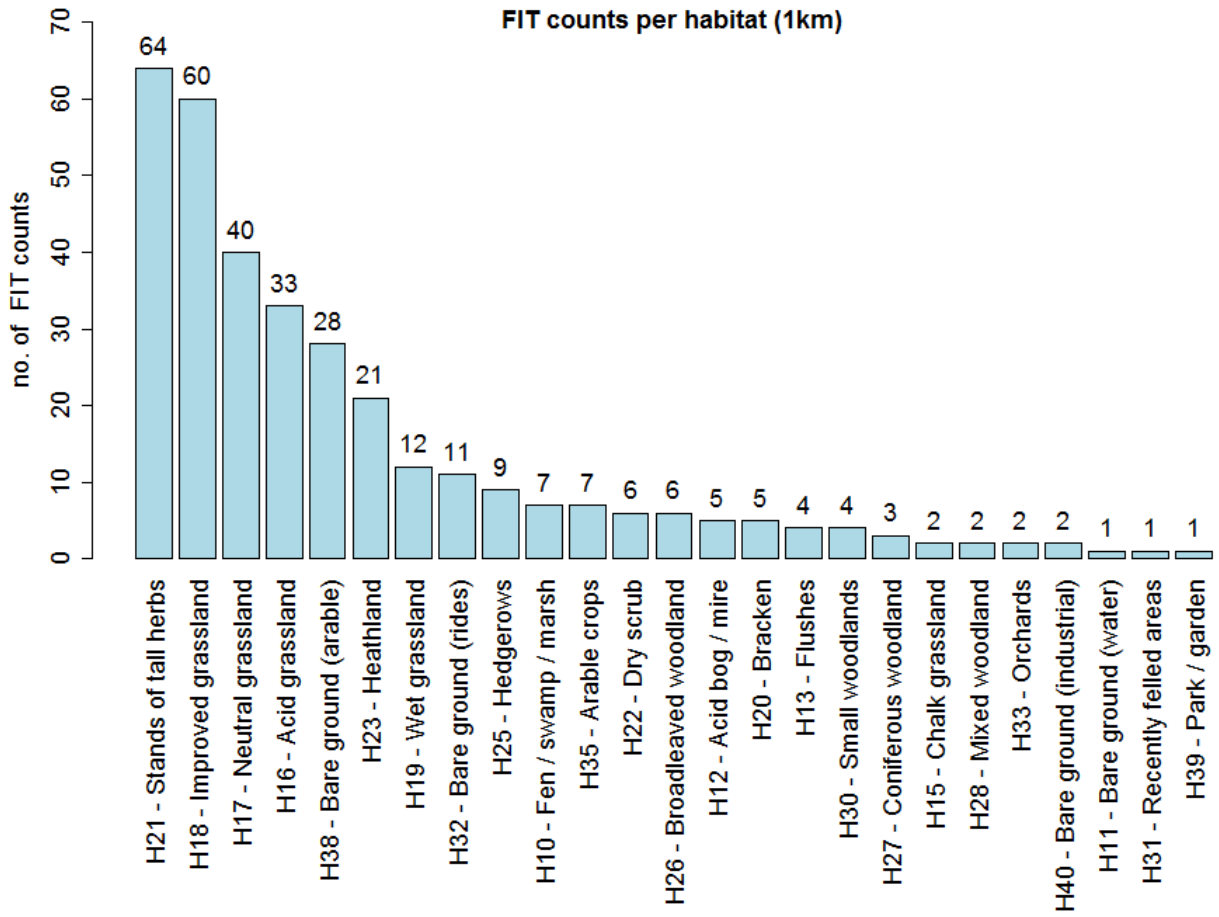


Figure 7. Number of insects of each taxonomic group recorded per 10-minute FIT Count by members of the public and within 1km survey squares. Box plot lines show the median value, coloured boxes represent the interquartile range (central 50% of values), whiskers extend to 1.5 times this range, and circles represent individual counts outside this range. Counts of bumblebees, honey bees and solitary bees have been summed to give the 'all bees' category for comparison with the preliminary pan trap results (Figure 9). Small insects were <3mm long.

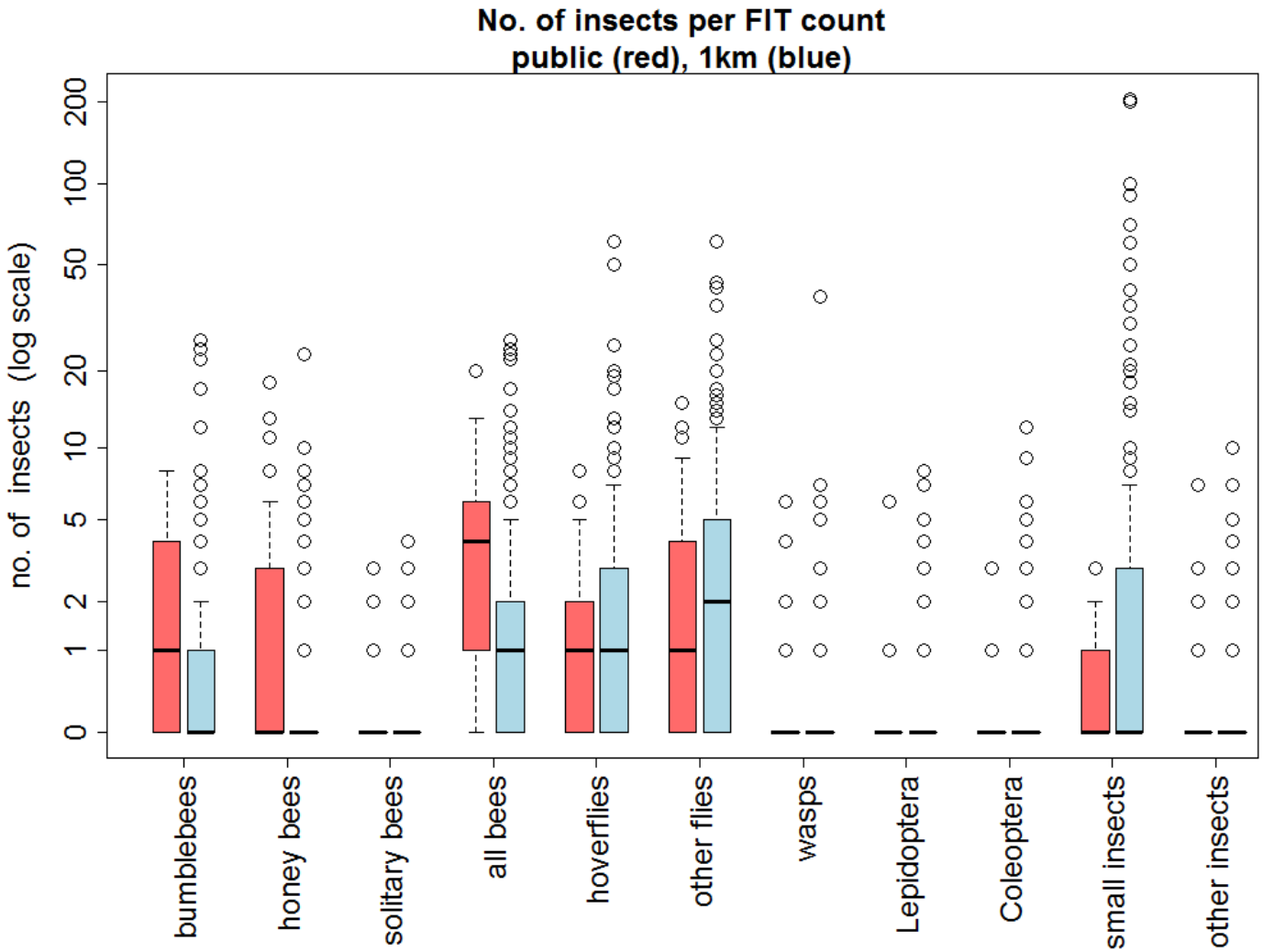


Figure 8. Local habitat types surrounding pan trap stations within the 1km survey squares in each country. Numbers above each bar refer to the number of pan trap stations within that habitat type. Habitats are based on the EUNIS pan-European classifications adopted by the Bumblebee Conservation Trust BeeWalks.

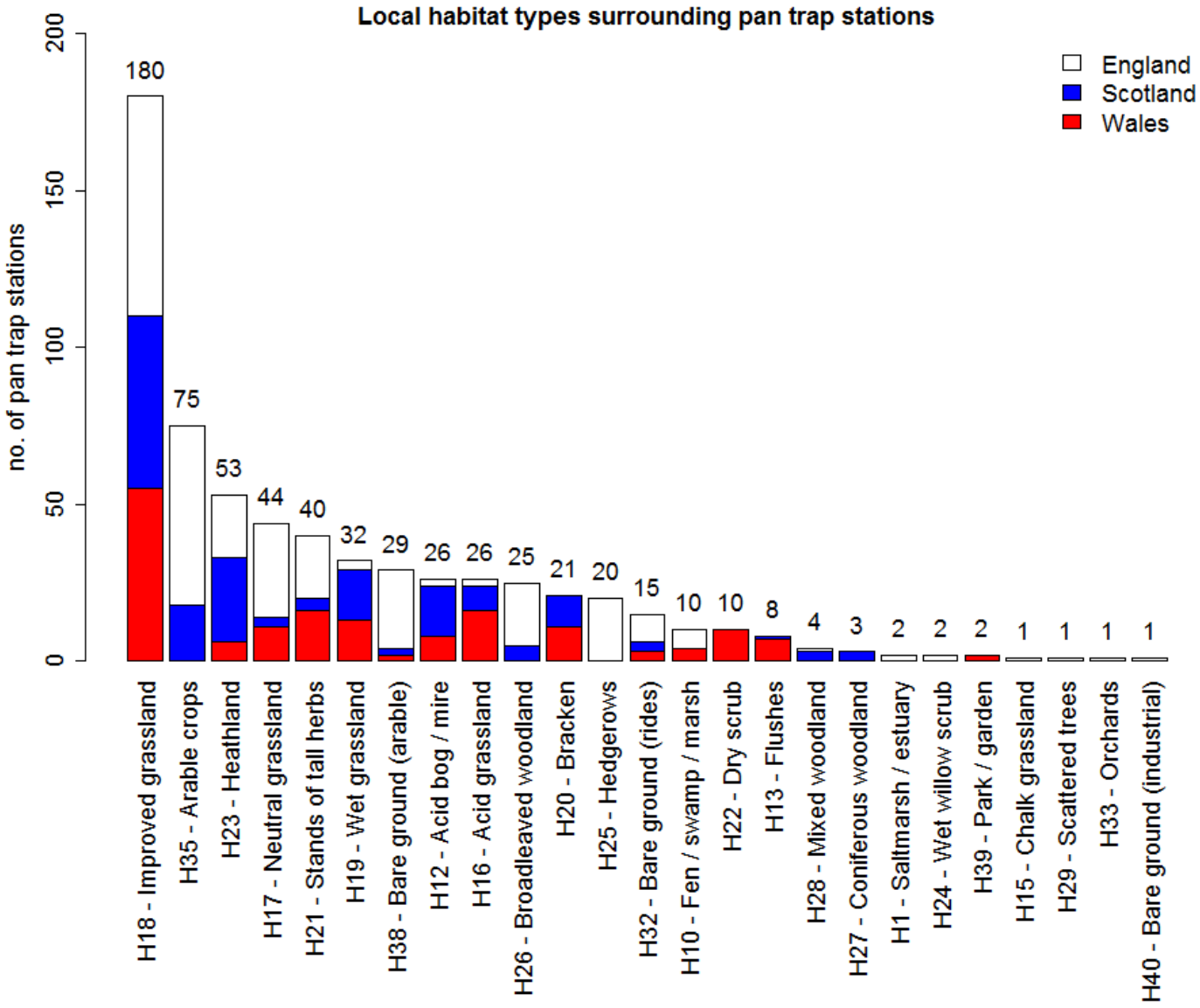


Figure 9. Number of insects of each taxonomic group captured in pan traps per 1km square survey visit (numbers captured within each 6 hour survey visit were summed from all five pan trap stations per square).

Box plot lines show the median value, coloured boxes represent the interquartile range (central 50% of values), whiskers extend to 1.5 times this range, and circles represent individual values outside this range. All bee and hoverfly specimens are being identified to species level; specimens of other groups have been archived with some additional levels of taxonomic resolution retained (i.e. wasps were counted separately as solitary, social or parasitic species; Lepidoptera were counted separately as either butterflies or moths). Small insects were <3mm long and here include pollen beetles.

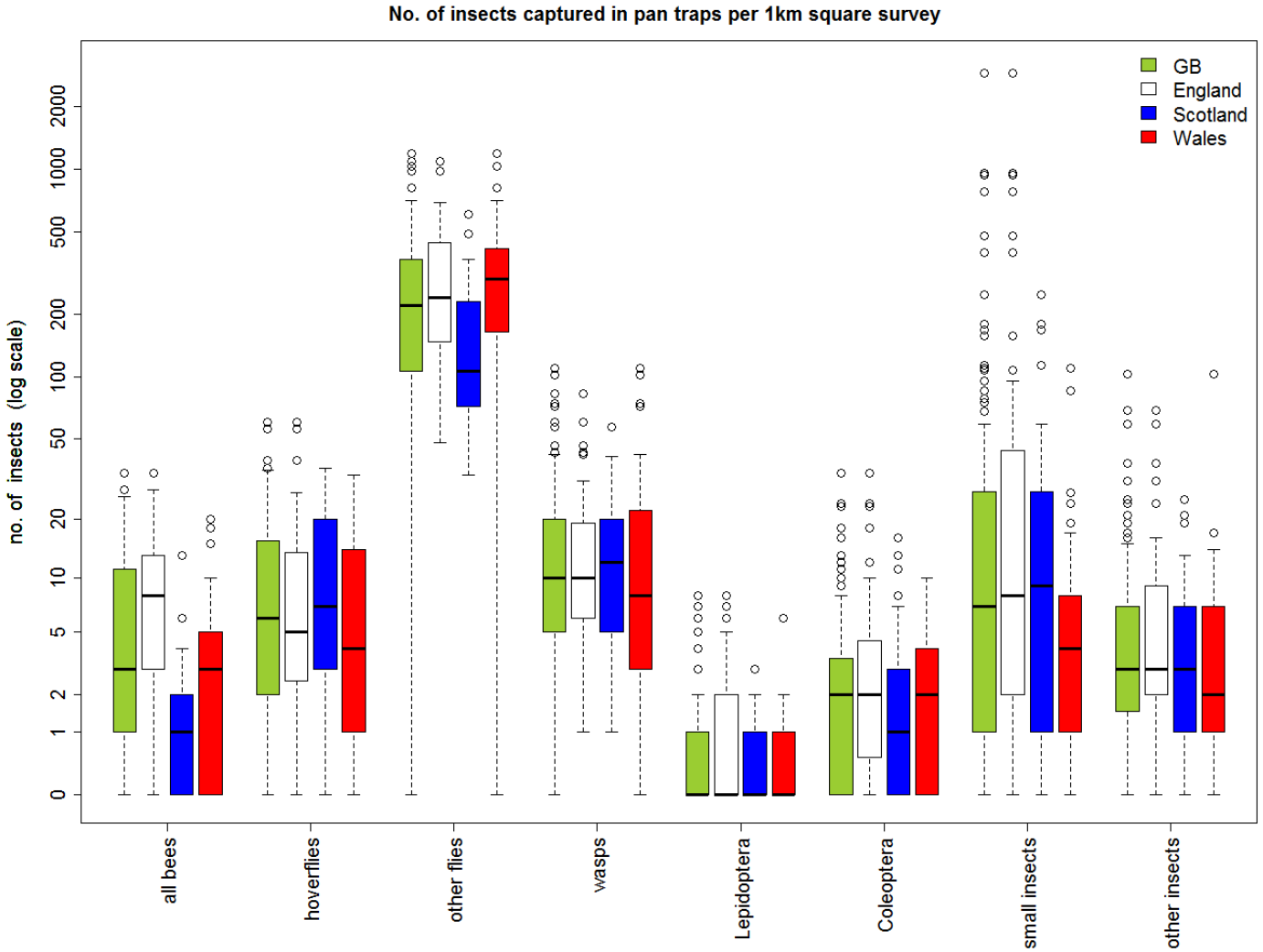


Table 1. Counts of different insect groups per 10-minute FIT Count (values show the total number of insects counted and mean number of insects per FIT Count with their standard errors at both GB and country levels). Small insects were <3mm long and included pollen beetles.

			all bees	hoverflies	other flies	wasps	Lepidoptera	Coleoptera	small insects	other insects
public FIT counts	total count GB		163	60	103	17	18	11	13	16
	mean count and standard error	GB (n=37)	4.4 (SE=0.7)	1.6 (SE=0.3)	2.8 (SE=0.6)	0.5 (SE=0.2)	0.5 (SE=0.2)	0.3 (SE=0.1)	0.4 (SE=0.1)	0.4 (SE=0.2)
		England (n=24)	5.8 (SE=1.0)	1.5 (SE=0.3)	2.8 (SE=0.8)	0.5 (SE=0.3)	0.7 (SE=0.3)	0.3 (SE=0.1)	0.3 (SE=0.1)	0.2 (SE=0.2)
		Isle of Man (n=2)	1.5 (SE=1.5)	1.5 (SE=0.5)	1.5 (SE=0.5)		1.0 (SE=0.0)			4.0 (SE=3.0)
		Scotland (n=11)	2.0 (SE=0.8)	1.9 (SE=0.8)	3.1 (SE=1.1)	0.5 (SE=0.4)		0.4 (SE=0.3)	0.5 (SE=0.3)	0.2 (SE=0.1)
1km FIT counts	total count GB		604	790	1,194	130	72	107	1,807	114
	mean count and standard error	GB (n=336)	1.8 (SE=0.2)	2.4 (SE=0.3)	3.6 (SE=0.3)	0.4 (SE=0.1)	0.2 (SE=0.0)	0.3 (SE=0.1)	5.4 (SE=1.1)	0.3 (SE=0.1)
		England (n=169)	2.7 (SE=0.3)	3.2 (SE=0.5)	3.9 (SE=0.5)	0.6 (SE=0.2)	0.3 (SE=0.1)	0.3 (SE=0.1)	8.9 (SE=2.1)	0.3 (SE=0.1)
		Scotland (n=90)	0.6 (SE=0.1)	1.3 (SE=0.2)	2.1 (SE=0.3)	0.1 (SE=0.0)	0.1 (SE=0.1)	0.3 (SE=0.1)	1.6 (SE=0.3)	0.1 (SE=0.0)
		Wales (n=77)	1.2 (SE=0.2)	1.8 (SE=0.4)	4.4 (SE=0.9)	0.1 (SE=0.1)	0.1 (SE=0.0)	0.4 (SE=0.1)	2.1 (SE=0.5)	0.8 (SE=0.2)

			bumblebees	honey bees	solitary bees
public FIT counts	total GB		70	86	7
	mean count and standard error	GB (n=37)	1.9 (SE=0.4)	2.3 (SE=0.7)	0.2 (SE=0.1)
		England (n=24)	2.0 (SE=0.4)	3.6 (SE=1.0)	0.2 (SE=0.1)
		Isle of Man (n=2)			1.5 (SE=1.5)
		Scotland (n=11)	2.0 (SE=0.8)		
1km FIT counts	total GB		390	142	72
	mean count and standard error	GB (n=336)	1.2 (SE=0.2)	0.4 (SE=0.1)	0.2 (SE=0.0)
		England (n=169)	1.8 (SE=0.3)	0.6 (SE=0.2)	0.3 (SE=0.1)
		Scotland (n=90)	0.3 (SE=0.1)	0.1 (SE=0.0)	0.1 (SE=0.1)
		Wales (n=77)	0.8 (SE=0.2)	0.4 (SE=0.1)	0.1 (SE=0.0)

Table 2. Counts of different insect groups captured in pan traps per 1km square survey visit (numbers captured within each 6 hour survey visit were summed from all five pan trap stations per square before calculating means and standard errors across all survey visits at GB and country levels). Small insects were <3mm long and included pollen beetles, with other groups (e.g. butterflies and moths) combined for comparison with group levels in Table 1.

	n = number of survey visits	all bees	hoverflies	other flies	wasps	Lepidoptera	Coleoptera	small insects	other insects
total count GB		818	1,297	35,607	2,104	108	409	9,120	902
mean count and standard error	GB (n=127)	6.4 (SE=0.6)	10.2 (SE=1.0)	280.4 (SE=20.5)	16.6 (SE=1.7)	0.9 (SE=0.1)	3.2 (SE=0.5)	71.8 (SE=25.9)	7.1 (SE=1.2)
	England (n=59)	10.0 (SE=1.0)	10.3 (SE=1.7)	312.0 (SE=28.9)	15.7 (SE=2.1)	1.2 (SE=0.3)	4.0 (SE=0.9)	129.6 (SE=54.8)	8.1 (SE=1.7)
	Scotland (n=35)	1.7 (SE=0.5)	11.9 (SE=1.9)	162.7 (SE=22.9)	15.1 (SE=2.3)	0.5 (SE=0.1)	2.7 (SE=0.7)	31.3 (SE=9.7)	5.3 (SE=1.0)
	Wales (n=33)	5.1 (SE=1.1)	8.3 (SE=1.6)	348.7 (SE=49.2)	19.7 (SE=5.0)	0.6 (SE=0.2)	2.4 (SE=0.5)	11.5 (SE=4.1)	7.3 (SE=3.1)