Pollinating London Together (PLT) Report of Pollinator and Habitat Surveys 2024

AUTHOR:
Dr Konstantinos Tsiolis

SURVEYORS:
Dr Konstantinos Tsiolis
George Allen
Joris Rockx

CHAIR OF PLT SCIENCE GROUP:
Dr Heather Barrett-Mold OBE

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John Burton (appolinted Jan 2021)

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Andrew Gibb
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Gillian Taylor
Dr Konstantinos Tsiolis
Gemma Waugh

This report aims to:

1. Summarise the outcome of the surveys.
2. Help guide plans.
3. Inform landowners.
4. Use the report as a basis for the press release.

Abstract

Urbanisation significantly impacts the presence, abundance, and distribution of flower-visiting insects worldwide. Although urban green spaces can provide beneficial habitats for many pollinators, the quality of these habitats, as well as the availability of food and nesting resources for pollinating insects in the City of London, has not been thoroughly researched. In 2024, a survey was conducted across 45 green spaces, including roof gardens and ground-level gardens, to assess pollinator diversity, abundance, and the resources available for pollinators. The most abundant groups of recorded pollinators were honeybees (37%), bumblebees (25%), solitary bees (15%), and hoverflies (11%). The survey identified 48 species of bees, 27 species of hoverflies, 8 species of butterflies, and 5 species of moths. The top three plant genera attracting the most insect visits were *Salvia*, *Achillea*, and *Nepeta*. In terms of the highest diversity of pollinating insects, the leading plant genera were *Erigeron*, *Achillea*, and *Geranium*. Most wild bees recorded during the survey were cavity nesters (93%), reflecting the availability of natural cavities in the City of London. Enhancing the variety of food and nesting resources in the City of London could improve the diversity of flower-visiting insects, which is essential for sustainable pollination services.

Introduction

Pollinators are contributing greatly to plant reproduction, food production and security (Ollerton et al. 2011; Ollerton 2021), considering that 87.5% of plant species and 75% of agricultural crops globally are animal-pollinated (Klein et al. 2007; Ollerton et al. 2011). The annual market value of this service is estimated at £180–442 billion worldwide (Potts et al. 2016). Given the importance of the ecosystem services they provide, conservation of pollinators should be considered a high priority for promoting human welfare and maintaining functioning ecosystems (Potts et al. 2010; Potts et al. 2016). However, climate change and various anthropogenic impacts on nature, such as agricultural expansion, fragmentation, urbanisation and habitat loss, are recognised as some of the leading causes of pollinator decline worldwide (Potts et al. 2010; Dicks et al. 2021; Millard et al. 2021; Teixido et al. 2022).

The expansion of human settlements drives urbanisation, leading to heat island effects, the introduction of non-native species, pollution, and habitat loss and fragmentation (Harrison & Winfree 2015; Liu et al. 2016; Wenzel et al. 2020). Urbanisation can significantly affect pollinator abundance and diversity, adversely affecting plant reproduction (Bennett et al. 2020; Millard et al. 2021; Teixido et al. 2022). Nevertheless, studies in the literature show that urban greenspaces could support a considerable diversity of plants and animals (Sandström et al. 2006; Aronson et al. 2017). Urban greenspaces often have a high availability of nesting and food resources, particularly for pollinators (Hall et al. 2017; Baldock et al. 2019). Recent reviews indicate that urbanisation might have a lesser negative effect on generalist pollinators (Wenzel et al. 2020; Silva et al. 2021) and a stronger negative effect on specialist pollinators, such as species with specific food resources and habitat requirements (Spotswood et al. 2021). Urban greenspaces vary considerably in the availability of microhabitats, food resources, management practices, and structural complexity; therefore, the provision of habitat for wildlife and maintenance of biodiversity also vary significantly (e.g. Aronson et al. 2017; Gomes et al. 2023).

It is the third season (2022, 2023, 2024) of PLT flower-visiting insect surveys and the fifth season of habitat surveys, as described below. These two aspects have been brought together in the surveys and this report. Four rounds of surveys – 1) early spring, 2) late spring, 3) early summer, 4) late summer – took place at 45 sites (see Fig. 1 and Appendix 2) in 2024 to gather data on the diversity and abundance of pollinators and pollinator-friendly plants in the City of London. Thirty-five of the sites were ground-level gardens, and ten were roof gardens. Sites were chosen to vary in size, shape, plant species and general habitat quality. This report explores the findings of 2024 season.

Methods

The following methodology was used:

1. The number of transects per site was decided according to the diversity of flowering plants and the size of a given site. The same number of transects per site were undertaken across the season. The length of each transect was approximately 10 metres, and the width was 1 metre.
2. The approximate percentage cover of flowering plants, green, and bare ground per transect was recorded.
3. Flowering plants were identified at genus level, the percentage cover of plant genus in the transect was recorded, and the number of floral units was recorded using the Baldock et al. (2015) methodology.
4. A 2-minute pollinator survey was carried out per transect, the timer being stopped whenever recording and potting specimens. Bees (including honeybees), hoverflies, butterflies, and moths were identified at the species level, and other flies, beetles, and wasps were identified at the group level. Pollinators were only recorded if they landed on flowers, and plants visited by each pollinator were also recorded at the genus level to help us understand the plant preferences of various pollinator groups/species.

5. A 10-minute break followed to allow disturbed pollinators to return to the transect area, and another 2-minute pollinator survey was undertaken.
6. Each site was assessed, and scores were given for the availability of pollinator-friendly planting, nesting resources, use of pesticides, monitoring of the site, and pollinator diversity recorded at the site (see Appendix 1). Scores and recommendations on improving the site for pollinators were provided wherever necessary. Individual reports for the greenspaces reviewed were shared with the greenspace managers (Appendix 1).

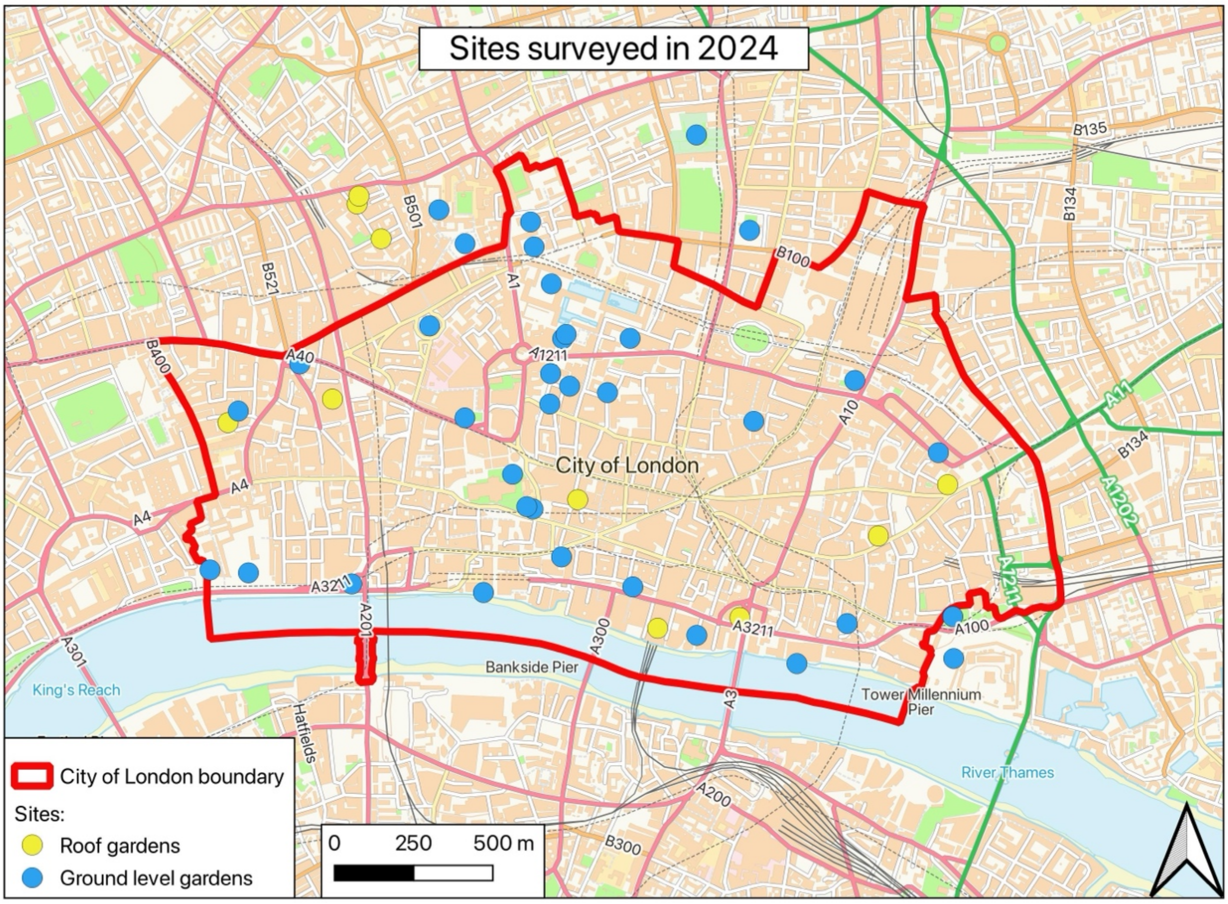

Figure 1: Map of surveyed sites in 2024. Blue markers are for ground-level gardens, and yellow markers are for roof gardens.

Results

Flower-visiting insects of the City of London

A total of 3,448 flower-visiting insects were recorded in the City of London during the four rounds of surveying in 2024. Thirty-five per cent of recorded pollinators were honeybees, 25% bumblebees, 15% solitary bees, 11% hoverflies, 7% other flies, 3% wasps, 1% beetles, < 1% butterflies, and < 1% moths. This includes the honeybee, 8 bumblebee species, 39 solitary bee species, 27 hoverfly species, 8 butterfly species, and 5 moth species. The overall abundance of recorded pollinators across sites is presented in Figure 2, and a list of species is presented in Table 1 below.

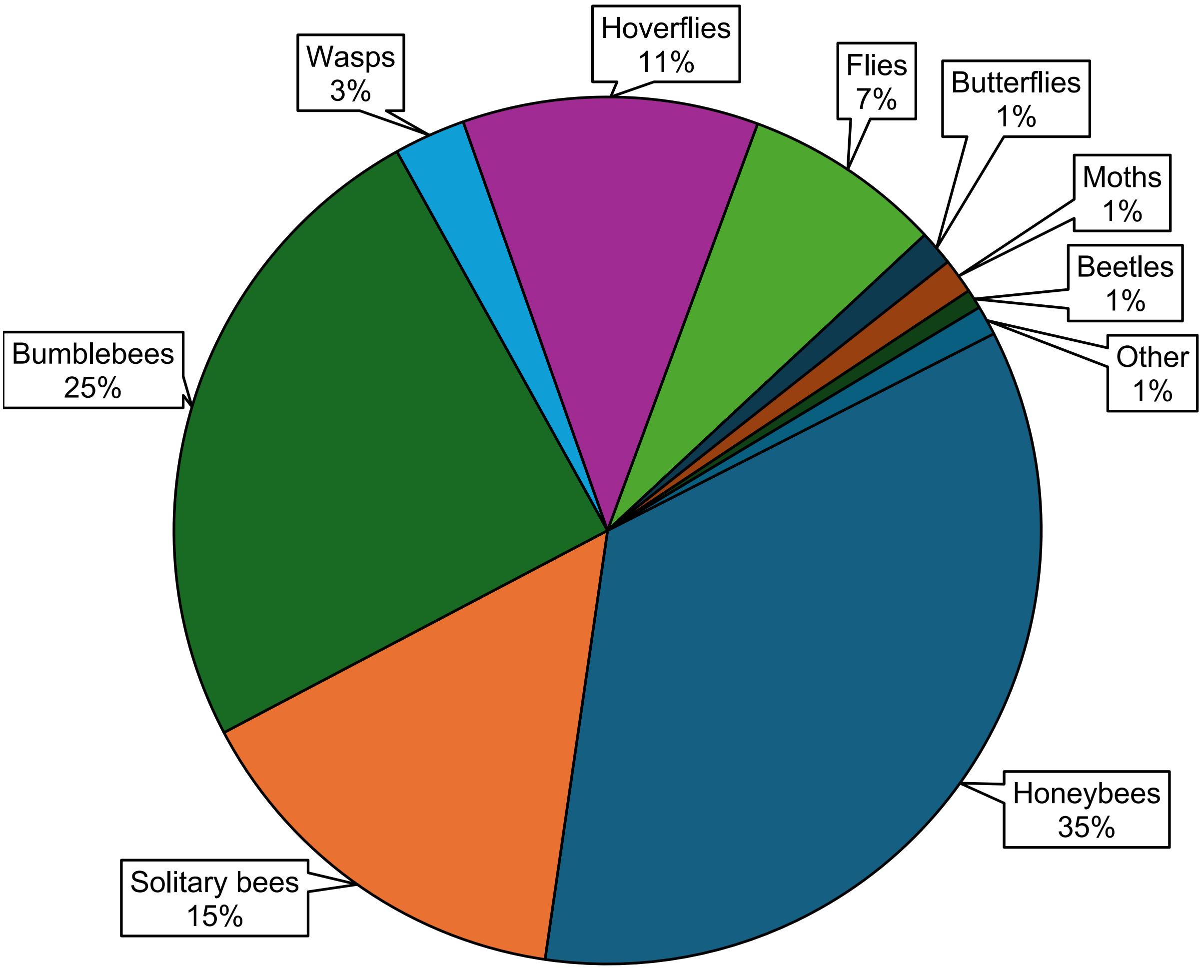

Figure 2: Abundance of main insect pollinator groups recorded in 2024 in the City of London.

Table 1: List, abundance and percentage of genera/species based on the total records of insect pollinators recorded in 2024 in the City of London.

Flower-visiting species/groups	Group ID	Abundance	%
Apis mellifera	Honeybee	1,199	34.77
Bombus lucorum agg.	Bumblebee	408	11.83
Bombus pascuorum	Bumblebee	356	10.32
Fly	Fly	256	7.42
Syritta pipiens	Hoverfly	139	4.03
Hylaeus communis	Solitary bee	109	3.16
Wasp	Wasp	90	2.61
Myathropa florea	Hoverfly	60	1.74
Lasioglossum smeathmanellum	Solitary bee	60	1.74
Episyrphus balteatus	Hoverfly	48	1.39
Lasioglossum morio agg.	Solitary bee	47	1.36
Lasioglossum calceatum/albipes	Solitary bee	41	1.19
Bombus pratorum	Bumblebee	38	1.10

Pyrausta aurata	Moth	38	1.10
Other	Other	38	1.10
Bombus terrestris	Bumblebee	36	1.04
Solitary bee	Solitary bee	33	0.96
Eristalis arbustorum	Hoverfly	32	0.93
Hylaeus hyalinatus	Solitary bee	31	0.90
Pieris rapae	Butterfly	27	0.78
Beetle	Beetle	23	0.67
Osmia bicornis	Solitary bee	23	0.67
Anthidium manicatum	Solitary bee	22	0.64
Anthophora quadrimaculata	Solitary bee	22	0.64
Eristalis tenax	Hoverfly	20	0.58
Eupeodes corollae	Hoverfly	20	0.58
Sphaerophoria scripta	Hoverfly	15	0.44
Anthophora plumipes	Solitary bee	15	0.44
Lasioglossum spp.	Solitary bee	14	0.41
Megachile willughbiella	Solitary bee	12	0.35
Megachile centuncularis	Solitary bee	11	0.32
Lasioglossum morio	Solitary bee	10	0.29
Colletes daviesanus	Solitary bee	8	0.23
Andrena nitida	Solitary bee	6	0.17
Pieris brassicae	Butterfly	5	0.15
Bombus humilis	Bumblebee	5	0.15
Andrena nigroaenea	Solitary bee	5	0.15
Vanessa atalanta	Butterfly	4	0.12
Eupeodes luniger	Hoverfly	4	0.12
Melanostoma scalare	Hoverfly	4	0.12
Merodon equestris	Hoverfly	4	0.12
Volucella inanis	Hoverfly	4	0.12
Coelioxys elongata	Solitary bee	4	0.12
Melitta haemorrhoidalis	Solitary bee	4	0.12
Nomada ruficornis	Solitary bee	4	0.12
Pararge aegeria	Butterfly	3	0.09
Bombus hortorum	Bumblebee	3	0.09
Helophilus pendulus	Hoverfly	3	0.09
Platycheirus scutatus	Hoverfly	3	0.09
Scaeva pyrastri	Hoverfly	3	0.09
Sphaerophoria spp.	Hoverfly	3	0.09
Vollucela zonaria	Hoverfly	3	0.09
Andrena haemorrhoa	Solitary bee	3	0.09
Anthophora furcata	Solitary bee	3	0.09
Osmia caerulescens	Solitary bee	3	0.09
Celastrina argiolus	Butterfly	2	0.06
Polygonia c-album	Butterfly	2	0.06
Chrysolina americana	Beetle	2	0.06
Bombus hypnorum	Bumblebee	2	0.06

Criorhina ranunculi	Hoverfly	2	0.06
Eupeodes bucculatus	Hoverfly	2	0.06
Heringia spp.	Hoverfly	2	0.06
Syrphus ribesii	Hoverfly	2	0.06
Choreutis nemorana	Moth	2	0.06
Dragonfly	Other	2	0.06
Andrena bicolor	Solitary bee	2	0.06
Andrena flavipes	Solitary bee	2	0.06
Chelostoma campanularum	Solitary bee	2	0.06
Megachile lapponica	Solitary bee	2	0.06
Nomada flava	Solitary bee	2	0.06
Nomada panzeri	Solitary bee	2	0.06
Osmia leaiana	Solitary bee	2	0.06
Xestia c-nigrum	Moth	2	0.06
Xestia xanthographa	Moth	2	0.06
Pieris napi	Butterfly	1	0.03
Vanessa cardui	Butterfly	1	0.03
Bombus lapidarius	Bumblebee	1	0.03
Cheilosia caerulescens	Hoverfly	1	0.03
Eristalis pertinax	Hoverfly	1	0.03
Eumerus funeralis/strigatus	Hoverfly	1	0.03
Melangyna spp.	Hoverfly	1	0.03
Platycheirus nielseni	Hoverfly	1	0.03
Syrphus vitripennis	Hoverfly	1	0.03
Xanthogramma pedissequum	Hoverfly	1	0.03
Cydalima perspectalis	Hoverfly	1	0.03
Ant	Other	1	0.03
Andrena florea	Solitary bee	1	0.03
Andrena nigrospina	Solitary bee	1	0.03
Andrena scotica	Solitary bee	1	0.03
Andrena spp.	Solitary bee	1	0.03
Andrena tibialis	Solitary bee	1	0.03
Anthophora bimaculata	Solitary bee	1	0.03
Lasioglossum leucozonium	Solitary bee	1	0.03
Megachile ligniseca	Solitary bee	1	0.03
Melecta albifrons	Solitary bee	1	0.03
Nomada fulvicornis	Solitary bee	1	0.03
Nomada goodeniana	Solitary bee	1	0.03
Nomada zonata	Solitary bee	1	0.03
Ectemnius ruficornis	Wasp	1	0.03
Gasteruption jaculator	Wasp	1	0.03
	Total	3,448	

Flower-visiting insects in roof gardens

A total of 842 flower-visiting insects were recorded on roof gardens during the four rounds of surveying in 2024. Forty-nine per cent of recorded pollinators were honeybees, 27% bumblebees, 11% solitary bees, 4% hoverflies, 5% other flies, 3% wasps, < 1% beetles, < 1% moths, and 1% butterflies. This includes the honeybee, 15 solitary bee species, 5 bumblebee species, 10 hoverfly species, 4 butterfly species, and 1 moth species. The overall abundance of recorded rooftop pollinators is presented in Figure 3, and a list of species is presented in Table 2 below.

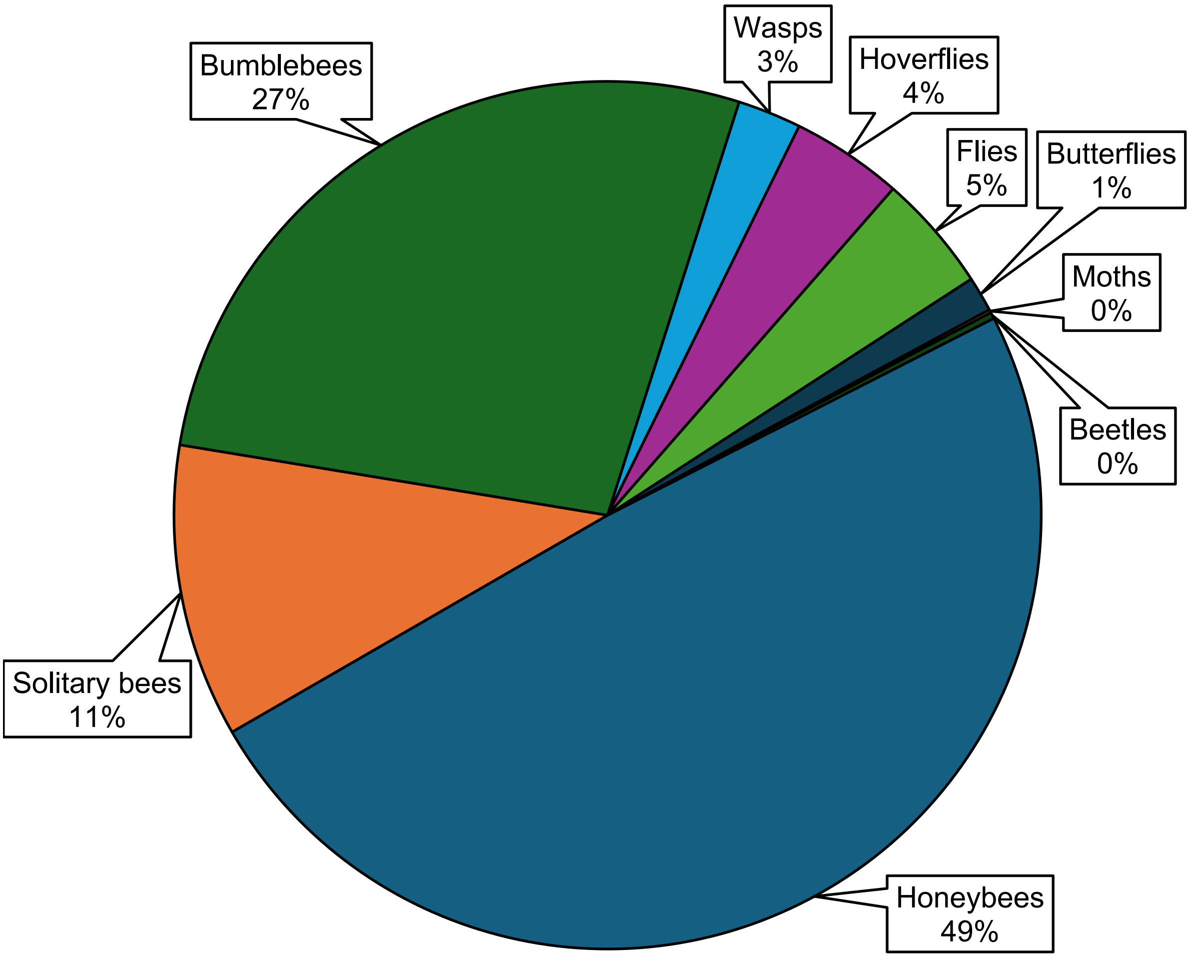

Figure 3: Abundance of main insect pollinator groups recorded in 2024 on rooftops in the City of London.

Table 2: List of flower-visiting species/groups genera and species recorded in 2024 on rooftops in the City of London.

Flower-visiting species/groups	Group ID	Abundance	%
Apis mellifera	Honeybee	414	49.17
Bombus lucorum agg.	Bumblebee	144	17.10
Bombus pascuorum	Bumblebee	74	8.79
Fly	Fly	37	4.39
Hylaeus communis	Solitary bee	20	2.38
Wasp	Wasp	20	2.38
Lasioglossum smeathmanellum	Solitary bee	15	1.78
Hylaeus hyalinatus	Solitary bee	10	1.19
Bombus terrestris	Bumblebee	9	1.07
Eupeodes corollae	Hoverfly	8	0.95
Syritta pipiens	Hoverfly	8	0.95
Anthophora quadrimaculata	Solitary bee	8	0.95
Osmia bicornis	Solitary bee	8	0.95
Pieris rapae	Butterfly	7	0.83
Episyrphus balteatus	Hoverfly	7	0.83
Lasioglossum calceatum/albipes	Solitary bee	6	0.71
Anthidium manicatum	Solitary bee	4	0.48
Lasioglossum morio	Solitary bee	4	0.48
Lasioglossum morio agg.	Solitary bee	4	0.48
Eristalis tenax	Hoverfly	3	0.36
Beetle	Beetle	2	0.24
Bombus pratorum	Bumblebee	2	0.24
Pararge aegeria	Butterfly	2	0.24
Eristalis arbustorum	Hoverfly	2	0.24
Eupeodes luniger	Hoverfly	2	0.24
Sphaerophoria scripta	Hoverfly	2	0.24
Andrena haemorrhoa	Solitary bee	2	0.24
Andrena nitida	Solitary bee	2	0.24
Anthophora furcata	Solitary bee	2	0.24
Anthophora plumipes	Solitary bee	2	0.24
Megachile willughbiella	Solitary bee	2	0.24
Bombus humilis	Bumblebee	1	0.12
Pieris brassicae	Butterfly	1	0.12
Vanessa cardui	Butterfly	1	0.12
Merodon equestris	Hoverfly	1	0.12
Sphaerophoria spp.	Hoverfly	1	0.12
Volucella inanis	Hoverfly	1	0.12
Pyrausta aurata	Hoverfly	1	0.12
Andrena nigroaenea	Solitary bee	1	0.12
Anthophora bimaculata	Solitary bee	1	0.12
Lasioglossum spp.	Solitary bee	1	0.12
	Total	**842**	

Pollinator-friendly planting

Pollinators were recorded on 71% of flowering plants in the City of London. Two hundred and twenty-one plant genera were visited by pollinating insects. See Table 3 below, which shows the top 10 and 100 plant genera for pollinator visits and species/groups. Assessments of pollinator-friendly planting in the 45 surveyed sites suggest that 38.25 % (SE = ± 3.58) of planting in the City of London is pollinator-friendly.

Table 3: Top 10 and 100 plant genera for pollinator visits (left) and pollinator species/groups (right) of plants recorded in 2024 in the City of London.

	Plant	Visits	Plant	No. of species/groups
Top 10	***Salvia***	**249**	***Erigeron***	**25**
	Achillea	**153**	***Achillea***	**24**
	Nepeta	**153**	***Geranium***	**23**
	Geranium	**143**	***Pentaglottis***	**21**
	Erigeron	**107**	***Aster***	**20**
	Verbena	**94**	***Salvia***	**18**
	Aster	**89**	***Leucanthemum***	**17**
	Lavandula	**84**	***Veronica***	**17**
	Bistorta	**68**	***Nepeta***	**16**
	Rudbeckia	**66**	***Ranunculus***	**14**
11	*Leucanthemum*	55	*Rosa*	14
12	*Abelia*	52	*Eurybia*	13
13	*Echium*	52	*Ceanothus*	12
14	*Rosa*	50	*Dasiphora*	12
15	*Eriocapitella*	49	*Rudbeckia*	12
16	*Eurybia*	49	*Calendula*	11
17	*Pentaglottis*	49	*Campanula*	11
18	*Origanum*	46	*Allium*	10
19	*Hydrangea*	41	*Bellis*	10
20	*Veronica*	39	*Lavandula*	10
21	*Campanula*	37	*Lysimachia*	10
22	*Centaurea*	37	*Verbena*	10
23	*Linaria*	36	*Centaurea*	9
24	*Allium*	32	*Eriocapitella*	9
25	*Stachys*	32	*Scabiosa*	9
26	*Hebe*	30	*Silene*	9
27	*Teucrium*	30	*Abelia*	8
28	*Ranunculus*	28	*Bistorta*	8
29	*Bellis*	27	*Ceratostigma*	8
30	*Bupleurum*	27	*Deutzia*	8
31	*Ceanothus*	27	*Eschscholzia*	8

32	*Clinopodium*	27	*Hydrangea*	8
33	*Dasiphora*	26	*Jacobaea*	8
34	*Euphorbia*	26	*Linaria*	8
35	*Limonium*	26	*Mentha*	8
36	*Cirsium*	25	*Stachys*	8
37	*Hylotelephium*	25	*Teucrium*	8
38	*Ceratostigma*	24	*Valeriana*	8
39	*Symphyotrichum*	23	*Agastache*	7
40	*Valeriana*	23	*Astrantia*	7
41	*Lysimachia*	22	*Camassia*	7
42	*Symphytum*	22	*Echium*	7
43	*Cosmos*	21	*Euphorbia*	7
44	*Agapanthus*	19	*Glebionis*	7
45	*Agastache*	19	*Hebe*	7
46	*Malva*	19	*Origanum*	7
47	*Scabiosa*	19	*Senecio*	7
48	*Calendula*	18	*Sonchus*	7
49	*Coreopsis*	18	*Antirrhinum*	6
50	*Hedera*	18	*Bupleurum*	6
51	*Persicaria*	18	*Choisya*	6
52	*Alstroemeria*	17	*Cirsium*	6
53	*Astrantia*	17	*Clinopodium*	6
54	*Callianthe*	16	*Coreopsis*	6
55	*Caryopteris*	16	*Helminthotheca*	6
56	*Digitalis*	16	*Hibiscus*	6
57	*Echinacea*	16	*Hylotelephium*	6
58	*Eschscholzia*	16	*Picris*	6
59	*Fuchsia*	16	*Symphyotrichum*	6
60	*Jacobaea*	16	*Ageratum*	5
61	*Buddleja*	14	*Aralia*	5
62	*Glebionis*	14	*Euonymus*	5
63	*Kniphofia*	14	*Geum*	5
64	*Polygala*	14	*Hedera*	5
65	*Veronicastrum*	14	*Lamium*	5
66	*Ageratum*	13	*Lobularia*	5
67	*Mentha*	13	*Lotus*	5
68	*Oenothera*	13	*Persicaria*	5
69	*Picris*	13	*Phlomis*	5
70	*Pseudodictamnus*	13	*Primula*	5
71	*Trifolium*	13	*Pyracantha*	5
72	*Antirrhinum*	12	*Thymus*	5
73	*Deutzia*	11	*Aloysia*	4
74	*Echinops*	11	*Brachyglottis*	4

75	*Melissa*	11	*Buddleja*	4
76	*Silene*	11	*Caryopteris*	4
77	*Sonchus*	11	*Cleome*	4
78	*Camassia*	10	*Cornus*	4
79	*Cephalaria*	10	*Cosmos*	4
80	*Cynara*	10	*Dahlia*	4
81	*Eupatorium*	10	*Digitalis*	4
82	*Lamium*	10	*Echinacea*	4
83	*Lobularia*	10	*Erodium*	4
84	*Philadelphus*	10	*Erysimum*	4
85	*Solidago*	10	*Helianthus*	4
86	*Thymus*	10	*Knautia*	4
87	*Tithonia*	10	*Kniphofia*	4
88	*Aralia*	9	*Limonium*	4
89	*Ballota*	9	*Penstemon*	4
90	*Choisya*	9	*Philadelphus*	4
91	*Helianthus*	9	*Pseudodictamnus*	4
92	*Hibiscus*	9	*Solidago*	4
93	*Lotus*	9	*Succisa*	4
94	*Lythrum*	9	*Symphytum*	4
95	*Senecio*	9	*Tanacetum*	4
96	*Succisa*	9	*Vernonia*	4
97	*Cornus*	8	*Agapanthus*	3
98	*Geum*	8	*Anthemis*	3
99	*Knautia*	8	*Armeria*	3
100	*Borago*	7	*Ballota*	3

Wildflowers in the moat at the Tower of London.

Does higher plant diversity reflect higher pollinator diversity?

The graphs below demonstrate that plant genera diversity significantly influences the diversity of pollinators in a given area (Figs 4, 5 and 6). High diversity of pollinator-friendly planting could result in a high diversity of pollinator species/groups and vice versa. Please note that the recorded plants were identified at the genus level, not the species level.

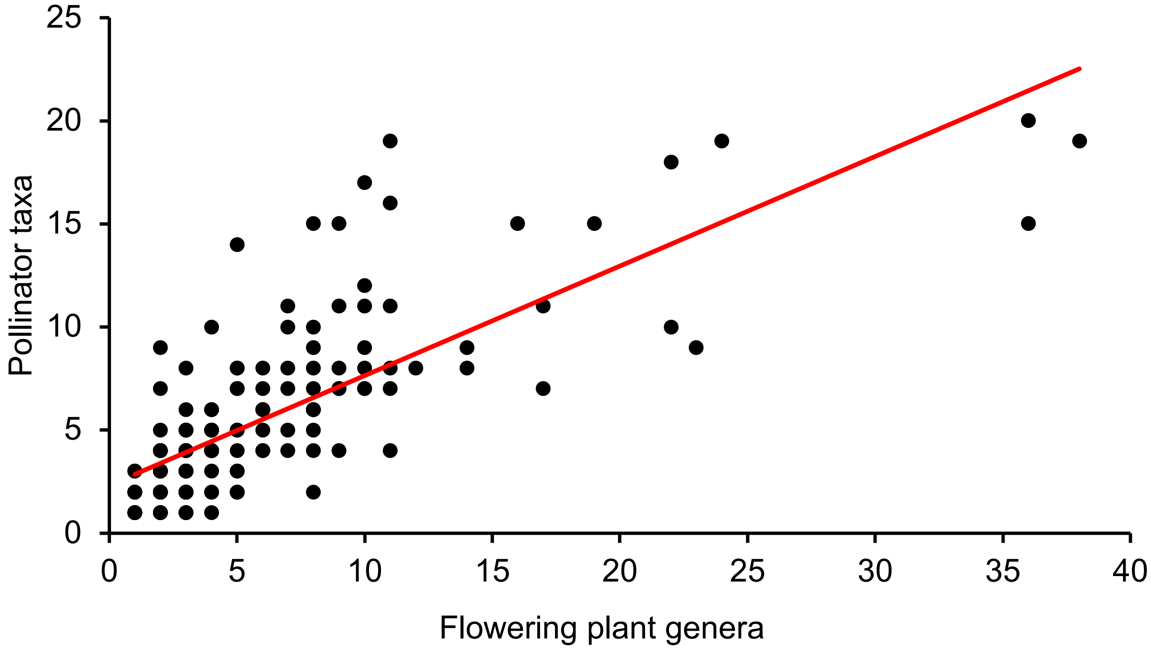

Figure 4: The graph shows a significant positive correlation (Spearman's rank correlation, r= 0.774, n= 156, p =<0.001) between flowering plant genera and recorded pollinator taxa.

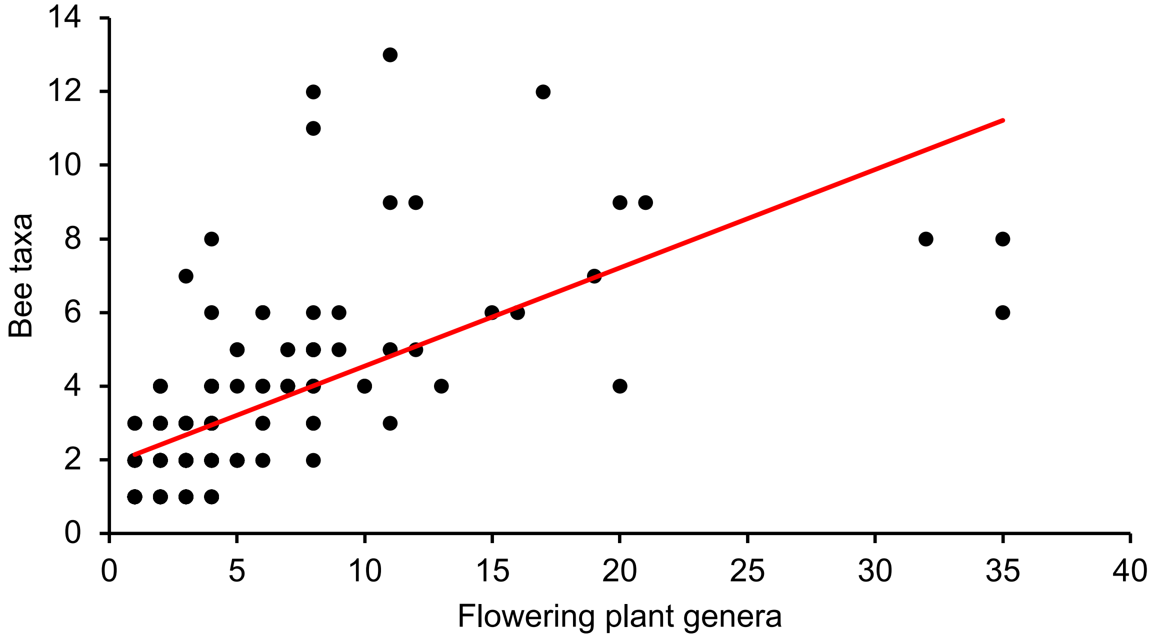

Figure 5: The graph shows a significant positive correlation (Spearman's rank correlation, r= 0.731, n= 151, p =<0.001) between flowering plant genera and bee taxa.

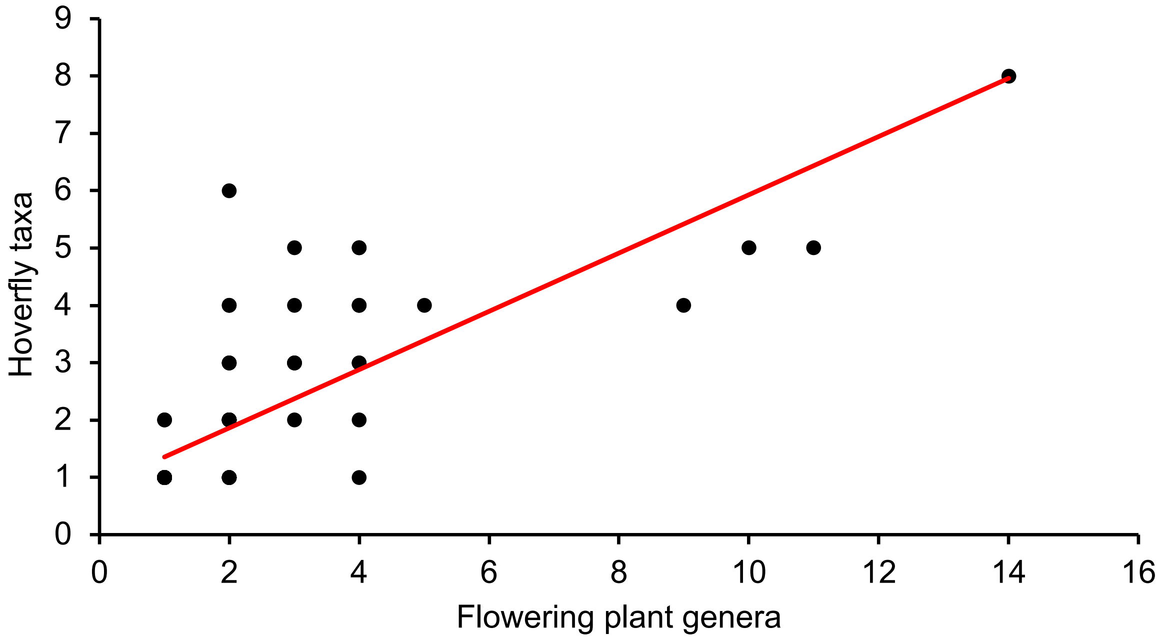

Figure 6: The graph shows a significant positive correlation (Spearman's rank correlation, r= 0.836, n= 85, p =<0.001) between flowering plant genera and hoverfly taxa.

Konstantinos netting a bee.

Bee nesting behaviours

A total of 1,254 non-cleptoparasitic wild bees (non-honeybees) were identified at species level. Of these, 93% were cavity nesters, while 7% were ground nesters (Table 4). An interesting observation was the wool-carder bee (*Anthidium manicatum*) nesting in the armrest of a wooden bench at Christchurch Greyfriars Church Garden (Fig. 13) since at least 2022.

Left: A wall cavity used by cavity-nesting bees. Right: The nest entrance of a ground-nesting bee.

A wool-carder bee (*Anthidium manicatum*) on *Stachys* spp.

Figure 13: Nests of wool-carder bee (*Anthidium manicatum*) in the armrest of a wooden bench at Christchurch Greyfriars Church Garden.

Figure 14: Barbican Wildlife Garden. Left: PLT bee hotel for cavity-nesting bees and mound of sandy loam bare soil for ground-nesting bees. Right: Solitary bee nesting in bee hotel.

Table 4: Bee nesting habits. Bee species were pulled out with their nesting habit as assigned by Stuart Roberts[1] in his traits database. **Carder** – Uses moss and dry grass to make the covering of the nest. **Renter** – Nests just below ground in old mammal burrows or in existing cavities of walls, plant stems, or wood. **Excavator** – Excavates burrows in soil (mining bees). Species accounts on the BWARS website (https://www.bwars.com/) were also checked, and any notable additional information was added (e.g. those that will utilise buildings/walls for nesting).

Species	Abundance	%	Nesting	Notes
Apis mellifera	1199	34.77	Renter: Existing cavities	Above ground – commercially in bee hives
Andrena bicolor	2	0.06	Excavator: Ground	Underground
Andrena flavipes	2	0.06	Excavator: Ground	Underground
Andrena florea	1	0.03	Excavator: Ground	Underground
Andrena haemorrhoa	3	0.09	Excavator: Ground	Underground
Andrena nigroaenea	5	0.15	Excavator: Ground	Underground
Andrena nigrospina	1	0.03	Excavator: Ground	Underground
Andrena nitida	6	0.17	Excavator: Ground	Underground
Andrena scotica	1	0.03	Excavator: Ground	Underground
Andrena tibialis	1	0.03	Excavator: Ground	Underground
Anthidium manicatum	22	0.64	Renter: Existing cavities	Hollow plant stems, masonry walls, soil
Anthophora bimaculata	1	0.03	Excavator: Ground	Underground
Anthophora furcata	3	0.09	Renter: Existing cavities	Above ground – Nest in rotten wood
Anthophora plumipes	15	0.44	Excavator: Ground	Vertical surfaces including masonry walls
Anthophora quadrimaculata	22	0.64	Excavator: Ground	Vertical surfaces including masonry walls
Bombus hortorum	3	0.09	Renter: Existing cavities	Underground
Bombus humilis	5	0.15	Carder	Above ground – Tall and open grasslands
Bombus hypnorum	2	0.06	Renter: Existing cavities	Above ground – Natural/artificial bird nests, small mammal nests
Bombus lapidarius	1	0.03	Renter: Existing cavities	Underground
Bombus lucorum agg.	408	11.83	Renter: Existing cavities	Underground
Bombus pascuorum	356	10.32	Carder	Above ground – Tall and open grasslands, under hedges/plant litter

Bombus pratorum	38	1.10	Renter: Existing cavities	Underground and above ground in natural/artificial bird nests
Bombus terrestris	36	1.04	Renter: Existing cavities	Underground
Chelostoma campanularum	2	0.06	Renter: Existing cavities	Above ground – Nest in pre-existing holes (e.g. woodworm) in dead wood
Coelioxys elongata	4	0.12	Cleptoparasite	Cuckoo bee
Colletes daviesanus	8	0.23	Excavator: Ground	Vertical surfaces including masonry walls
Hylaeus communis	109	3.16	Renter: Existing cavities	Above ground – Nest in a variety of natural and artificial cavities
Hylaeus hyalinatus	31	0.90	Renter: Existing cavities	Above ground – Nest in a variety of natural and artificial cavities
Lasioglossum calceatum/albipes	41	1.19	Excavator: Ground	Underground
Lasioglossum leucozonium	1	0.03	Excavator: Ground	Underground
Lasioglossum morio	10	0.29	Excavator: Ground	Underground
Lasioglossum smeathmanellum	60	1.74	Excavator: Ground	Vertical surfaces including masonry walls
Megachile centuncularis	11	0.32	Renter: Existing cavities	Above ground – Nest in wood, masonry walls
Megachile lapponica	2	0.06	Renter: Existing cavities	Above ground – Nest in dead wood and hollow stems
Megachile ligniseca	1	0.03	Renter: Existing cavities	Above ground – Nest in dead wood
Megachile willughbiella	12	0.35	Renter: Existing cavities	Aboveground – Nest in wood, masonry walls
Melecta albifrons	1	0.03	Cleptoparasite	Cuckoo bee
Melitta haemorrhoidalis	4	0.12	Excavator: Ground	Underground
Nomada flava	2	0.06	Cleptoparasite	Cuckoo bee
Nomada fulvicornis	1	0.03	Cleptoparasite	Cuckoo bee
Nomada goodeniana	1	0.03	Cleptoparasite	Cuckoo bee
Nomada panzeri	2	0.06	Cleptoparasite	Cuckoo bee
Nomada ruficornis	4	0.12	Cleptoparasite	Cuckoo bee
Nomada zonata	1	0.03	Cleptoparasite	Cuckoo bee
Osmia bicornis	23	0.67	Renter: Existing cavities	Above ground – Nest in a variety of natural and artificial cavities
Osmia caerulescens	3	0.09	Renter: Existing cavities	Above ground – Nest in a variety of natural and artificial cavities
Osmia leaiana	2	0.06	Renter: Existing cavities	Above ground – Nest in a variety of natural and artificial cavities

[1] Freelance Entomologist and Ecological Consultant

Case studies

A. Bunhill Fields Burial Ground

Bees and wasps were recorded nesting in decaying tree trunks at Bunhill Fields Burial Ground (Figs. 16, 17). This highlights the value of decaying wood in greenspaces, a valuable nesting resource for several flower-visiting insects (Ferro 2018). The harebell carpenter bee (*Chelostoma campanularum*) was nesting in high numbers in a decaying tree (Fig. 17). It is one of Britain's smallest bees and is known to nest in small-bore beetle burrows or woodworm-infested wood planks (Else & Edwards 2018). It feeds mainly on *Campanulaceae* but strongly prefers the harebell plant (hence its name), which was present at the site (Fig. 18).

Ground-nesting spring *Andrena* bee species have also been recorded nesting in the enclosed areas of the burial ground (see Fig. 15). The recorded species were *Andrena cineraria, Andrena nitida, Andrena haemorrhoa, Andrena scotica* and *Andrena nigroaenea*. These are apple-pollinating species (Hutchinson et al. 2021), and the value of solitary bees for UK apple pollination has been estimated at £51 million p.a. (Garratt et al. 2016). They are common species in the south-east of England but uncommon in the City of London, most likely due to a lack of suitable nesting habitats. Konstantinos found these *Andrena* species nesting in undisturbed, semi-shaded, semi-vegetated habitats in apple orchards during his PhD research (Tsiolis 2023) and such habitat is provided in abundance at this site due to vegetation growth during spring months and tree cover. However, recording nests of such species is challenging as they often nest under vegetation, and the tumuli (the volcano-shaped mounds of earth females make in the nest excavation phase) can be washed away or flattened after rainfall. One way to locate their nest is by following the bee when it returns loaded with pollen back to the nests or following the cleptoparasites (cuckoo bees). Ground-nesting bee species generally prefer nesting in south/south-east-facing bare ground with abundant sunlight (Sardiñas & Kremen 2014). These *Andrena* species seem to have different nesting preferences.

Nomad bees (*Nomada* spp.) have been observed flying just above vegetation (20–30cm) and diving into the vegetation when they locate a nest in the enclosed areas (see Fig. 15) of this site. The *Nomada* species, cleptoparasites (cuckoo bees) of *Andrena* species (mainly, not exclusively) are after their nests. *Nomada* species can locate nest cells at the provisioning phase. While the nest owners are out foraging, the female *Nomada* enters the nest and lays an egg inside the cell. Once the nest owner finishes stocking the cell, she lays her own egg and then seals the cell. When the cuckoo larva hatches, it feeds on the egg or young larvae of the host and uses the food resources for its own development (Falk 2016).

Interestingly, despite the high nesting activity of *Andrena* species, none were recorded feeding on plants at the site, which likely means they are getting their food resource from other nearby habitats. Three of these *Andrenids* (*Andrena nitida*, *Andrena* *haemorrhoa*, and *Andrena scotica*) were recorded on the rooftop of a five-storey building in south Islington feeding on firethorn (*Pyracantha* spp.).

Figure 15: Enclosed burial area at Bunhill Fields Burial Ground.

Figure 16: Nesting of predatory wasps in a decaying tree trunk (left) and wood dust from a nest excavation (right) at Bunhill Fields Burial Ground.

Figure 17: Nesting of *Chelostoma campanularum* in beetle/woodworm burrows in decaying tree trunk.

Figure 18: *Chelostoma campanularum* on *Sonchus* (left) and Campanula (right).

The three case studies below are sites where they followed recommendations provided by PLT in autumn 2023 on increasing diversity of food and nesting resources, and an increase in diversity of species (species richness and species evenness) of flower-visiting insects was recorded in 2024. Other factors driving these changes might have been related to weather conditions and changes to local habitat. They are not the only sites; there are just three examples.

B. Middle Temple

There has been an increase in the diversity of flower-visiting insects (Fig. 7) and a 67% increase in species richness at Middle Temple in 2024 compared to 2023. There has been an increase in the diversity of bumblebees, solitary bees and butterflies (Fig. 8) in 2024 compared to 2023.

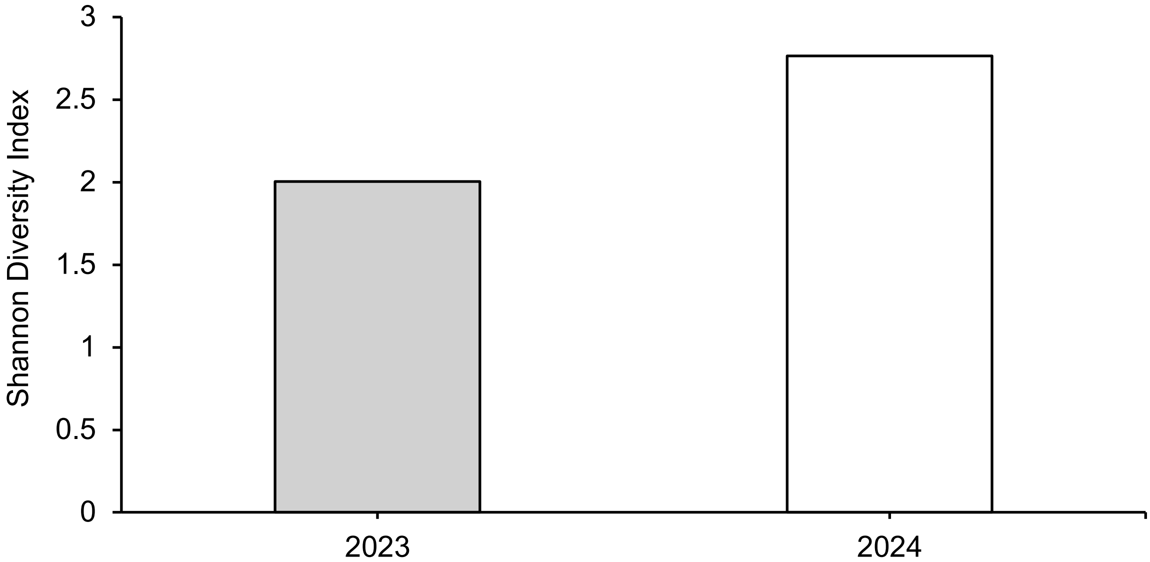

Figure 7: Bar plot of Shannon diversity index values demonstrating the diversity of flower-visiting insects recorded at Middle Temple in 2023 and 2024.

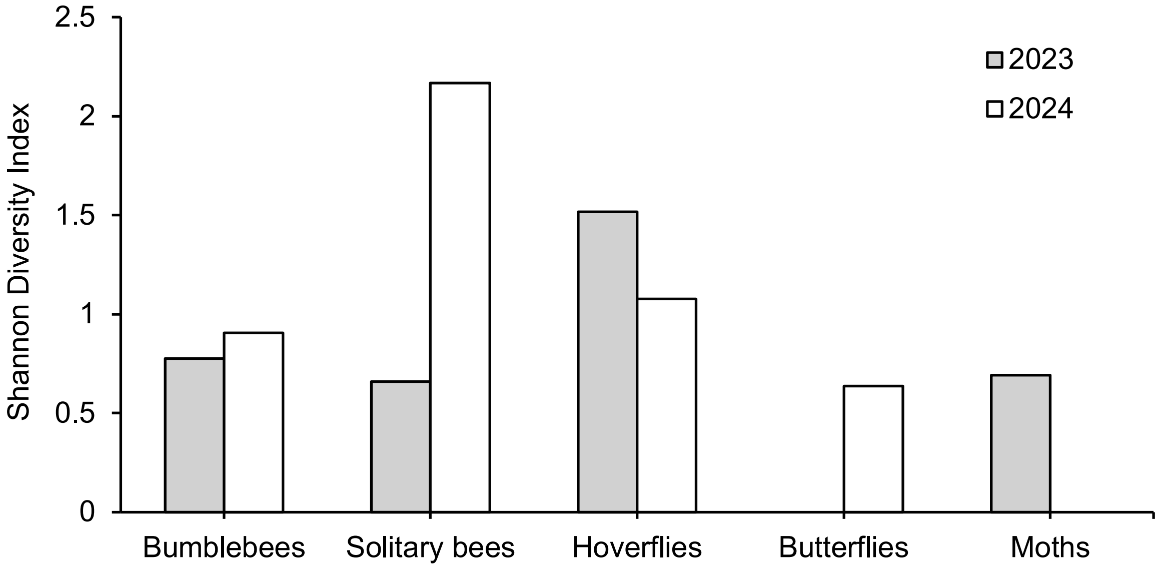

Figure 8: Bar plot of Shannon diversity index values demonstrating the diversity of bees, hoverflies, butterflies and moths recorded at Middle Temple in 2023 and 2024.

C. Barbican Wildlife Garden

There has been an increase in the diversity of flower-visiting insects (Fig. 9) and a 37% increase in species richness at Barbican Wildlife Garden in 2024 compared to 2023. There has been an increase in the diversity of bumblebees, solitary bees and hoverflies (Fig. 10) in 2024 compared to 2023.

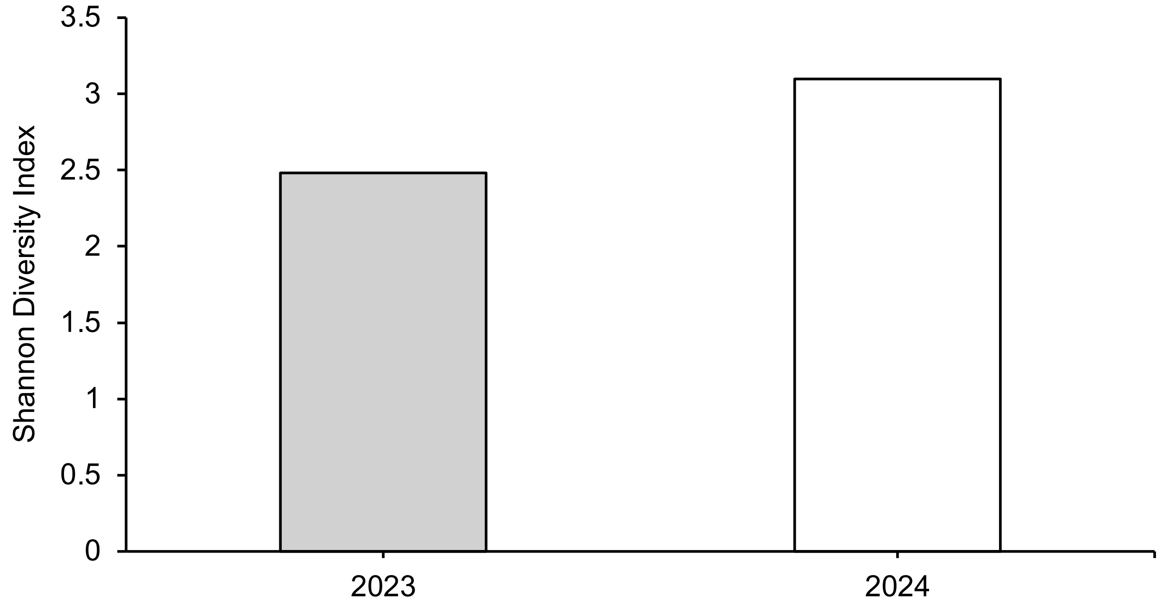

Figure 9: Bar plot of Shannon diversity index values demonstrating the diversity of flower-visiting insects recorded at Barbican Wildlife Garden in 2023 and 2024.

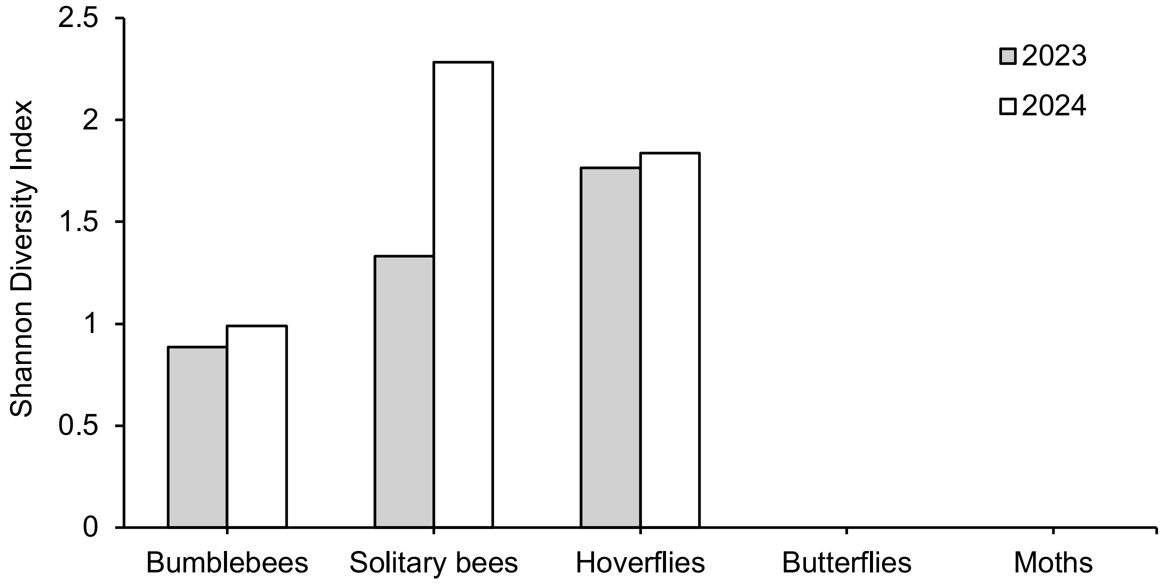

Figure 10: Bar plot of Shannon diversity index values demonstrating the diversity of bees, hoverflies, butterflies and moths recorded at Barbican Wildlife Garden in 2023 and 2024.

D. Charterhouse Gardens

There has been an increase in the diversity of flower-visiting insects (Fig. 11) and a 21% increase in species richness at Charterhouse Gardens in 2024 compared to 2023. There has been an increase in the diversity of bumblebees, solitary bees, hoverflies and butterflies (Fig. 12) in 2024 compared to 2023.

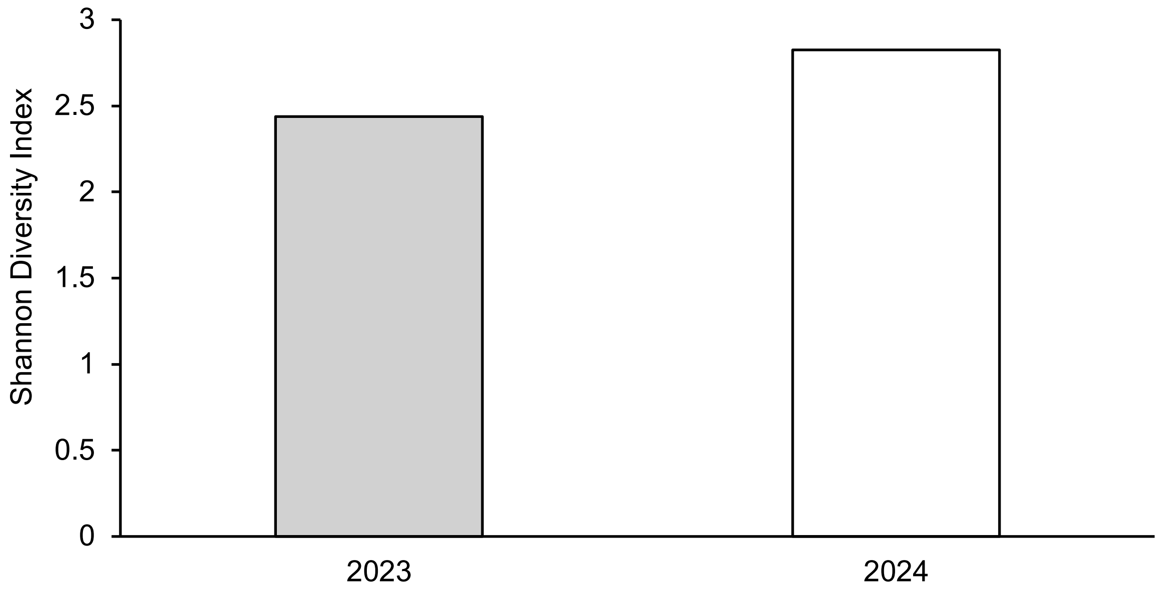

Figure 11: Bar plot of Shannon diversity index values demonstrating the diversity of flower-visiting insects recorded at Charterhouse Gardens in 2023 and 2024.

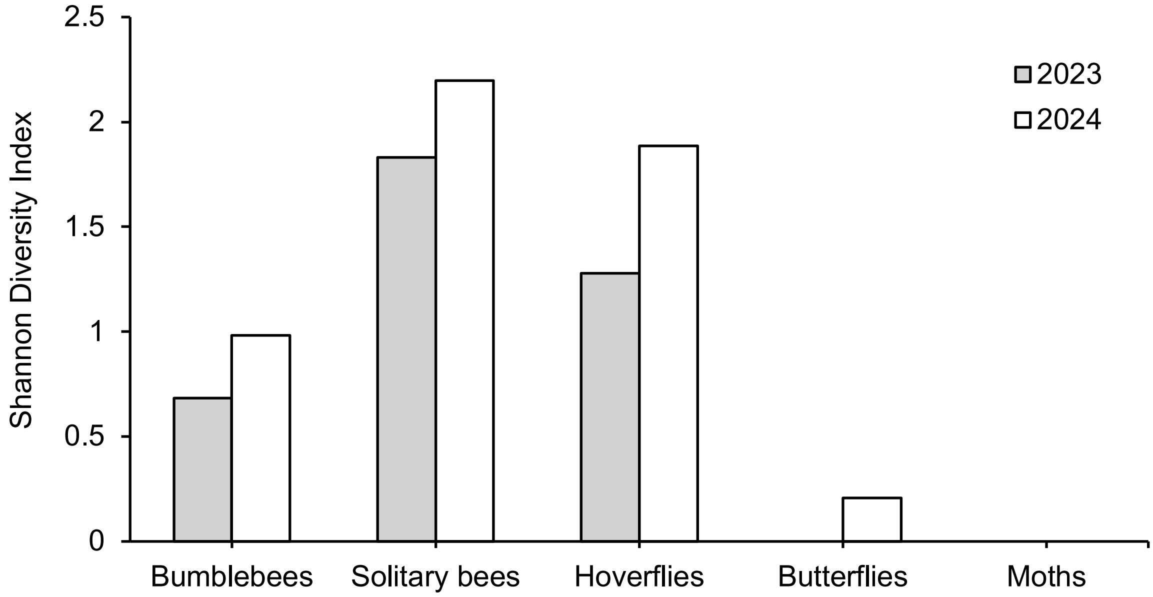

Figure 12: Bar plot of Shannon diversity index values demonstrating the diversity of bees, hoverflies, butterflies and moths recorded at Charterhouse Gardens in 2023 and 2024.

Discussion

Pollinator diversity in the City of London

A diversity of flower-visiting insects was recorded in the City of London, as shown in Table 1. While butterflies and moths are among the most visually appealing groups of pollinators, they were recorded in very abundance and diversity in the City of London (see Fig. 2 and Table 1). A possible explanation for this low abundance could be that most butterfly observations are made while they are in flight, whereas this study only recorded insects visiting flowers. Additionally, many moth species are nocturnal, and only a limited number of moth trap surveys were conducted in 2024. We plan to increase the number of nocturnal moth trap surveys in 2025.

Most people associate bee decline with honeybees and bumblebees, as they are often the only bees they know. Residents and businesses often assume they can help bees by purchasing a beehive for their garden or rooftop. This likely contributed to the accumulation of honeybee colonies in some urban areas, such as London. This study recorded honeybees in the City of London and nearby surveyed sites at 35% abundance of all recorded flower-visiting insects. Baldock et al. (2015) surveyed 12 UK cities in the UK and recorded honeybees on average at 11% in urban areas. Stevenson et al. (2020) have reported an unsustainable high number of beehives in Greater London, considering the availability of food resources. Recent studies highlight that a high abundance of honeybees in a given area can negatively impact wild bee populations (Henry & Rodet 2018; Renner et al. 2021; MacInnis et al. 2023; MacKell et al. 2023). There are around 270 bee species in the British Isles, and the honeybee (*Apis mellifera*) is only one of them (Else & Edwards 2018).

Honeybees are facing stresses such as ectoparasitic mites, vectored viruses and predators such as Asian hornets (Lin et al. 2024), yet they are not in decline globally, nor in the UK (Ollerton 2021). On the other hand, wild bees are in decline due to habitat loss, climate change, pesticide use, reduction in floral resources and the spread of parasites and pathogens from managed bee species (Potts et al. 2016; Janousek et al. 2023). Honeybees are valuable pollinators but not the answer to all pollination needs. The City of London Corporation states that "wild bees (bumblebees and solitary bees) are target species identified in the Biodiversity Action Plan. There is an over-proliferation of honeybees in the City, and beehives aimed at attracting or accommodating them should not be included in the design of development schemes" (City of London Corporation 2024). We need a diversity of bee species and other pollinators such as butterflies, hoverflies, beetles, and wasps to ensure the sustainability of pollination services (Senapathi et al. 2021). Urban areas could support a great diversity of insect pollinators. Baldock et al. (2015) found bee richness higher in urban areas than in farmland. Urban areas are expanding, and local authorities should focus on enhancing their habitat for pollinators. PLT aims to help inform suitable habitats for pollinators in urban areas and increase awareness of the importance of pollinators and their needs.

Pollinator-friendly planting

The relationship between plants and pollinators could be one of the most ecologically important interactions between animals and plants. Without pollinators, many plants could not set seed and reproduce. Without plants to provide nectar, pollen and other rewards, many animal populations would decline, and consequently, other species would be negatively impacted (Kearns et al. 1998; Ollerton et al. 2011). Of the plants available in the City of London at the time of surveying in 2024, a list of plants visited by flower-visiting insects is provided in this report, as well as a list of plants with the number of flower-visiting insect species/groups they support (Table 3). Plants were identified at the genus level, and variation may exist within recorded genera. Floral traits such as size, color, and nectar or pollen production can differ among plant species.

It is essential to provide abundant food resources for pollinators from March to October, not just for adults but also for the reproductive stages (larvae) of some pollinating insects such as butterflies. This study has shown that a high diversity of pollinator-friendly planting could reflect a high diversity of pollinating insect species. Neumann et al. (2024) also found flower richness positively correlated with pollinator diversity and abundance. A study in the south-west of England found that gardens can provide valuable food resources for farmland pollinators, especially in spring when farmland supplies are low; gardens could provide between 50% and 95% of nectar in farmland landscapes (Timberlake et al. 2024). Baldock et al. (2015) found that urban flower-visiting insects tend to forage from more plant species and visit a lower percentage of available plant species than in nature reserves and farmland, which could be explained by higher plant richness in urban areas.

Comma (*Polygonia c-album*) on *Aster* spp.

Green roofs

There has been an increase in green roofs in London since introducing the Living Roofs and Walls Policy into the London Plan Policy in 2008 (Gedge et al. 2008; Grant et al. 2019). An estimated 150 hectares of green roofs were present in the Greater London Area in 2017 (Grant et al. 2019). Studies have shown that green roofs could provide valuable food resources for pollinating insects (Passaseo et al. 2021; Jacobs et al. 2023). Solitary bees have short flight ranges, and usually, the smaller the bee, the shorter the flight range is and vice versa, as it depends on how much energy can be stored for activity (Gathmann & Tscharntke 2002). Consequently, recording small solitary bees (about 4–6 mm in body length) such as *Hylaeus communis* and *Lasioglossum smeathmanellum* on roof gardens was a pleasant surprise. Such species were recorded in a roof garden above a 15th-storey building. How the pollinating insects reach the roof gardens, whether they nest in the roof gardens or travel between them, needs further investigation.

Bees might be facing various challenges using green roofs, such as 1) thin substrates, which are often unsuitable for ground-nesting bees to nest, 2) lack of cavities for cavity-nesting bees, 3) access to water, and 4) habitat connectivity. One of the main advantages of roof gardens in the City of London is that they receive high amounts of sunlight exposure compared to ground-level gardens, which can often be shaded. Sunlight and warm temperatures are beneficial for both plants and pollinators. Studies in the literature suggest that various green roof characteristics can influence pollinator communities, such as the size of the site (Madre et al. 2013), vegetation cover (Kratschmer et al. 2018), height (MacIvor 2016), and proportion of greenspace in neighbouring landscape (Tonietto et al. 2011). More research must be done to help us better understand what specific habitat characteristics are required on green roofs to attract a considerable diversity of pollinating insects and what the limiting factors are.

Nesting resources

Bee nesting resources are often overlooked. The survival of bees depends highly on the availability of food and nesting resources (Potts et al. 2016). Ninety-three per cent of recorded non-honeybee species were cavity nesters. Such high abundance can be explained by cavities in many old buildings and the Roman walls in the City of London. We should not be concerned that such insects will destroy the walls to take advantage of existing cavities. They do not remove building materials but only shape them to create their nest (Else & Edwards 2018). Bees and other cavity-nesting insects have co-existed with such structures for a long time.

On the contrary, a low abundance of ground-nesting bees has been recorded (only 7% of recorded non-honeybee species). Such abundance reflects the limited availability of bare soil in the City of London. When available, it is often in the shade as many ground-level gardens in the City of London receive a lot of shade (K. Tsiolis, personal observation). Bees are ectotherms and depend on warm temperatures for activity and reproduction (Antoine & Forrest 2020). Gardeners and site managers should maintain or create artificially bare ground habitats for ground-nesting bees at sunny locations (contact PLT for more information). Approximately 70% of the 270 bee species in the British Isles are ground nesters (Else & Edwards 2018), and their survival is highly dependent on suitable nesting habitats. Soil disturbance is another factor that can affect bee nesting or even damage nests during offspring development or overwintering life stages (Fig. 19), and it should be avoided at known or potential nesting sites.

Figure 19: The life cycle of ground-nesting bees (Harmon-Threatt 2020). Nesting stages: 1) initiation, 2) construction, 3) development, 4) overwintering, 5) emergence. Cavity-nesting bees have the same life cycle but nest in cavities (e.g. walls, hollow plant stems).

Conclusion

Pollinators are essential for pollinating natural ecosystems and our crops. However, they are under threat, and they need our help. The City of London has a considerable diversity and abundance of pollinating insects. Still, it can be enhanced by improving and increasing the diversity of food and nesting resources in green spaces, ensuring the provision of suitable habitats for as many pollinating insects as possible, especially along the biodiversity corridors of the City of London. Collaboration with boroughs outside the City of London could lead to the creation of additional habitats, improving connectivity and facilitating the movement of pollinating insects. We should focus on increasing the diversity of pollinator-friendly plants and enhancing nesting resources for both cavity-nesting and ground-nesting species. It is essential to maintain a sustainable balance between honeybees and wild pollinators, especially in urban areas where resources are limited. Raising awareness about the importance and diversity of pollinators and their needs is also necessary. In 2025, PLT will conduct a study to explore the significance of green spaces and pollinators for human well-being. Additionally, PLT will perform detailed data analysis in 2025, examining various biotic and abiotic factors to identify the drivers of pollinator diversity and abundance in the City of London. Let's support PLT in their efforts to save wild pollinators.

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Appendix

Appendix 1: Scoring sheet/report for greenspaces based on habitat quality, which includes the percentage of flower cover and the availability of nesting resources like bee hotels and bare soil, along with flower-visiting insect surveys conducted in 2024 and a summary of the recorded data.

Category	Score	Criteria
Plants for pollinators: floristic value, seasonal availability and forage for life cycle stages.	0	0%
	1	20%
	2	40%
	3	60%
	4	80%
	5	100%
Comment:		
Nesting for pollinators	0	No nesting resources
	1	Unsuitable or little nesting resources
	2	Suitable nesting resources, no maintenance
	3	Suitable nesting resources, well-maintained
Comment:		
Use of pesticides	0	Regular use of pesticides
	1	Occasional use of pesticides
	2	Only occasional use of fungicides
	3	No use of pesticides
Monitoring	0	No
	1	Yes
Comment:		
Pollinator species/groups found	0	0
	1	1–2
	2	3–4
	3	5–6
	4	7–8
	5	9–10
	6	11–12
	7	13–14
	8	15–16 +
Total	**/ 20**	

List and count of flower-visiting species/groups genera and species recorded at the site in 2024:

Flower-visiting species/group	Count

List of plant genera recorded at the site in 2024 and number of flower-visiting insect visits:

Plant genera	Visits

Appendix 2: List of sites surveyed for flower-visiting insects and habitats in 2024 and their coordinates.

Sites	Coordinates
Roof gardens	
Aldgate School	51.51357, -0.07772
Bread Street	51.51342, -0.09457
Cannon Bridge House	51.50972, -0.09108
Euromonitor International	51.52220, -0.10416
Goldman Sachs International	51.51646, -0.10560
The Goldsmiths' Centre	51.52097, -0.10320
Britton Street	51.52198, -0.10425
The Garden at 120	51.51217, -0.08093
Weil 110 Fetter Lane	51.51587, -0.11038
Wells Fargo Capital Finance	51.50996, -0.08733
Public sites	
Angel Lane	51.50949, -0.08931
Beech Gardens	51.52063, -0.09625
Breams Garden	51.51619, -0.10990
Bunhill Fields Burial Ground	51.52368, -0.08873
Christchurch Greyfriars Church Garden	51.51583, -0.0996
Cleary Garden	51.51181, -0.09537
Dark House	51.50861, -0.08479
Dukes Planters	51.51449, -0.0781
Festival Garden	51.51319, -0.09661
Finsbury Square Garden	51.52094, -0.08642
FOCG Meadow	51.518, -0.09506
Millennium Beds	51.51086, -0.09896
New Change	51.51326, -0.09689
Smithfield Rotunda Garden	51.51846, -0.1011
St Andrew Holborn Garden	51.51748, -0.10705
St Botolph Churchyard	51.5166, -0.08182
St Dunstan in the East Church	51.50971, -0.08246
St Mary Aldermanbury Garden	51.51644, -0.09308
St Mary Staining	51.51665, -0.0948
St Pauls Cathedral Churchyard	51.51419, -0.0975
Trinity Square Gardens	51.50983, -0.07764
Victoria Embankment Garden	51.5112, -0.10494
Whittington Gardens	51.51091, -0.09216
Private sites	
Barber-Surgeons' Physics Garden	51.51812, -0.0949
Barbican Thomas More	51.51956, -0.09551
Barbican Wildlife Garden	51.52134, -0.09638
Charterhouse Square	51.52077, -0.09939
Charterhouse Gardens	51.52175, -0.10054
Drapers' Hall Garden	51.51552, -0.08646
Goldsmiths	51.51616, -0.09572

Inner Temple	51.51159, -0.10963
Middle Temple	51.5117, -0.11137
Minotaur Statue – Stairs	51.51796, -0.09199
Plaisterers Roman Fort Ruins	51.51702, -0.09565
Tower of London – Moat	51.50864, -0.07765


Common carder bumblebee (*Bombus pascuorum*) on *Dasiphora* spp.


Tree bumblebee (*Bombus hypnorum*) on *Cephalaria* spp.


White-tailed/Buff-tailed bumblebee (*Bombus lucorum* agg) on *Verbena* spp.