UK Pollinator Monitoring Scheme

Annual Report 2022

UK Centre for Ecology & Hydrology

JNCC

PoMS

UK Pollinator Monitoring Scheme

Welcome

This is the first annual report of the UK Pollinator Monitoring Scheme (PoMS), highlighting progress during the 2022 season as well as providing an overview of survey coverage since the scheme's initial implementation in 2017. The report also documents ongoing analyses of trends in different insect pollinator groups from PoMS data collected by dedicated volunteers between 2017 and 2021, and includes news and updates from the partnership.

PoMS aims to understand how insect pollinator populations are changing across the UK through implementing two large-scale surveys: the Flower-Insect Timed Count (FIT Count) and the 1 km square survey. These surveys use a combination of volunteer and professional recorders to collect data on the abundance and distribution of flower-visiting insects and floral resources from a wide range of habitats across the UK. The UK PoMS partnership is coordinated by UKCEH, further details are provided on page 34.

We plan to produce a similar annual report each year, so it would be great to hear any feedback. Which parts of the report did you like most, what could be improved or are there other types of article you would like to see in future?

Discover PoMS

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How to cite

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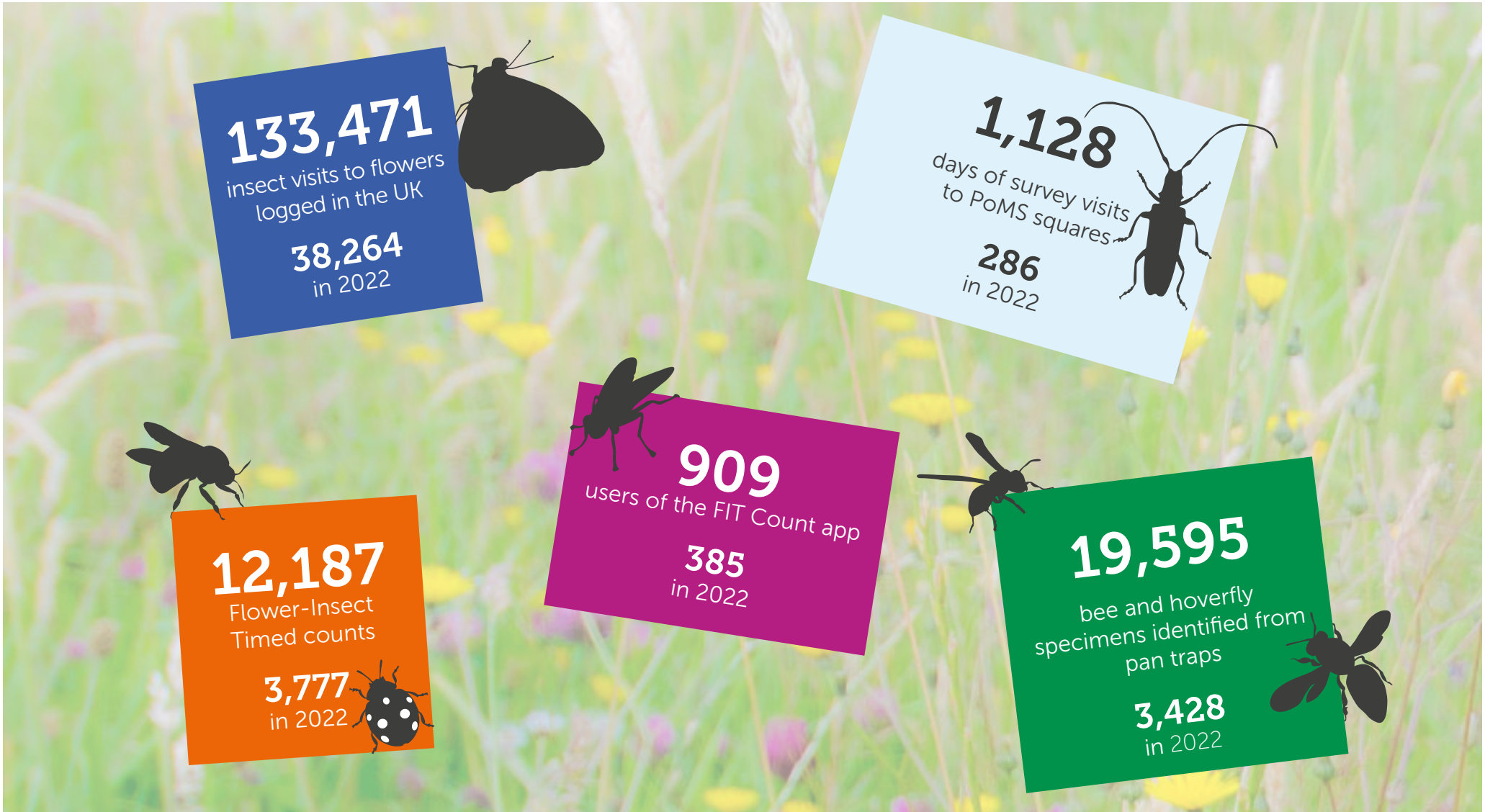
This report can be downloaded from: https://ukpoms.org.uk/reports

Contents

References to publications and websites are indicated with hyperlinks like this [1] and are listed on pages 32-33

Front: Orange-tailed Mining Bee (*Andrena haemorrhoa*) on apple blossom. Nadine Mitschunas © UKCEH

Back: Hoverfly on Buttercup. © Barry Wells



Alan Lawlor © UKCEH

PoMS in numbers

In each box, the first value is for all years (2017-2022) whilst the second value is for 2022

Latest news from UK PoMS

Claire Carvell and Martin Harvey (UKCEH) provide a round-up of PoMS activities during the past year and look forward to the 2023 season.

The past year has been one of transition for the PoMS project. Having entered its sixth year, a new partnership agreement was signed between JNCC and UKCEH, ensuring the continuation of UK PoMS from 2022 until 2025. Importantly, this new arrangement aligns PoMS with the set of other long-term UK-wide biodiversity monitoring schemes [1] that are collectively supported by JNCC, UKCEH, and a range of non-governmental organisations.

Like many other schemes, PoMS has bounced back from the understandably low survey coverage of 2020, when restrictions were imposed by the COVID-19 pandemic. Last year, we saw not only the fantastic contribution of at least 50 volunteers and our team of mentors on the 1 km square surveys, and a further increase in FIT Count coverage to 3,777 counts submitted in 2022 (read more on pages 6-10), but also opportunities to re-engage with potential new recruits and members of the public at a range of face-to-face events. Read more about PoMS outreach activities that took place during 2022 across the UK and beyond during 2022 in "PoMS on Tour" and "PoMS abroad" on pages 26-29.

The PoMS team said goodbye to **Katty Baird** who is moving on to new pastures after her incredible efforts supporting volunteers and surveys across the 22 PoMS 1 km squares in Scotland from 2020 to 2022. Thank you Katty!

"It's a fantastic role, though challenging at times trying to organise surveys around the unpredictable Scottish weather. I will miss sunning myself on beautiful hillsides this summer... there is definitely 'down time' during the day and I loved entertaining myself with bug-hunting, botanising and photography.

- *Katty Baird, 2022*

© Katty Baird

During 2022 we also conducted a questionnaire survey to understand more about the motivations and barriers to participation in PoMS. Overall, it was fantastic to see that of the 424 respondents, 95% of people agreed that they enjoyed carrying out PoMS surveys. Read more about the findings and how we are working to better support volunteers in the future in our news item[2] on the PoMS website.

PoMS has also set up a new mailing list. After much behind the scenes work in Mailchimp, we were able to launch our first update just before Christmas and plan to use this approach to keep volunteers and subscribers up to date. To find out what's happening in 2023 you can subscribe to the mailing list[3] for all our news updates, and you can also follow PoMS on Twitter @PoMScheme.

And finally, you never know what might turn up on a FIT Count! Since 2018, Teyl de Bordes has volunteered for the PoMS 1 km square surveys at a site in the Scottish borders, and last summer some close attention to flower-visiting insects produced an amazing observation, as Teyl explains:

"I had just done a FIT Count for my square on a hawthorn hedge and moved to a lonely dandelion for a third FIT Count, when from the corner of my eye I noticed a small insect on Common Mouse-ear flowers. I probably would have missed it had I not been on my knees for the FIT Count. I quickly took some pictures as I did not recognise it. Once I got home I tried to find it in the micro-moth book, with no luck, but eventually realised it was in the macro moth book. It turned out to be a Small Yellow Underwing, the first Scottish record for this moth since 1943 and first Borders record since 1880!"

Small Yellow Underwing moth on Common Mouse-ear flowers, seen during a PoMS survey – the first Scottish record for almost 80 years! Recorded and photographed by Teyl de Bordes.

Flower-Insect Timed Counts

FIT Counts were developed with the aim of encouraging a wide range of people to get involved in pollinator monitoring, whilst also generating data on flower visitation and plant-pollinator interactions that is not being collected by any other existing scheme. The recorder spends **10 minutes** counting the insects that visit the flowers of a chosen plant species within a **50 cm quadrat** (ideally from our list of 14 target flowers, although other flowers can be used). Information on flower abundance and habitats surrounding the FIT Count quadrat, and the weather, is also collected to help explain variation in the insect data and explore the effects of changes in these other variables over time, where the data allows.

FIT Count resources include survey guidance, a recording form, insect and flower guides, 2-minute video guides, online forms for data capture and the mobile app that was launched in 2021. All are available in both English and Welsh through the PoMS website.

Overall, since 2017 a total of 12,187 FIT Counts has been submitted, representing an incredible 2,031 hours of observation and **133,471 flower-insect interactions**! Thanks are due to the 1,456 recorders who submitted counts from all corners of the UK.

While PoMS has seen a steady increase in FIT Counts year on year in England, the map (Figure 1), the chart (Figure 2) and Table 1 all highlight the scope to increase coverage in Scotland and Wales for future years. Records from the mobile app now constitute around 58% of all public FIT Counts, which should help widen the reach of this citizen science survey.

Flower-Insect Timed Counts (FIT Counts) are simple systematic surveys collecting data on abundance of flower visitors across a variety of habitats and plant groups. Here, Claire Carvell, Martin Harvey and Robin Hutchinson (UKCEH) summarise coverage to date and highlight the fantastic contribution volunteers are making to this survey.

Martin Harvey © UKCEH

Volunteers conducting a FIT Count on Bramble during a FSC course on pollinators

The FIT Count app was launched in 2021 with English and Welsh languages, and is available to download from Google Play or the App Store

Detail	Years	England	Scotland	Wales	N Ireland	Total UK
Total number of FIT Counts	2017 - 2022	9,018	1,653	1,052	464	12,187
	2022	2,998	328	271	180	3,777
Number of FIT Counts submitted by the public	2017 - 2022	7,933	843	509	404	9,689
	2022	2,794	123	171	126	3,214
Number of FIT Counts on 1 km square surveys	2017 - 2022	1,085	810	543	60	2,498
	2022	204	205	100	54	563
Number of FIT Counts submitted via the app	2021 - 2022	3,185	314	173	287	3,959
	2022	1,572	86	116	104	1,878
Insect visits to flowers logged	2017 - 2022	105,776	15,269	9,151	3,275	133,471
	2022	32,252	2,365	2,229	1,402	38,248
Total number of recorders	2017 - 2022	1,170	158	103	50	1,456
	2022	366	45	46	39	490
Total number of recorders using the app	2021 - 2022	738	83	61	41	909
	2022	289	35	34	32	385
Total number of public recorders	2017 - 2022	1,143	144	92	47	1,398
	2022	346	40	40	34	450

Table 1. Summary of survey coverage and uptake of Flower-Insect Timed Counts submitted to UK PoMS

The FIT Count was launched to 'the public' in 2018 and runs every year between 1st April and 30th September. FIT Counts have also been carried out as part of the PoMS 1 km square survey protocol since 2017. Note data for 2022 is still subject to further checks.

Figure 1. Map showing the location of 10 km squares in which one or more FIT Counts have taken place across the UK since 2017, by survey type

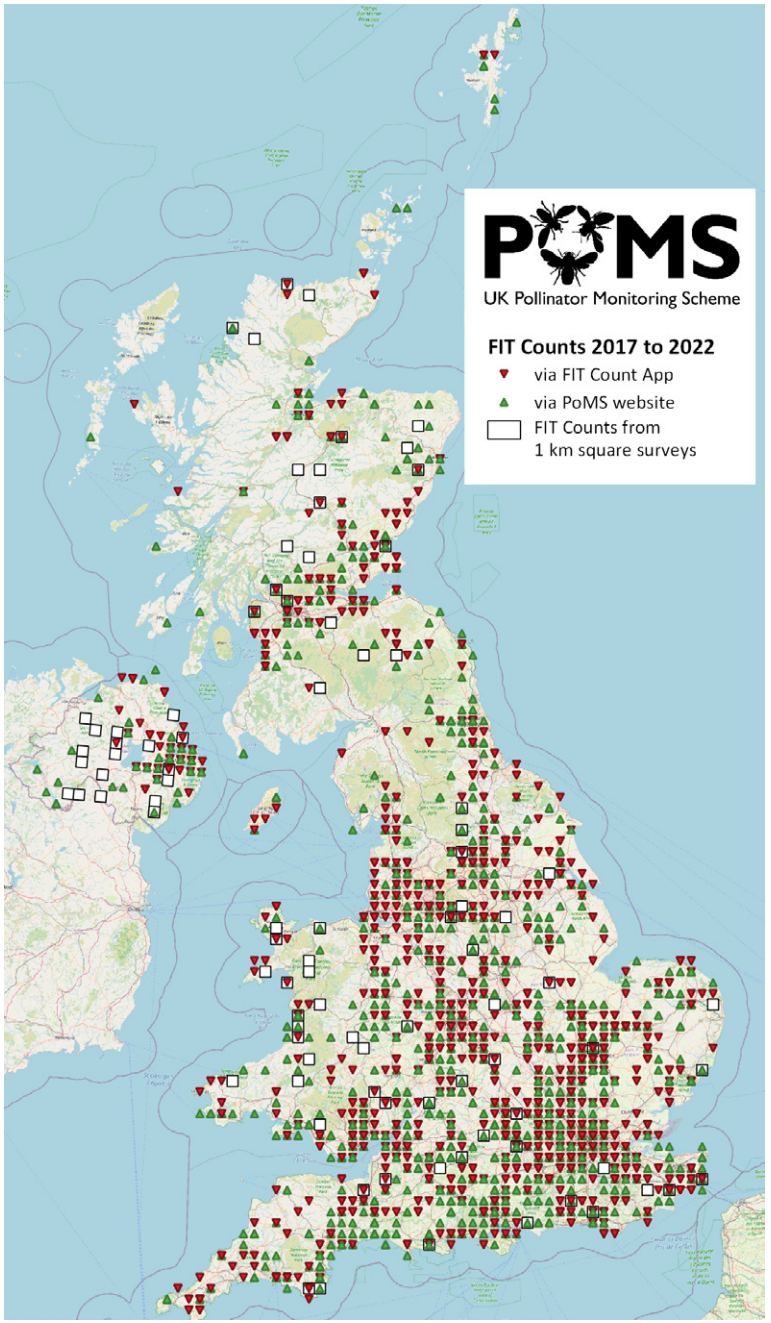
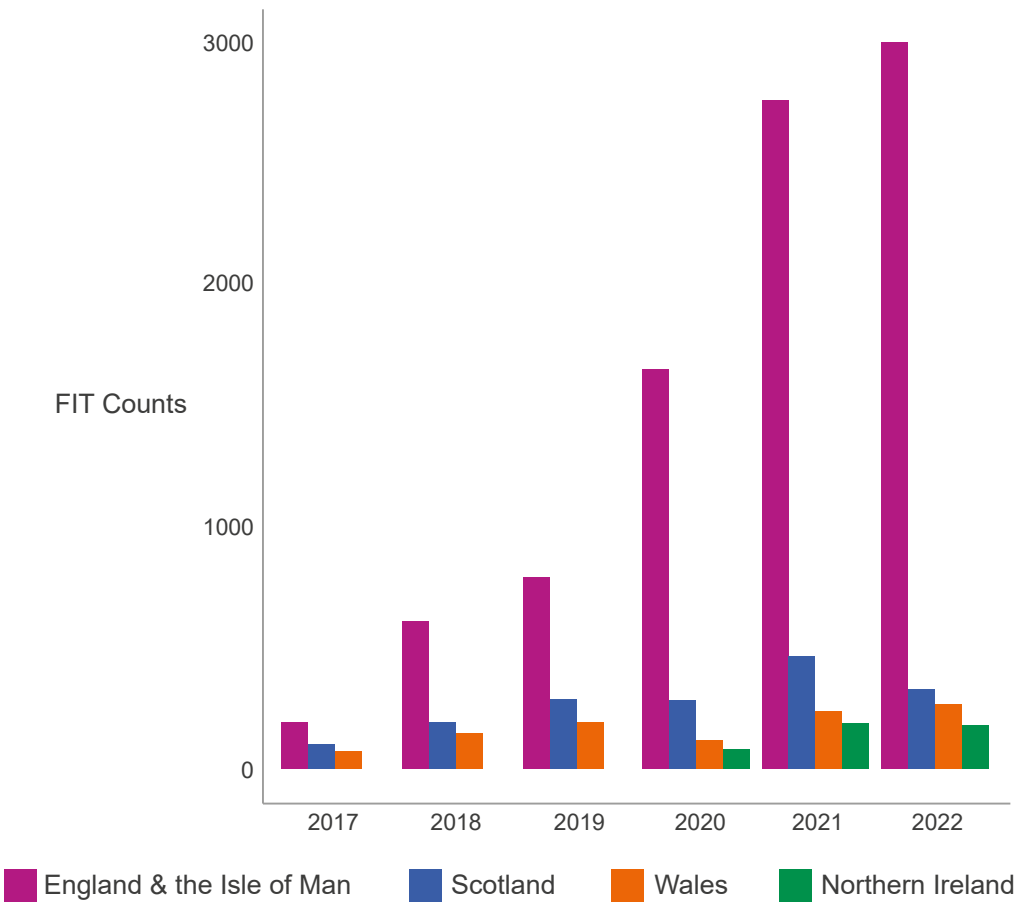


Figure 2. FIT Counts have shown a steady increase in uptake each year, with 3,777 counts submitted in 2022. FIT Counts in Northern Ireland began in 2020



Insects and target flowers

A series of interactive charts has been set up on the PoMS website[4] to showcase the FIT Count data by target flower. Here, you will see that to date, the target flower with the greatest number of FIT Counts is Buttercup, likely due to its prevalence in the wider countryside on PoMS 1 km squares, followed by Lavender which has the highest number of counts of the garden flowers. Overall, more counts were conducted on 'other' flowers from 2020 onwards than on any individual target flower, reflecting the high proportion of FIT Counts in gardens (overall 50% of all the public FIT Counts) and low number of common horticultural species in the target flower list.

The target flower with the highest average number of insects per FIT Count (24) is Ivy, followed closely by Hogweed with 23 insects per FIT Count (Table 2). More interesting still are the contrasting patterns of visitation by different insect groups to the target flowers. On Buttercup, the average of 6 insects per 10-minute count is dominated by the 'other flies' and small insects (Figure 3, page 10).

Table 2. Summary of FIT Count results by target flower, showing the average total number of insect visits per 10-minute count across all years of the survey (2017-2022)

Target flower	Total insects	Total counts	Average per 10-min count	Most common insect visitors
Ivy *Hedera*	4,057	172	24	other flies; honeybees
Hogweed *Heracleum sphondylium*	9,748	427	23	small insects; other flies
Knapweeds (Common or Greater) *Centaurea nigra* or *scabiosa*	8,870	606	15	bumblebees; honeybees
Bramble (Blackberry) *Rubus fruticosus agg.*	6,604	454	15	small insects; hoverflies
Lavender (English) *Lavandula angustifolia*	12,763	881	14	bumblebees; honeybees
Thistle *Cirsium* or *Carduus*	9,845	694	14	small insects; other flies
Ragwort *Jacobaea/Senecio species*	9,603	750	13	hoverflies; other flies
Buddleja	6,653	519	13	honeybees; bumblebees
Hawthorn *Crataegus*	1,496	196	8	other flies; small insects
Heathers *Calluna* or *Erica species*	1,396	202	7	other flies; small insects
Buttercup *Ranunculus species*	5,378	939	6	other flies; small insects
Dandelion *Taraxacum officinale agg.*	4,007	666	6	small insects; other flies
White Dead-nettle *Lamium album*	967	169	6	bumblebees; other flies
White Clover *Trifolium repens*	3,519	645	5	small insects; bumblebees

On Ivy, the average of 24 insects per 10-minute count is dominated by honeybees and solitary bees, wasps, hoverflies and other flies (Figure 3).

The sheer number of 'other flies' (those not belonging to the hoverfly group) and small insects (less than 3mm long) visiting many PoMS target flowers is a reminder of the significance of these often 'forgotten pollinators'. These numbers should not, however, be interpreted as a measure of pollination effectiveness, which of course relates to the complex specialisations we see in different insect groups and is another whole science in itself (perhaps a topic for a PoMS blog in the future).

Please do keep your FIT Counts coming in!
As the dataset grows, we plan to conduct analyses at the level of individual target flowers to investigate whether patterns of insect visitation are changing year-on-year.

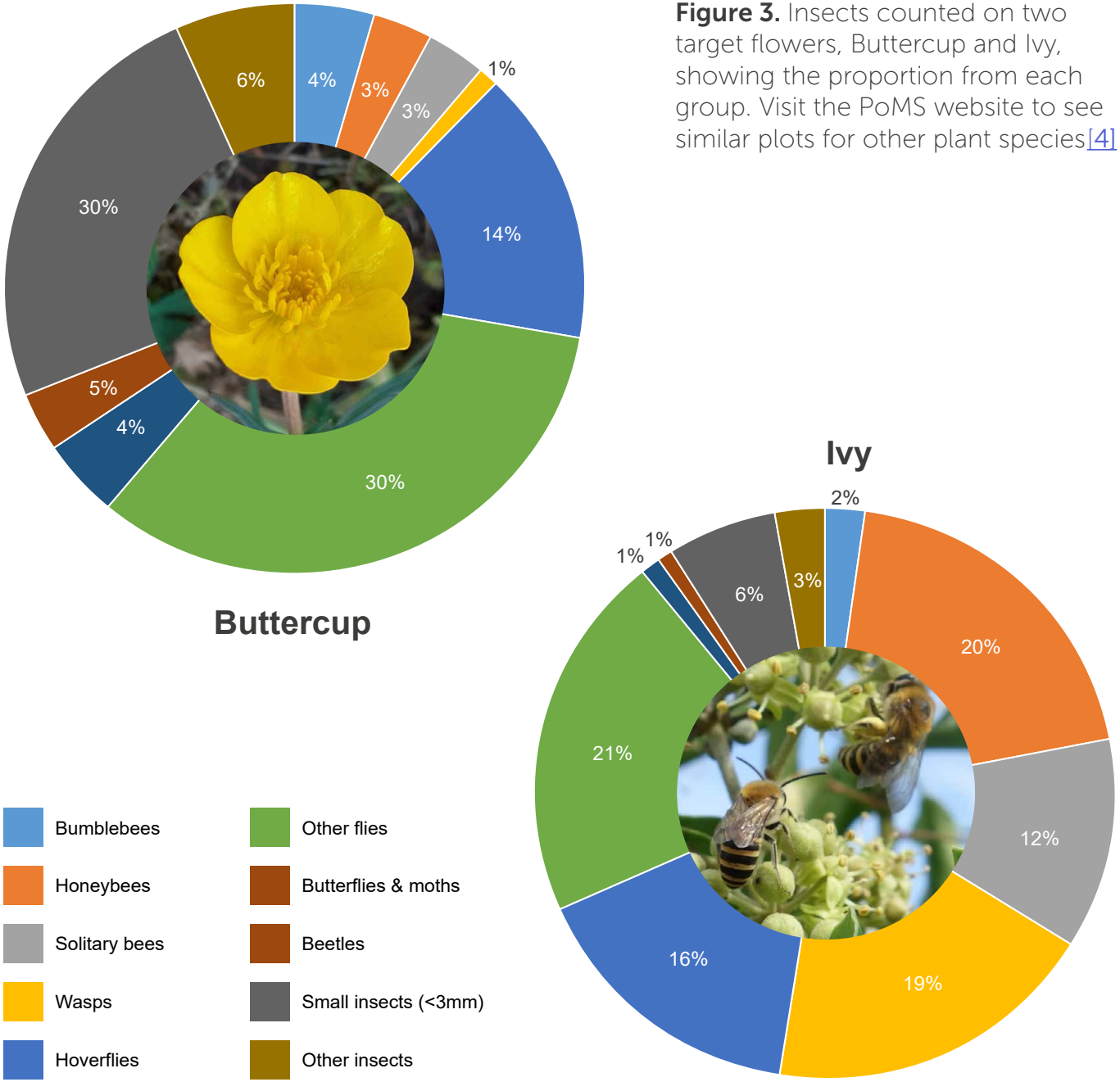


Figure 3. Insects counted on two target flowers, Buttercup and Ivy, showing the proportion from each group. Visit the PoMS website to see similar plots for other plant species[4]

The PoMS 1 km square survey

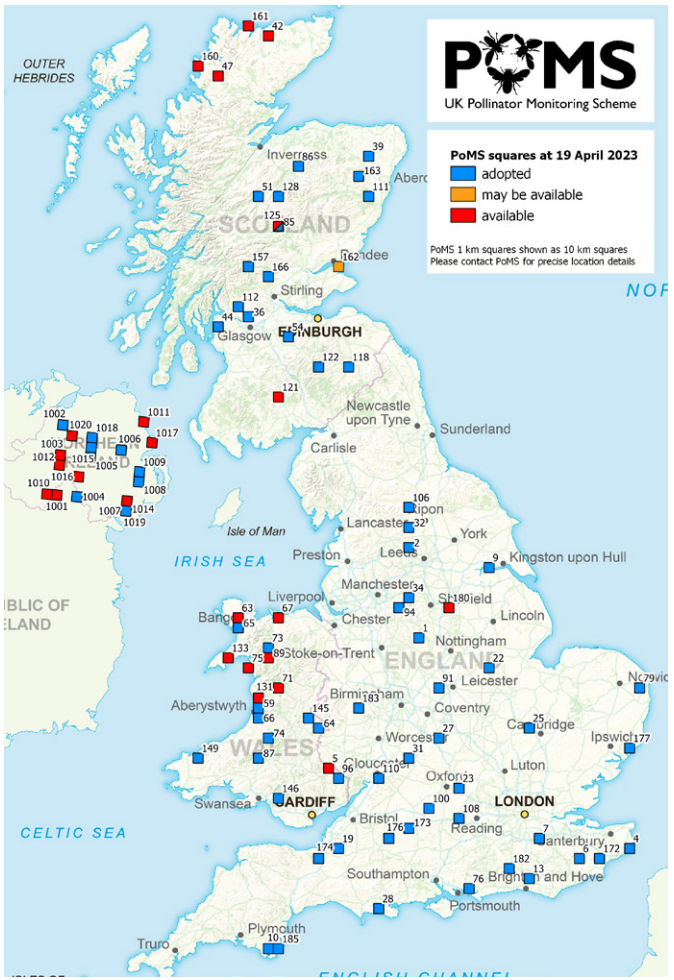
The PoMS 1 km square survey is a systematic survey of pollinators and floral resources from a core set of sites across the UK. It generates species-level data for bees and hoverflies using pan traps, providing new records of occupancy and distribution, as well as data to detect changes in abundance of key groups across a range of insect taxa. Here, Claire Carvell, Martin Harvey and Robin Hutchinson (UKCEH) summarise coverage to date.

This survey was set up in 2017 across 75 randomly selected 1 km squares in Great Britain, stratified to represent the relative cover of agricultural and semi-natural land use in each country [5]. In 2021 squares were set up in Northern Ireland to expand the overall network to 95 squares (Figure 4). Sampling is conducted on up to four visits from May to September each year by a combination of volunteers and PoMS team surveyors.

The 'one-person-one-day' protocol was designed to be implemented by non-experts and involves setting out five pan trap stations (each with three bowls painted UV-bright yellow, blue and white, mounted at vegetation height and filled with water) along a diagonal of each square for six hours. During this time the surveyor collects data on floral resources (number of flowers within a two metre radius of the trap station) and habitats surrounding the pan traps and undertakes at least two FIT Counts. Collected samples are sent back to UKCEH for sorting and identification, and surveyors enter their other survey data via the PoMS website.

Figure 4. Location of 1 km square survey sites across the UK. Surveys on 'available' squares in red are covered by the PoMS survey team each year until they are adopted by volunteers.

We are extremely grateful to the landowners who allow access for PoMS surveys, and to the volunteers who undertake them. Each year they receive a bespoke report which lists the bee and hoverfly species sampled and the flowering plants spotted in their 1 km square



Survey coverage 2017-2022

Since 2017, a total of 1,128 survey visits have been made, typically covering around 70 PoMS 1 km squares per year, but increasing to 84 squares in 2022 (Figure 5 and Table 3). Survey effort has generally reflected the number of squares set up in each country (36 in England, 22 in Scotland, 17 in Wales). Surveys were suspended from April to early July 2020 due to the restrictions imposed during the COVID-19 pandemic, but recovery has been excellent with an average of 3.6 visits per square achieved in 2021 and 2022. Surveys in Northern Ireland (coordinated by staff at DAERA) were conducted on five squares in 2021 and 13 squares in 2022 and data from these sites will be included in our analyses once sufficient coverage is achieved.

Over the years, the number of volunteers adopting squares has increased steadily with an impressive 64% of the 95 squares having a trained volunteer surveyor in 2022. Several of the more remote PoMS squares remain available across Scotland, Wales and Northern Ireland (Figure 4), and we encourage anyone interested to get in touch for further information on what's involved.

Table 3. Coverage of the PoMS 1 km survey and samples processed from 2017-2022

Note figures for 2022 may be subject to minor changes following final checks and data cleaning

Detail	Year	England	Scotland	Wales	Northern Ireland	Total UK
Number of 1 km survey days	2017	59	35	33	NA	127
	2018	94	32	22	NA	148
	2019	108	62	64	NA	234
	2020	54	24	12	NA	90
	2021	119	61	57	6	243
	2022	117	76	61	32	286
Number of squares surveyed	2017	36	19	17	NA	72
	2018	33	17	15	NA	65
	2019	33	21	17	NA	71
	2020	32	18	11	NA	61
	2021	33	18	15	5	71
	2022	33	21	17	13	84
Number of samples processed (One sample is from three bowls at a pan trap station)	2017	295	175	165	NA	635
	2018	465	156	110	NA	731
	2019	540	305	313	NA	1,158
	2020	270	120	60	NA	450
	2021	593	305	284	30	1,212
	2022	581	380	296	159	1,416
Bee & hoverfly taxa identified	2017-2022	208	115	149	33	234

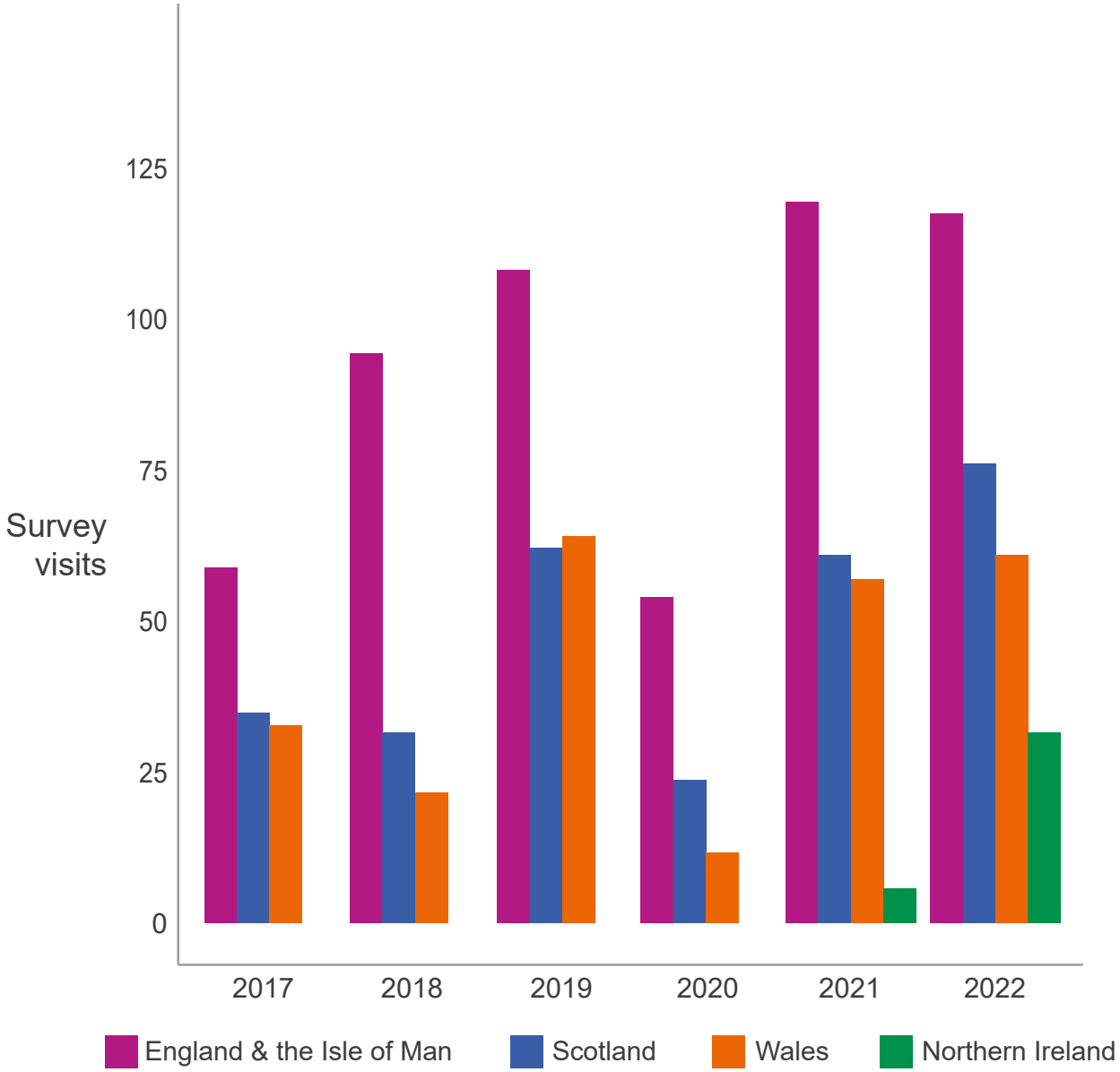
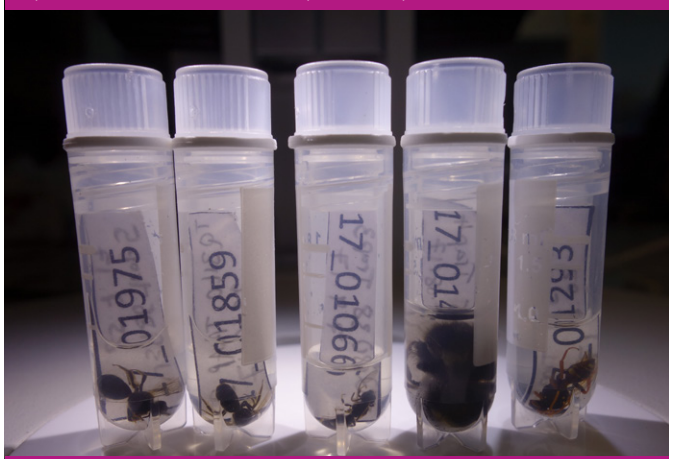


Figure 5. Number of 1 km square survey visits by country between 2017 and 2022

The PoMS taxonomists carry out detailed examinations to identify all bee and hoverfly specimens from the pan traps

Claire Carvell © UKCEH



Bee and hoverfly specimens from pan traps, individually coded and ready for identification

Nadine Mitschunas © UKCEH

What's in a pan trap?

The PoMS pan trapping protocol has been carefully designed to minimise the number of insects caught, while still sampling enough individuals to measure changes over time[6]. Typically the traps catch three to four bees and hoverflies per set of three pans during a 6-hour survey, though these numbers vary depending on factors including location and time of year.

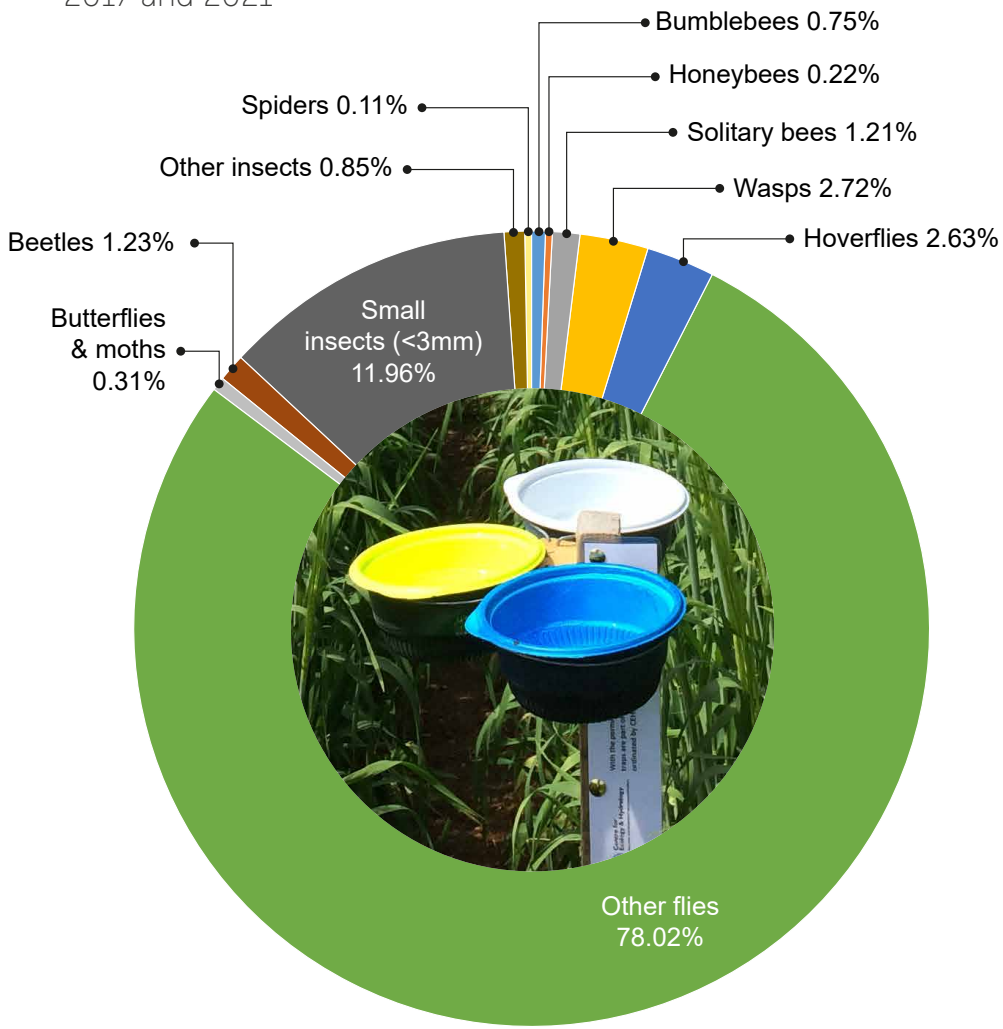
Insects from the PoMS 1 km square samples are stored in small tubes of alcohol and returned to the UKCEH labs for analysis and curation. This includes a full count of all insects sampled in the pan traps, broken down by species group. All bees and hoverflies are then identified to species level by expert taxonomists, while other groups are stored for potential future identification.

Between 2017 and 2021 a total of 336,397 individual specimens were sampled and processed, including 7,329 bees and 8,838 hoverflies belonging to 234 species. These represent the spread of species that we would typically expect to find across the sampled areas of the UK, including some interesting finds that are described on pages 20-21.

The pie chart (Figure 6) shows the average composition of a PoMS pan trap sample by insect group. Note the large proportion of 'other' non-hoverfly flies, making up on average 78% of a sample, with the bees and hoverflies making up only around 4.8% of a typical sample.

For 2022 we are excited to have welcomed four new taxonomists into the PoMS team. They worked alongside our long-standing experts to become familiar with the protocols, and all attended a 2-day 'QA' workshop in February to check and compare findings. Together, they identified a total of 1,842 bees and 1,586 hoverflies (numbers subject to minor changes) from surveys in 2022.

Figure 6. Average composition of a PoMS pan trap, taken from 4,186 samples (trap stations) collected across the UK between 2017 and 2021



A key aim of the UK PoMS partnership is to expand taxonomic capacity and skills in the identification of pollinators, to enable future monitoring efforts to continue. We are also in touch with partners at the Natural History Museum to continue exploring molecular genetic approaches to understand more about insect community change from the pan trap samples. Watch this space for updates in future reports.

A first look at our 5-year results

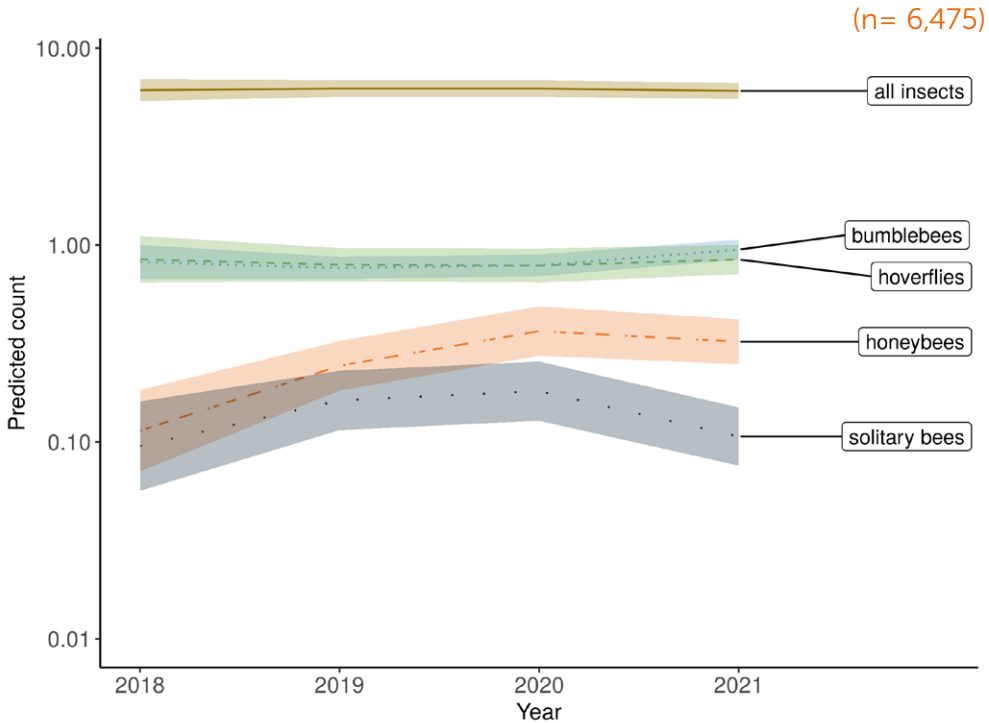
With four years of data from the public FIT Count survey and five years from the 1 km square survey, we are able to begin statistical analyses that will give an indication of changes in different pollinator groups over time. As with any large-scale biodiversity monitoring survey, to ensure robust results requires sufficient data throughout the recording period together with an understanding of variation around any trends (often shown by a 95% confidence interval). It is relatively 'early days' for PoMS, therefore we are able to report changes at GB level using the data generated from England, Scotland and Wales between 2017 and 2021, for the more commonly recorded insect groups in each of the PoMS surveys. Although data from 2022 are available, they are still going through cleaning and quality assurance pipelines and are therefore not ready to be included in the analysis.

Modelling the data and interpreting graphs

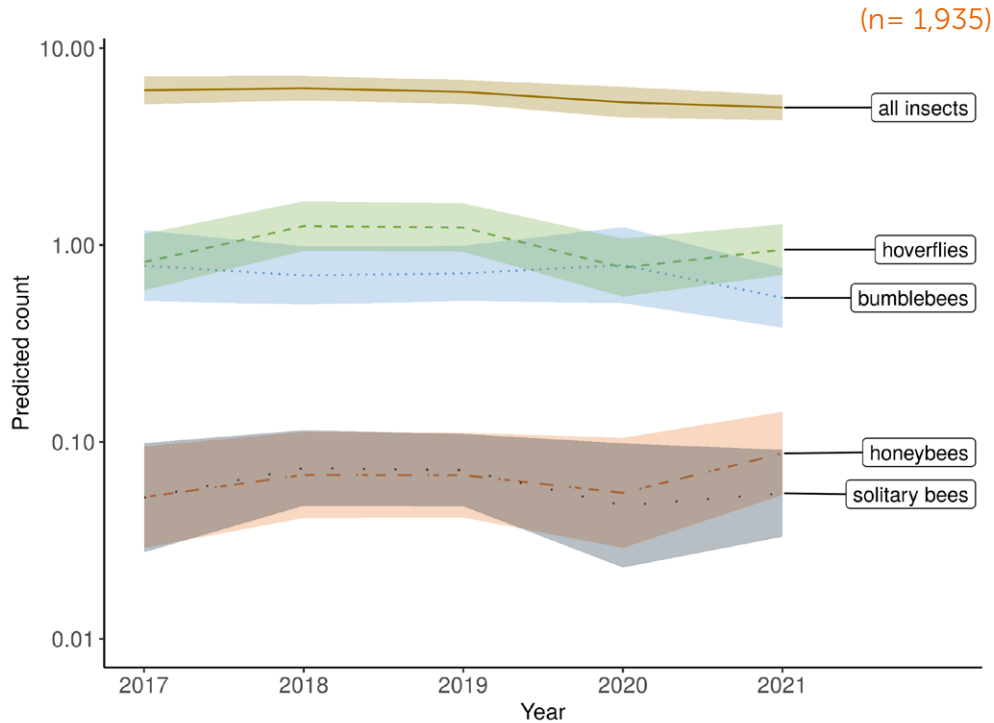
Insect numbers can vary for many different reasons, including weather and other environmental factors. Changes in these variables can make it difficult to detect a temporal trend in number of pollinating insects. We use statistical models to account for variation in insect numbers due to environmental factors and derive robust estimates of temporal trends in insect abundance. We model data from the 'public' FIT Counts, 1 km square FIT Counts and pan trap surveys separately and we include the following variables: year, month, site, flower count in the quadrat or around the pan trap, flower structure of the target flower (open or closed), broad habitat type, wind speed and amount of sunshine during the survey.

The graphs on the next two pages are plotted showing the counts (or species richness) estimated by the model (on the y axis) for each year (the x axis). Each graph shows the trend in average number of insects counted as a solid line and the associated uncertainty as shaded areas (95% confidence interval).

A FIT Count survey - recorders collect information on environmental factors such as flower abundance, habitat type and weather conditions during the survey which can be included in models to account for variation in insect numbers



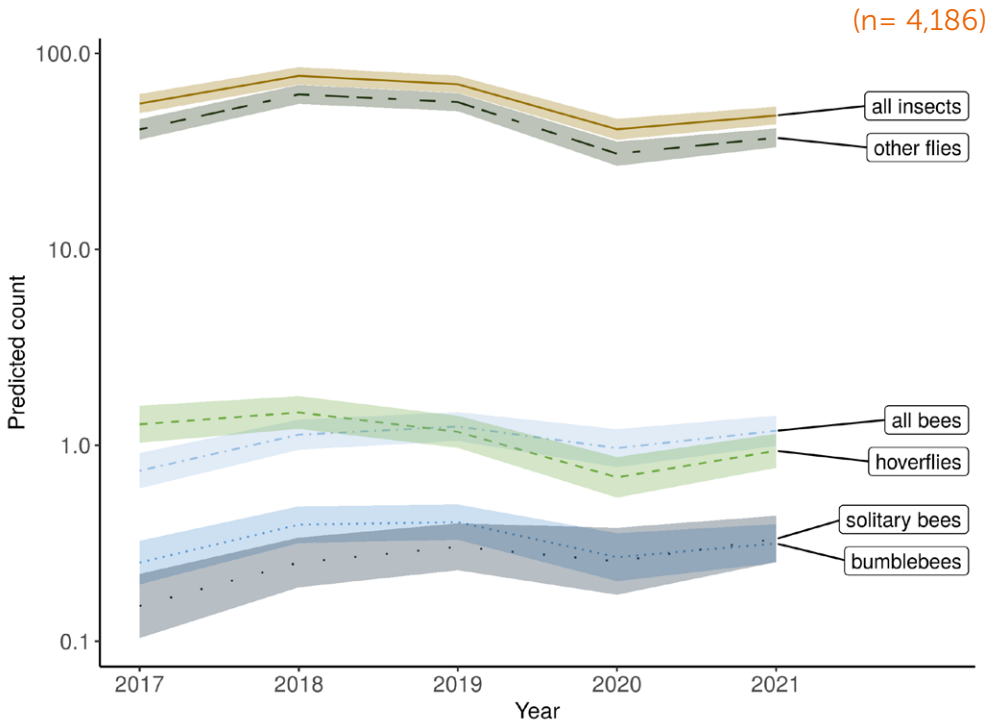
a) Insect abundance per 10-minute count from the public FIT Counts



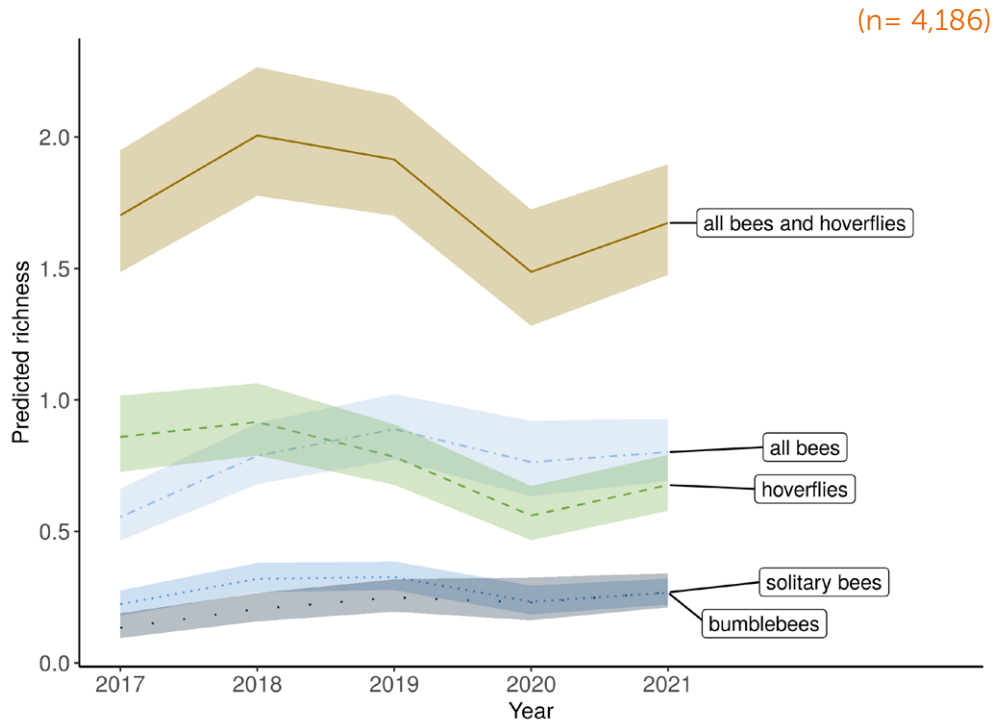
b) Insect abundance per 10-minute count from the 1 km FIT Counts

Figure 7 a,b. Results showing predicted counts from statistical models on PoMS FIT Count datasets between 2017/2018 and 2021

Note: where predicted counts are shown, numbers on the y axis represent the predicted number of insects per FIT Count or trap station, plotted on a log-10 scale to allow presentation of the overall trend alongside trends for each insect group.



c) Insect abundance per pan trap station



d) Richness of bee and hoverfly species per pan trap station

Figure 7 c, d. Results showing predicted counts and species richness from statistical models on PoMS pan trap datasets between 2017 and 2021

Note: where predicted counts are shown, numbers on the y axis represent the predicted number of insects per FIT Count or trap station, plotted on a log-10 scale to allow presentation of the overall trend alongside trends for each insect group. Species richness is plotted on a normal scale.

Overall, we see pollinator numbers fluctuating across the 5 years of PoMS to date (Figure 7 a-d). However, given the large uncertainty and high inter-annual variability typical of insect numbers, it is difficult to make definitive statements about overall changes, and we should be cautious about interpreting these plots in terms of general declines or increases in insect abundance or richness over this 5-year period. As we collect more data in the next few years we will be able to detect longer-term trends in insect numbers beyond annual fluctuations.

Estimated counts from the FIT Counts (Figure 7 a, b) show the relative numbers of bumblebees, hoverflies, honeybees and solitary bees to be similar between the public and 1 km square surveys. This suggests that despite the lower overall levels of expertise in insect group identification among the public FIT Count recorders, and the large proportion of counts carried out in gardens, they are capturing a similar picture of the flower-visiting insect community to those counts carried out in the wider countryside across the 1 km square network.

Emerging effects of explanatory variables

Some patterns of interest have emerged from the environmental variables included in the models so far, suggesting that these additional measures collected by PoMS volunteers will prove important in interpreting the data.

From FIT Counts:

- The number of floral units in a FIT Count quadrat has a positive effect on number of insects seen, across all groups.
- Overall, more insects (and hoverflies in particular) are recorded visiting 'open' structure flowers, such as Hogweed and Bramble, than 'closed' structure flowers, but bumblebee numbers are higher on 'closed' flowers with long flower tubes, such as Lavender and Dead-nettle.
- Bumblebees and solitary bees tend to be more abundant on FIT Counts in gardens than in countryside locations (although this may reflect the high number of garden counts on Lavender within our sample).
- More insects are counted on FIT Counts where the quadrat is 'entirely in sunshine' and when there is just a light wind, and fewest where the quadrat is entirely shaded and/or in windier conditions.
- Flower patches that are more or less isolated from other flowers tend to have lower numbers of insect visitors on FIT Counts than those patches that are within a larger patch of flowers.

Hoverflies and other flies, seen here on Hogweed (*Heracleum sphondylium*), are recorded in higher numbers on flowers with 'open' than 'closed' structure

From PoMS pan traps:

- The number of insects sampled does not appear to be significantly affected by the number of flowers (measured as floral units) surrounding the pan trap (within 2 m).
- Overall insect abundance and abundance of bumblebees and hoverflies in the pan traps increased through the season to a peak in August. For the solitary bees, abundance was highest in May, gradually decreasing towards September, as we would expect given that many solitary bee species have spring flight periods.
- Our models suggest that there are differences in abundance of some insect groups sampled in pan traps in 1 km squares dominated by agriculture vs. squares dominated by semi-natural habitats. Further research will explore the extent of these differences and whether changes are occurring at different rates in the two landscape types.

What's next?

Importantly, patterns of change in total numbers of bumblebees or hoverflies likely hide fluctuation in the status of individual species. Currently the most comprehensive data on species-level changes are available from the BeeWalk transect scheme (Bumblebee Conservation Trust[7]) and the UK Biodiversity Indicator for pollinating insects[8], both showing increasing and decreasing species, but with the Indicator suggesting that a greater proportion of bee and hoverfly species have decreased than increased in their distribution since 1980. As the PoMS dataset grows, species-level changes in abundance can be modelled with species for which sufficient data have been collected.

A more detailed set of tabulated model results and technical description has been shared with the PoMS Steering group for review, and will be submitted this year for publication in a scientific journal. The methodology presented here is to be considered experimental at this point and the models are still exploratory and therefore subject to change in future reports. We are also developing metrics to report on percentage changes in insect numbers (with uncertainty), where possible at country level, in line with other surveys such as the UK Butterfly Monitoring Scheme[9], Breeding Bird Survey[10] and Bugs Matter citizen science survey[11]. We are committed to promoting an understanding of approaches to robust scientific monitoring and ensuring that PoMS outputs are scientifically valid in order to support evidence-based decision-making in the future.

The technical details

We use generalised linear mixed models with a negative binomial distribution to model counts and/or richness of different insect groups. The effect of year is modelled as a natural spline with two degrees of freedom for the public FIT counts (only four years of data) and three degrees of freedom for the 1 km FIT counts and pan trap data. We include a random effect for site for FIT Counts and a nested random effect for pan trap station within 1 km square for the pan tap data, to account for between site variation in insect numbers that is not accounted for by the variables in the model. The counts presented in the plots are estimated marginal means from the final model, which are averaged over all levels of the categorical variables in the model and weighted by the number of observations within each level, with continuous variables kept at the mean.

Species highlights from the PoMS 1 km square survey

The PoMS 1 km survey uses pan traps to record insects in a consistent way, gathering quantitative data on species abundance for hoverflies and bees. The survey is not designed to focus on rare species, but it is always interesting to find the occasional unusual species among the more widespread ones. Because many PoMS trap locations are in the 'wider countryside', away from nature reserves, they can add to our knowledge of species distribution in areas that may be under-recorded. Here, Martin Harvey (UKCEH) highlights four of the rarer species from the 1 km square surveys in 2022.

Dusky-horned Nomad Bee, *Nomada bifasciata*, and White-bellied Mining-bee, *Andrena gravida*

The Dusky-horned Nomad Bee was first found in Britain by Steven Falk, in Kent in 2018. "Nomad" bees in genus *Nomada* look rather like wasps, but are actually parasitic bees that lay their eggs in the burrows of other solitary bees. On hatching the nomad bee larva kills the egg or larvae of the host bee, and then feeds on the nectar and pollen provisions intended for the host larva (this behaviour is known as cleptoparasitism). The Dusky-horned Nomad Bee lays its eggs in the burrows of the White-bellied Mining-bee, itself a rare species confined to the south-east of England.

There are still very few British records of this nomad bee, which was recorded along with its host species from PoMS pan traps in Kent in 2022. The host *Andrena* bee has been expanding its range in recent years, and it seems likely that the *Nomada* bee will follow it. White-bellied Mining-bee likes open habitats where it can find bare ground in which to construct its burrows, and visits a wide range of flowers (on the continent it is an effective pollinator of orchard trees). More information is available on the BWARS website[12].

Nomada bifasciata

Andrena gravida

Pinewood Mason Bee, *Osmia uncinata*

One of two similar mason bees that are restricted to the Scottish Highlands. The Pinewood Mason Bee is found among pinewoods that have open clearings and rides. The female collects pollen from Bird's-foot Trefoil flowers, and they also visit Broom and Bilberry. Females make use of empty beetle burrows in pine trees, constructing multiple cells within the burrow using leaf pulp and laying an egg in each cell.

This bee was recorded from the PoMS 1 km survey for the first time in 2022 at one of the Scottish sites within its known range. More information and some fascinating images of the nesting burrows is available on the BWARS website[13].

Aspen Leaf Licker hoverfly, *Xylota tarda*

The hoverfly genus *Xylota* contains a number of species that are rarely seen visiting flowers, and instead they gather honeydew (the sweet sticky substance that aphids produce) and pollen grains from leaf surfaces, hence them being given the "leaf licker" name.

The Aspen Leaf Licker is a widespread in the UK but rarely encountered. Its larvae have been found in sap runs on Aspen tree trunks, and the adult hoverflies are also most often found near Aspens. A PoMS record from Scotland in 2022 is the first time it has been found as part of the 1 km square survey. More information is available on the Hoverfly Recording Scheme website[14].

Species data from the PoMS 1 km square surveys has been shared with BWARS and with the Hoverfly Recording Scheme, who collate records from many sources in order to add to our knowledge of these species. This in turn feeds in to other analyses and reviews, including a current project that Hymettus is undertaking to review the conservation status of bees in the UK. The PoMS species data is making a significant contribution to this work.

> *PoMS records have helped expand the known modern range of several species by providing high quality data from a number of under-sampled, often remote, regions.*
>
> • *Rowan Edwards, Hymettus*

Osmia uncinata

Xylota tarda

A volunteer's view from the field

Reflections from PoMS volunteer John Wells on his Cambridgeshire square and FIT Counts in Orkney and mainland Shetland with ex-Service voluntary ornithologists.

I first saw the PoMS adverts in correspondence from the British Trust for Ornithology (BTO). The head of surveys, Dawn Balmer, had contacted me to ask if I would be interested in helping as a volunteer for UKCEH. I had no previous experience of identifying insects other than knowing the major species groups but have completed the Wider Countryside Butterfly Survey (WCBS) since 2014. So I had some, albeit basic, experience of flying pollinators such as bees, wasps, hoverflies etc.

My PoMS square

In the spring of 2017 I was trained to set out the pan traps by UKCEH ecologist Nadine Mitschunas who was friendly and helpful, and very patient with an 'ageing aircraft techie' like myself!

Last year, one pan-trap just happened to be in a game cover strip of quinoa, sunflowers and maize. That crop was fun! Getting the post and pan-traps set with no space for a rucksack, or to kneel down, being rather cramped and toppling over at least twice had me giggling to myself! Other fun bits have been the cattle visitors to the trap at the edge of the farm track. Cattle often come and see what you are up to. This can be a little off-putting if you have not worked with cattle so always check with the farmer beforehand and make sure there's no bull amongst the ladies or if in any doubt, as per the PoMS guidance notes, re-locate your pan trap station out of reach of livestock.

FIT Counts in the Northern Isles

In the summer of 2018, my other main conservation interest, ornithology, took me to Eday, an outlier Island in Orkney with Royal Air Force Ornithological Society (RAFOS) and I jumped at the chance to do some FIT Counts there. It was a real treat to have the extra daylight hours of the Simmer Dim (midnight sun), which meant I got six good FIT Counts achieved. What was extra special, was seeing the Great Yellow Bumblebee (*Bombus distinguendus*),

John in his PoMS square

which has a restricted range to only a few areas in the North of Scotland and the Outer Isles. I have since researched, but I did not know that at that time.

Seabirds and pollinators

During 2019 RAFOS continued in our support to The Seabird Group on The Seabird Survey. This work took us to the Shetland Isles and participating in both the seabird census and PoMS, meant that I could add FIT Counts on the northern mainland of Shetland at Voxter House, an outward-bound centre near Bray. In the sheltered garden we undertook supplementary FIT counts, which added even more data for the UK PoMS team for, at that time, 'The most northerly FIT count in Britain', a small, but worthy claim to fame.

As I write this (December 2022), the 2022 survey period has closed, but I feel committed to continue my support as a surveyor in my region of East Anglia. I feel lucky, such that I was granted access to partake, learn and commit to the max; four counts / days per year at Conington village near St Ives, Cambs. I understand from the PoMS team that there remain available several random stratified 1 km PoMS squares open to keen hobbyists as volunteers; like myself. Please do consider it and contact poms@ceh.ac.uk. From my background as a 'birder' and keen wildlife supporter it shows you do not have to be a fully experienced or qualified entomologist to add value to this important monitoring scheme.

© John Wells

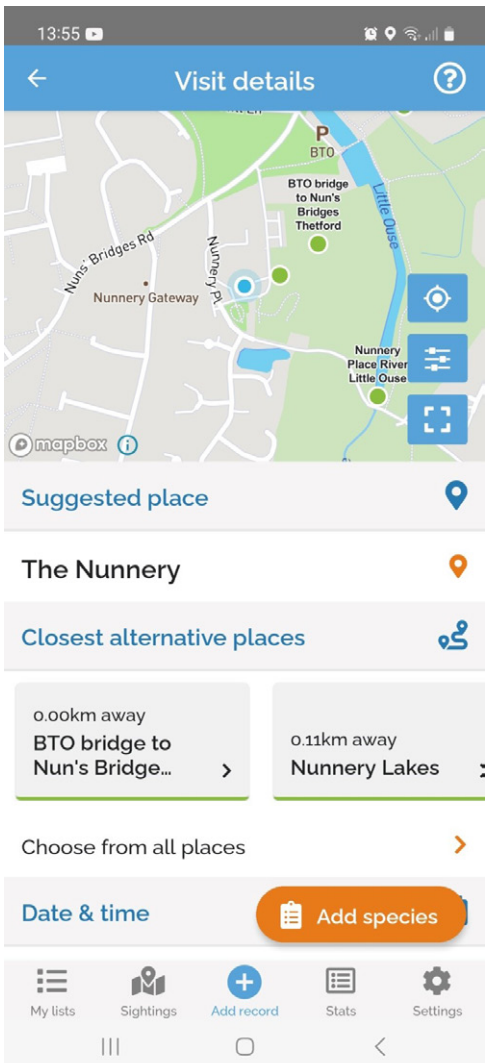
Great Yellow Bumblebee feeding on *Escallonia* flowers on Eday, Orkney

© Maggie Lentz unsplash.com

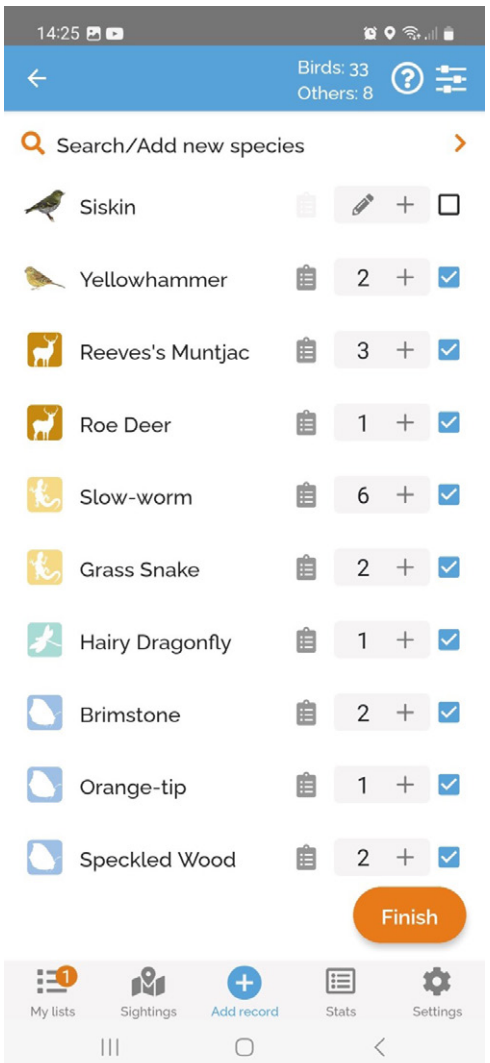
PoMS partner perspectives - promoting PoMS to birdwatchers

Dawn Balmer, Head of Surveys at the British Trust for Ornithology shares the ways in which our partners BTO have promoted PoMS and other opportunities for insect recording through their various surveys.

Many birdwatchers increasingly dabble in other taxa, especially butterflies and dragonflies. Our volunteers can record mammals and butterflies on their BTO/JNCC/RSPB Breeding Bird Survey squares as part of their annual breeding season surveys and volunteers taking part in Garden BirdWatch can record a host of common non-bird species in their weekly submissions. We've updated the BirdTrack app for mobile phones so that butterflies, orchids, mammals, dragonflies and amphibians and reptiles can now be recorded in BirdTrack alongside birds. Indeed, some BTO volunteers have turned into full pan-species listers! These 'non-bird' records collected by BirdTrack flow to the relevant recording scheme through a specially built link in iRecord.



The BirdTrack mobile app allows for a variety of taxa to be recorded alongside birds



Luisella Planeta Leoni via Pixabay.com

With this in mind, we know that some of our regular volunteers and members will have the skills and enthusiasm to take part in the Pollinator Monitoring Scheme. We promoted the Flower-Insect Timed (FIT) Counts to our Garden BirdWatchers through their quarterly magazine Bird Table, and to our BirdTrack volunteers through the monthly e-news, and to everyone that subscribes to the BTO e-news. We also provided information about the FIT Counts and the PoMS 1 km squares to our BTO Regional Network of over 350 volunteers. We have used social media to promote the surveys and have also promoted PoMS at local conferences by displaying posters. We're planning some online training on invertebrates for our Garden BirdWatchers later in the spring which we hope will give some the confidence to go on to contribute to FIT Counts. Find out more about the planned training through the Garden BirdWatch e-news[15].

John Wells, one of our keen BTO/RSPB/JNCC Wetland Bird Survey and BTO/JNCC/RSPB Breeding Bird Survey volunteers (and other surveys) has taken on a 1 km square and has also been carrying out FIT Counts in Orkney and Shetland whilst up there counting seabirds! (pages 22-23) Whilst there are some birdwatchers out there who are skilled and feel confident enough to take part, many still see identifying insect groups as a challenge. PoMS has produced excellent guides to insect groups and flowers that can be used, together with helpful videos on YouTube. BTO will continue to promote PoMS in 2023, and we have made a special effort to promote the 1 km square survey to our Regional Network in Wales.

PoMS on tour

The PoMS team always enjoys the chance to spread the word about pollinators and monitoring, whether in person or online. Here are some of the events we've been involved in over the last year.

We celebrated the start of the 2022 survey season with an online webinar as part of the **Field Studies Council's BioLinks** series. This gave an overview of PoMS and introduced some initial analysis of the data that has been collected. The webinar is available to view via YouTube: *Polling the pollinators*.

More celebrations were in the air for an event helping to promote **PoMS in Northern Ireland**. In June DAERA (the Department of Agriculture, Environment and Rural Affairs who are delivering PoMS in NI) hosted a workshop led by Richard Dawson and Ryan Mitchell to take participants through the methods for FIT Counts and the newly-established 1 km square survey. Read more on the PoMS website: *PoMS takes off in Northern Ireland*.

The same month Bumblebee Conservation Trust and RSPB were promoting pollinator conservation and demonstrating FIT Counts at the **Groundswell Regenerative Agriculture Festival**, in Hertfordshire, where we will have a PoMS presence again in 2023.

In July we took part in two research tours at the **Fruit Focus show**, an event for the fruit industry held at the NIAB crop science centre in Kent. Insects play a vital role in the pollination of fruit crops, and

Helen Bostock, RHS © RHS

Nadine and Claire demonstrating a FIT Count on Knapweed with staff at RHS Wisley

> *Being connected to nature is good for our wellbeing, and we've shown that can come from 'mindful moments' in nature, but can also come from taking part in citizen science, such as the PoMS FIT Counts*
>
> • *Michael Pocock, 2022*

Claire Carvell © UKCEH

as part of PoMS the team at University of Reading have been trialling the use of FIT Counts for monitoring pollinators in these crops – see *FIT counting crops* on the PoMS website. The same month saw the PoMS team visit **RHS Wisley** to give talks and demonstrate FIT Counts in the garden context, while our PoMS partner colleagues from Reading carried out FIT Counts for Defra's **Bees' Needs Week** at the amazing Superbloom site at the Tower of London, supported by Historic Royal Palaces and Pollinating London Together.

In September Claire Carvell spoke at **Shaping the Future for Pollinators – Innovations in Farmed Landscapes**, a conference organised by the Association of Applied Biologists with the British Ecological Society and Royal Entomological Society. Later that month there was a large gathering of pollinator projects and people at the **Big Buzz** conference, organised by the Cumbria Wildlife Trust, who have carried out some very successful work to promote habitat management for pollinators in their region. A wide range of presentations came from projects across the country. Ellen Lamborn and Richard Dawson ran a lively workshop on the PoMS surveys, and alongside this Morag McCracken gave a presentation on some of the other research carried out by UKCEH on the effects of agri-environment schemes on pollinator populations, while Martin Harvey and Gordon Port ran a workshop on species recording, including a focus on the **North East Bee Hunt** project. Talks and workshops can be seen via the Wildlife Trust's *Big Buzz* on YouTube.

Throughout the year the **Nature isn't Neat** project has been working with communities in Monmouthshire to support conservation of pollinators, and Richard Dawson was engaged to work on the project and encourage uptake of the PoMS surveys. For more on this project, including some helpful resources on pollinators, see *Nature isn't Neat*. And finally, Buglife have been running a number of online and in-person pollinator identification workshops and FIT Count sessions in connection with the **B-lines project** (more on the Buglife website).

While UK PoMS has engaged with several thousand people in one way or another, and received valuable pollinator data in return, a recent study led by colleagues at UKCEH took a different angle to evaluate the impact of taking part in citizen science on people's well-being and connection to nature[16]. FIT Counts were one of three nature-based activities featured in the study. The results showed that when compared with a control group, people participating in all three activities (individually or in combination) increased in nature connectedness, happiness and satisfaction with life.

Follow us on Twitter @PoMScheme for the most up-to-date information on events linking with PoMS.

PoMS abroad

PoMS is having an impact outside of the UK through exciting collaborations with researchers across the globe.

PoMS team members have been involved in two large collaborative projects to design and test approaches to national-scale pollinator monitoring beyond the UK. The SURPASS project[17] is a partnership between Argentina, Brazil, Chile and the UK to develop knowledge, build capacity and define tangible actions for monitoring, conservation and sustainable use of pollinators in South America. An initial consultation with a range of stakeholders identified timed observations of insects visiting flowers as a tangible method to prioritise for large-scale monitoring of a range of pollinator groups. Hence, we worked with teams in each country to adapt the FIT Count app which is now launched in Brazil and is set for release in Argentina and Chile within the coming year.

Closer to home, staff at UKCEH and the University of Reading are part of a large consortium of researchers under the SPRING project[18] (Strengthening Pollinator Recovery through INdicators and monitoring). SPRING is funded by the European Commission and supports preparation for implementation of the EU Pollinator Monitoring Scheme (EU PoMS) for wild bees, butterflies, hoverflies and moths using volunteer and professional recorders.

Eduardo Zattara

Claire observing bees on Dandelion in Patagonia (2018). Dandelion has been selected as a target flower across all countries adopting the FIT Count app

Bruno Albertini

Colleagues in Brazil trialling the FIT Count mobile app

A protocol similar to the UK PoMS 1 km survey is being trialled, using both pan traps and transect walks, and the FIT Count app is being translated and adapted by several member states. This could help standardise monitoring of pollinator numbers more widely and create an unparalelled global dataset of flower-insect interactions.

If you find yourself visiting Ireland, Cyprus, Sweden, Germany, Croatia, Luxembourg or Portugal and insects are on the wing, go to the "Settings" page of the app to find the range of countries and languages available this season!

For us in Brazil, a country of continental geographic extension and huge biodiversity, the translation of the FIT Count app to Portuguese and the selection of target flowers, types of habitat and insect groups that suit our context is extremely important. We were very excited about having an app that would allow us to systematize data collection in different regions and answer research questions that are of interest to our public. The partnership with the UK app development team was very productive and we are confident that those who use the app will learn about the pollinators of our country and contribute, directly or indirectly, to their conservation.

- *Natalia Pirani Ghilardi Lopes, Federal University of ABC, São Paulo, Brazil*

Plants for pollinators

If you are into wildlife gardening you might be interested in these three open access papers, reviewed by Nadine Mitschunas, UKCEH ecologist and PoMS field survey lead who was also winner of the BBC Gardeners' World 'Garden of the Year 2021' competition for her fabulous wildlife allotment gardens!

Attractiveness of ornamental cultivars to pollinators

The first paper by Rollings and Goulson (2019) assessed the attractiveness of 111 different ornamental plant cultivars for pollinators. The plants were grown in 1 m^2 plots in a nursery in South Oxfordshire and assessed over a 5-year period for visiting pollinators such as bees, hoverflies, butterflies and other insects. The authors found that there was an enormous variation in the number of insects the different plant cultivars attracted. *Calamintha nepeta* (Catmint) attracted the most insects, mainly honeybees, while *Silene dioica* (Red Campion) attracted no insects at all while being observed. Other good plants for pollinators were *Echium vulgare* (Vipers Bugloss) and *Verbena bonariensis* (Argentinian Vervain). Some plants such as *Eryngium planum* (Sea Holly) were visited by a high diversity of different insect groups while other plants such as *Sedum spectabilis* (Ice Plant) were mainly visited by honeybees. Interestingly, the total number of pollinators was not significantly different for native and non-native plants but native plants attracted a higher diversity of pollinators.

Wildflowers and bees

The second study by Nichols *et al.* (2019) looked at wildflower species and how attractive they are to bees. The study was carried out at Emorsgate Seeds©, Manor Farm near Bath, UK. In total, 45 different wildflowers were assessed and of these *Crepis capillaris* (Smooth Hawksbeard), *Taraxacum* agg. (Dandelion) and *Geranium pratense* (Meadow Cranesbill) had the greatest diversity of different bees visiting. At the opposite end *Silene vulgaris* (White Campion), *Veronica chamaedrys* (Germander Speedwell), and *Viola arvensis* (Field Pansy) were not visited by any bees during the surveys. *Campanula rotundifolia* (Harebell) and *Tripleurospermum inodorum* (Scentless Mayweed) attracted rarer solitary bees while *Sinapis arvensis* (Charlock) and *Chaerophyllum temulum* (Rough Chervil) were visited by a wide variety of solitary bees. The best wildflowers in the study for bumblebees were *Anthyllis vulneraria* (Kidney Vetch) and *Geranium pratense*.

© Nadine Mitschunas

Bombus terrestris (Buff-tailed bumblebee) male on *Eryngium planum* (Sea Holly)

© Martin Harvey

Solitary bee, *Osmia bicolor* male, on Dandelion

The need to keep pollinator-friendly plant lists up-to-date

The third study by Anderson *et al.* (2020) compared a list of plants most visited by bumblebees recorded by volunteers in a large citizen science programme called BeeWatch, which was run by PoMS partners at the Bumblebee Conservation Trust, with commonly available pollinator-friendly plant lists. The study found that while there is a certain agreement between the lists studied, there are also some marked differences such as *Lavandula angustifolia* (Lavender) being the most popular plant in the BeeWatch surveys and plants such as *Deutzia* spp. (Japanese Snow Flower) and *Agapanthus* spp. (African Lily) which were visited by bumblebees in the BeeWatch surveys not appearing in any of the other lists at all.

As the FIT Count surveys gather more observations of insects visiting a range of flowers from gardens and beyond, PoMS can help build a clearer picture of the plants providing for pollinators and how these may change over time.

Featured papers

Rollings, R. & Goulson, D. J. **Quantifying the attractiveness of garden flowers for pollinators.** Journal of Insect Conservation 23: 803–817 (2019)[19]

Nichols, R.N., Goulson, D. & Holland, J.M. **The best wildflowers for wild bees.** Journal of Insect Conservation 23, 819–830 (2019)[20]

Anderson, H.B., Robinson, A., Siddharthan, A. *et al.* **Citizen science data reveals the need for keeping garden plant recommendations up-to-date to help pollinators.** Scientific Reports 10, 20483 (2020)[21]

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Thank you

The UK PoMS Partnership

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The members of the PoMS Steering Group in 2022 were Paul Woodcock (JNCC), Pauline Campbell (DAERA), Paul Simpson (Defra), Athayde Tonhasca and Jim Jeffrey (NatureScot), Kathleen Carroll (Welsh Government), Una Fitzpatrick (All-Ireland Pollinators Plan), Susanna Phillips (Natural England), Fiona Highet (Science and Advice for Scottish Agriculture), Rachel Richards (Buglife) and Sophia Ratcliffe (National Biodiversity Network).

The UK PoMS team

Martin Harvey is the PoMS co-ordinator at UKCEH and the first point of contact for queries via the poms@ceh.ac.uk email. Claire Carvell is the project manager for PoMS, also based at UKCEH Wallingford and responsible for strategic direction, overseeing delivery of the surveys, data management and reporting, and liaising with JNCC and other partners. Nadine Mitschunas leads the field team with Chris Andrews and Angus Garbutt, and Francesca Mancini leads on statistical analysis of PoMS data, with Robin Hutchinson working on data management and communications. Other UKCEH team members are Nick Isaac, Lucy Ridding, Marc Botham and Helen Roy, and our partners are represented by Richard Comont (BBCT), Richard Fox and Megan Lowe (BC), Dawn Balmer and Rob Jaques (BC), Rowan Edwards (Hymettus), Mike Garratt and Simon Potts (Reading University), Bill Kunin (Leeds University) and Alfried Vogler (Natural History Museum).

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PoMS

UK Pollinator Monitoring Scheme

UK Pollinator Monitoring Scheme (2023).
The UK PoMS Annual report 2022
UK Centre for Ecology & Hydrology and
Joint Nature Conservation Committee

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The UK PoMS partnership

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Hymettus

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