Oikos

O18450
Fründ, J., Linsenmair, K. E. and Blüthgen, N. 2010. Pollinator diversity and specialization in relation to flower diversity. – Oikos 119: 1581–1590.

Appendix 1

Other factors probably influencing diversity

Quantifying landscape context

We estimated the effect of landscape context on pollinator diversity as potential reason for the positive diversity-diversity relationship. Landscape complexity was quantified by expert opinion in the following way:

- For each study site, a satellite aerial photograph of a landscape section of 990 m x 850 m centered around the study site was copied from Google^{TM} Earth (http://earth/google.com) in October 2008, and saved as image. This scale, covering distances of up to approximately 400 m from the focal site, corresponded roughly to the scale for which landscape effects on wild bee diversity have been described earlier (Steffan-Dewenter et al. 2002).
- On the basis of these images, landscape complexity was rated for each site by six scientists from the Agroecology group of the University of Göttingen (P. Batáry, C. Fischer, A. Flohre, S. Hänke, K. Krewenka, B. Scheid), who had experience in investigating and mapping landscape context, but were not informed about diversity data for the sites.
- Landscapes were visually rated on a scale from 0 (structurally poor, simple or cleared landscape, crop-dominated) to 10 (structurally rich, complex landscape, much semi-natural habitat). Landscapes achieving the highest rates had large amounts of orchards, hedges, forest patches and small scale grasslands.
- Landscape ratings of different scientists were very similar (Fig. 1). Therefore, average landscape ratings for each site were used for testing the effect of landscape on pollinator diversity.

We used this method only to explore possible error sources regarding our conclusion. We do not imply that it is well suited for studies focusing on the quantification of landscape effects.

Effects of the other factors

It was shown in the main text that pollinator species richness, but not Shannon diversity were correlated with the number of individuals captured. Also in a more detailed analysis (using linear regression), no effect of sampling intensity on diversity could be identified: The number of sampling quadrats had no significant effect on flower diversity ($p = 0.23$, $F_{1,25} = 1.52$). The number of minutes of transect walks had no significant effect on pollinator diversity ($p = 0.23$, $F_{1,25} = 1.51$).

We found no evidence that the observed diversity-diversity correlation was caused by confounding external factors. There was no significant difference in diversity between subregions, neither for flower diversity (t-test, $p = 0.55$, $t = 0.61$, DF = 20.6, mean H = 1.56 in 'A' and 1.45 in 'B') nor for pollinator diversity (t-test, $p = 0.36$, $t = -0.93$, DF = 17.7, mean H = 2.55 in 'A' and 2.65 in 'B').

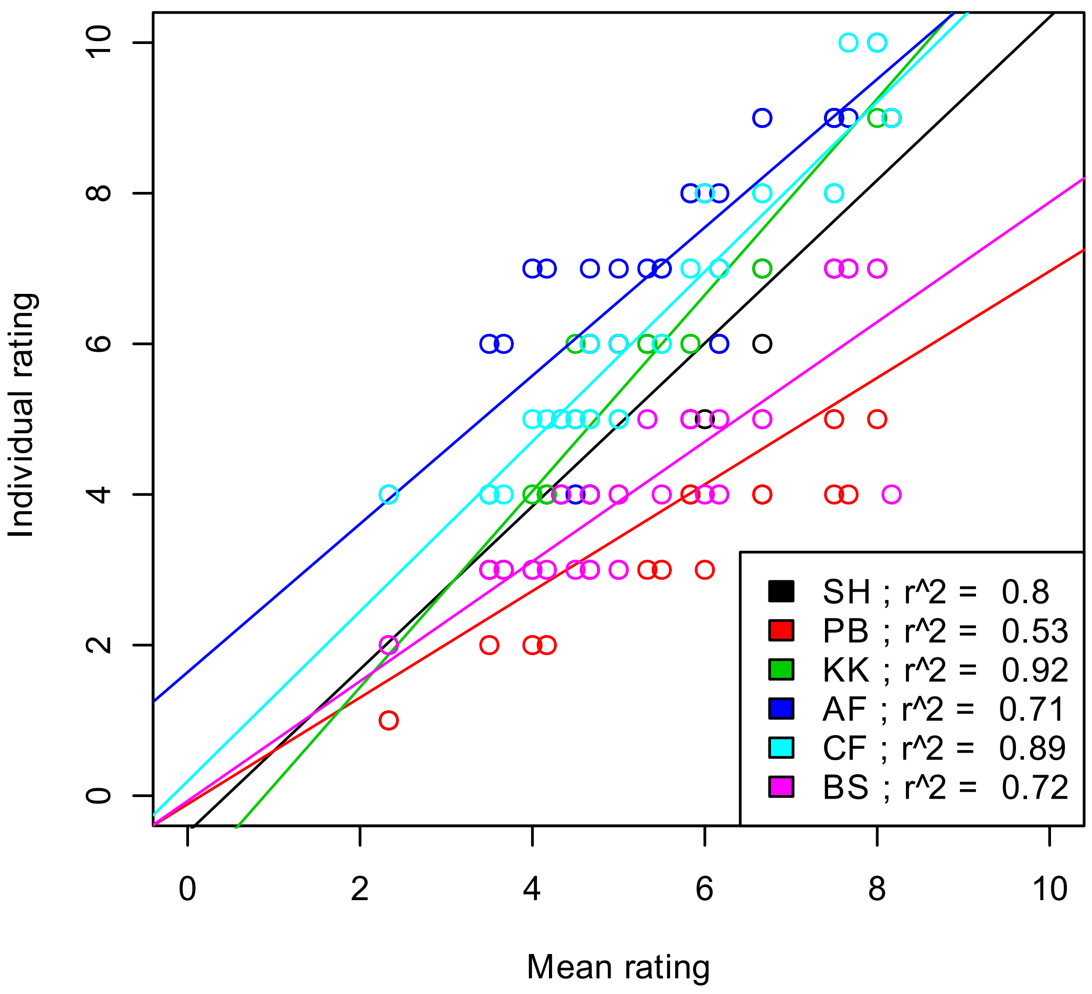

Figure 1. Correlation between mean landscape ratings (x-axis) and ratings by individual scientists (y-axis). This figure shows that landscape rates were highly consistent among scientists, confirming the reliability of this method.

Temperature during the survey positively influenced observed pollinator diversity ($p = 0.04$, $F_{1,25} = 4.6$), probably through its effect on wild bee activity. Landscape complexity score () had no significant effect on pollinator diversity, neither on Shannon diversity nor rarefied richness ($p = 0.19$, $F_{1,25} = 1.78$, and $p = 0.25$, $F_{1,25} = 1.36$). This did not change when it was included as an independent variable in a multiple regression model, together with temperature and flower diversity. Reducing that model by removing landscape as the factor with highest p-value lead to a model including both temperature and flower diversity as explanatory variables with a significant influence on pollinator diversity (with type I sum of squares - temperature: $p = 0.032$, $F_{1,24} = 5.2$; flower diversity $p = 0.048$, $F_{1,24} = 4.3$; with type II sum of squares and t-tests, only flower diversity was significant).

Additional analyses exploring potential problems

Effects of habitat area, sample size and season on diversity and specialization

For all of these factors, correlations were not significant ($p > 0.1$, area was log-transformed; Fig. 2, 3). Many of the meadows were connected to other meadows, so it was not possible to estimate the total area of source habitat. With our method, H2' is not sensitive to the number of observations.

Does the single-day approach overestimate specialization?

In the study year, 15 sites were sampled on a second day and two sites on two additional days (additional days not considered in main paper). To evaluate the effect of our snapshot-network approach, we constructed networks also based on more than one sampling day (Fig. 4). For seven of these sites an additional sampling day was within the 'sampling time' (i. e., the main period / in summer). To evaluate the effect of our snapshot-network approach, we constructed networks also based on more than one sampling day (Fig. 4). Adding an additional sampling day to the single-day networks considered in the main paper increased web size (number of individuals) by 37% on average. The networks based on 2 days were not more specialized than the single-day-webs (paired t-test, $t = -0.1033$, $N = 17$, $p = 0.919$; difference in H2'= -0.003).

Sample size dependence: species accumulation curves etc.

Using the 'Chao1' estimator in 'estimateR' (R-package 'vegan´) indicated a saturation of species richness of median 62%. Accumulation curves (Fig. 5) were constructed (by rarefactions) for species richness, Shannon diversity and specialization H2'. These show that while species richness did not reach saturation for some sites, both indices used for conclusions in our study were much closer to saturation. Hence, sample size does not appear to be a problem here. For smaller sample sizes than in (most of) our webs, H proofed to be sample-size-dependent, while H2' was generally unbiased even for very small samples - only the variance or uncertainty of H2' was larger for small samples.

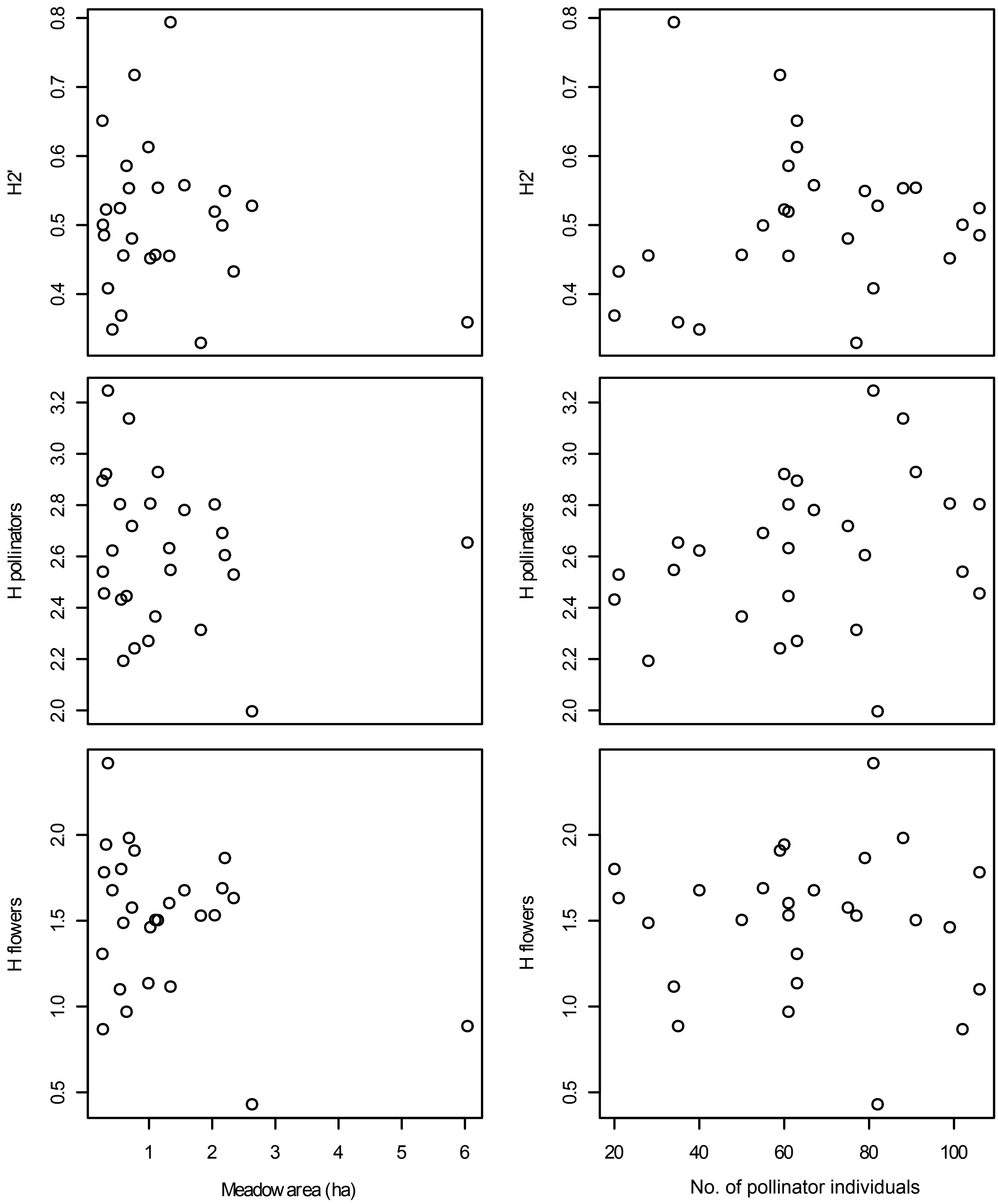

Figure 2. Relationship between two potentially confounding factors and the measures of diversity and specialization used in this study (27 networks from different sites). *H* is Shannon diversity (for flowers: based on flower area and number of flowers in plots). *H2'* is an index of network-level specialization.

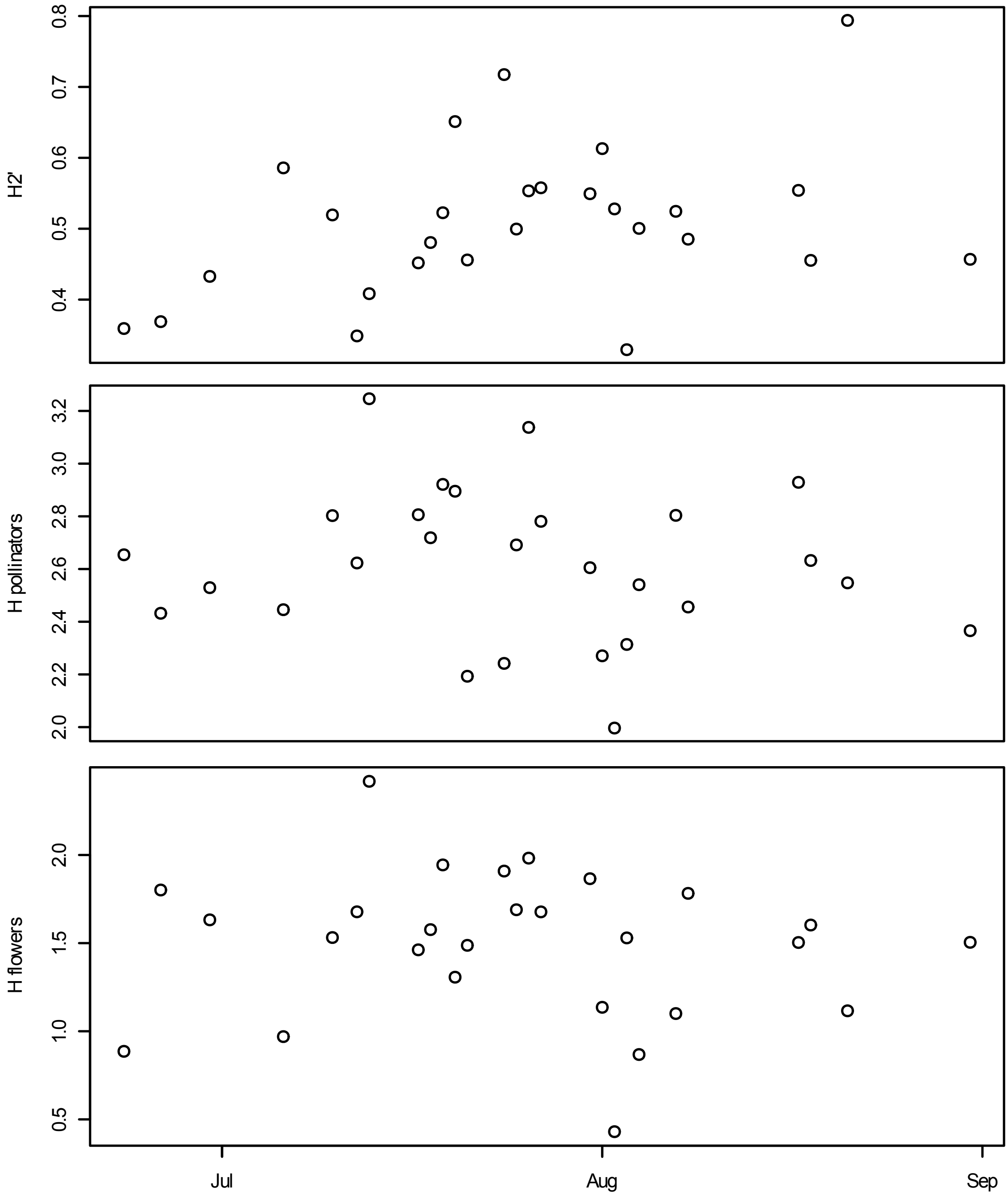

Figure 3. Relationship between the time in the season and diversity and specialization in the 27 networks (each from a different site and date). See Fig. 2 for further explanations.

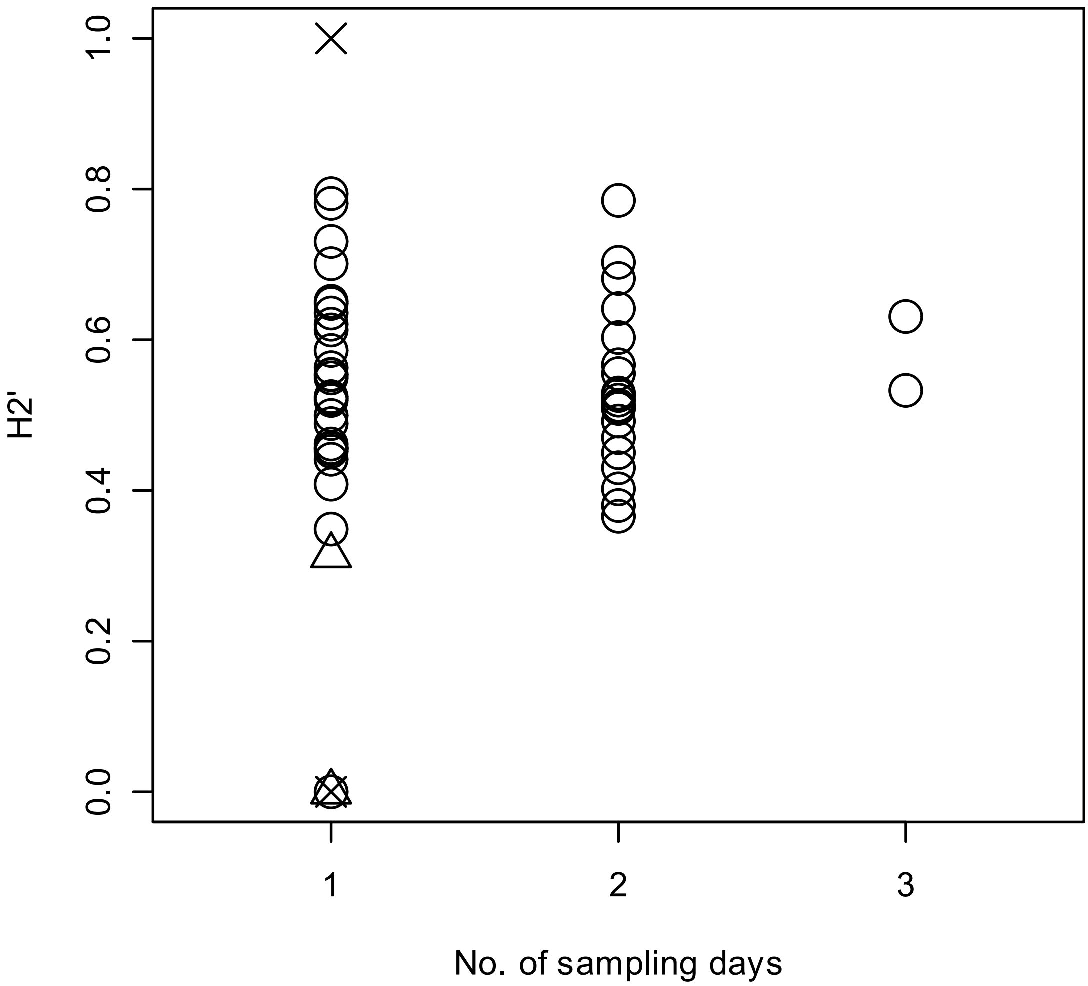

Figure 4. Network-level specialization in relation to the number of sampling days used for the network. This is an extended sample compared to the set of networks, using data from additional sampling days from the same sites and from the same year. Circles represent webs with at least 20 individuals (i. e. observations), triangles are webs with < 20 individuals, and crosses webs with < 10 individuals.

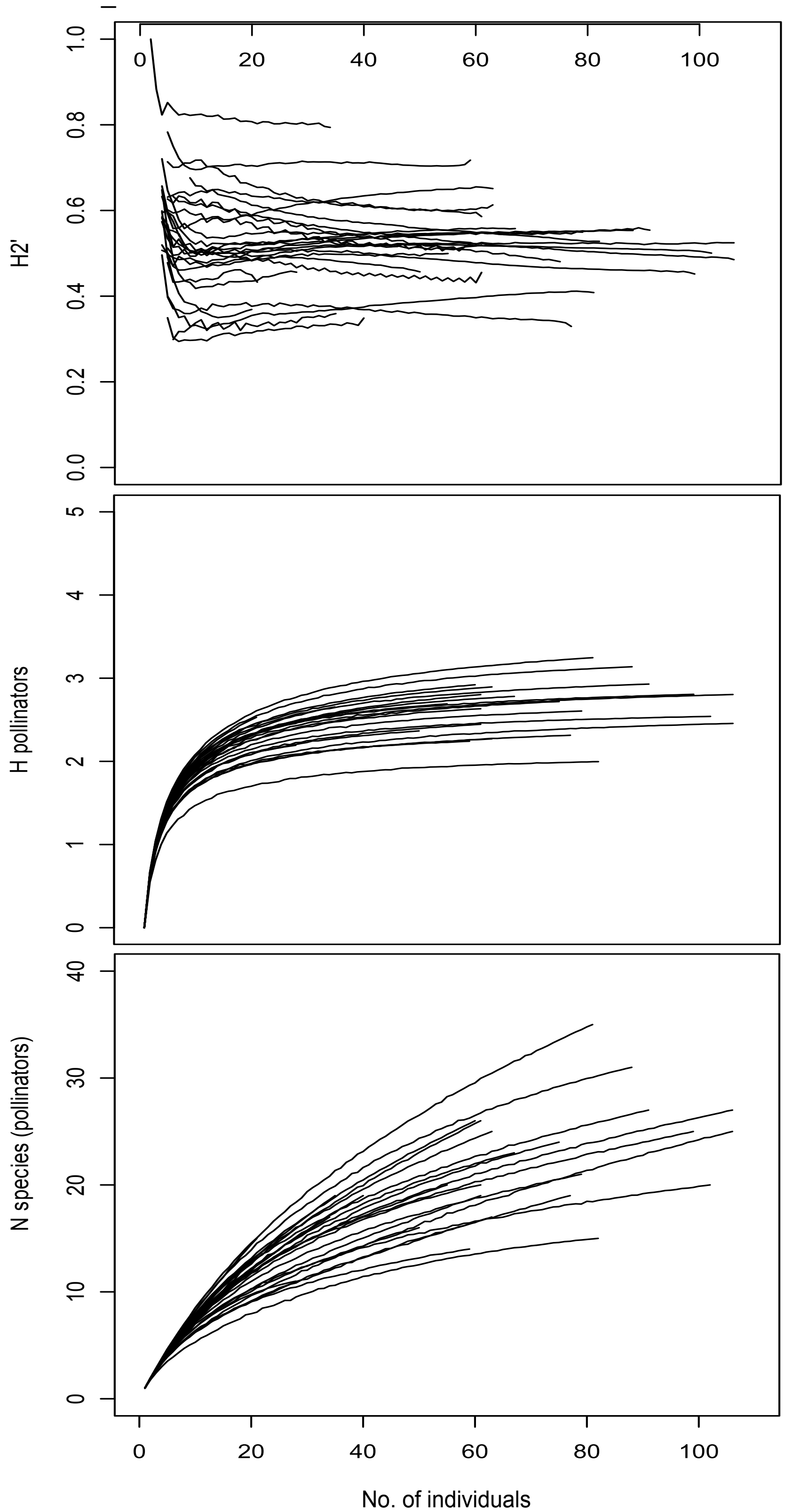

Figure 5. Accumulation curves for species richness and Shannon diversity of pollinators, and for specialization H2' of the interaction web (n = 1000 replicates per step).

Difference between plot and transect pollinator samples

Pollinator samples from plots had a smaller diversity than those from transects (paired t = -8.5, n = 27, p < 0.001; mean Shannon diversity plots = 2.01 and transects = 2.53). This was partly explainable by the lower number of individuals, but even when using rarefied richness plots had a lower diversity than transects (paired t = -4.9, n = 27, p < 0.001; mean rarefied richness plots = 4.52 and transects = 5.04; rarefaction to 6 individuals, which was the minimum of all 'subsamples', i.e. all plots of one web).

Community composition differed slightly between plots and transects (pooling all data for plots and transects, respectively; Bray-Curtis dissimilarity of relative abundances = 0.29), which was significantly different from a null model (table randomized with 'r2dtable', n = 10 000 replicates, mean dissimilarity = 0.27, p < 0.001).

Alternative analyses comparing flower preferences / realized flower visitation niches between sites for ten pollinator species: using Bray-Curtis dissimilarity

We used an alternative approach for comparing 'flower niches' of the ten most common pollinator species in our data set between webs. Similar to analysing community dissimilarity, we calculated pairwise Bray-Curtis dissimilarity between the flower visitation 'profiles' (i. e. number of visits per flower species) of each pollinator species in different webs. All webs including the pollinator species were used. 'Niche profiles' were calculated relative to the number of observations of the pollinator species per web (using absolute numbers of visits yielded a similar picture). Means were calculated from the tables of pairwise dissimilarities and plotted. To judge these values, we compared the observed values to two different nullmodels (keeping marginals constant, command 'r2dtable'):

(1) randomization of the 'niche profile' table (site x flower sp.) for the focal pollinator species; this simulates that 'niche profiles' are the same in all webs; it allows interactions with flower species not present at a site, but does *not* allow interactions with flower species never visited by the focal pollinator species

(2) randomization of the complete webs (flower sp. x pollinator sp.; this simulates that interactions are random and there is no true species-specific niche profile; it does *not* allow interactions with flower species not present at a site, but allows interactions with flower species never visited by the focal pollinator species

In general, results from these analyses conformed with the conclusions of the preference analyses in the main paper: 'niche profiles' differed between sites (observed values > nullmodel 1), but there was also some pollinator-species-specific signal in the 'niche profile' (observed values < nullmodel 2, i. e. a pollinator species visited more similar flower species than expected for random). In other words, the significance of networklevel specialization is not caused by arbitrary connections, but species identities matter. We can neither support approaches considering 'links as constant'.

Two error sources complicate the interpretation of these results and are responsible for the high observed dissimilarity values:

(a) different flower species present at different sites

(b) often low number of observations per web and pollinator species

Problem (a) explains some part of the difference between observed values and nullmodel 1, so this may not indicate differences in pollinator behaviour (or 'non-trivial' changes of 'realized preferences') but might simply reflect differences in flower availability (which are ignored by nullmodel 1). Problem (b) is responsible for the high dissimilarity in general but particularly with nullmodel 2 - the wider the niche, the higher the chance for zero-overlap and therefore a dissimilarity of 1, increasing the mean dissimilarity. In the Preference analysis of the main paper, problem (a) is avoided by incorporating expected values. Problem (b) may effect the absolute values of the Preference Index, but not the significance presented there.

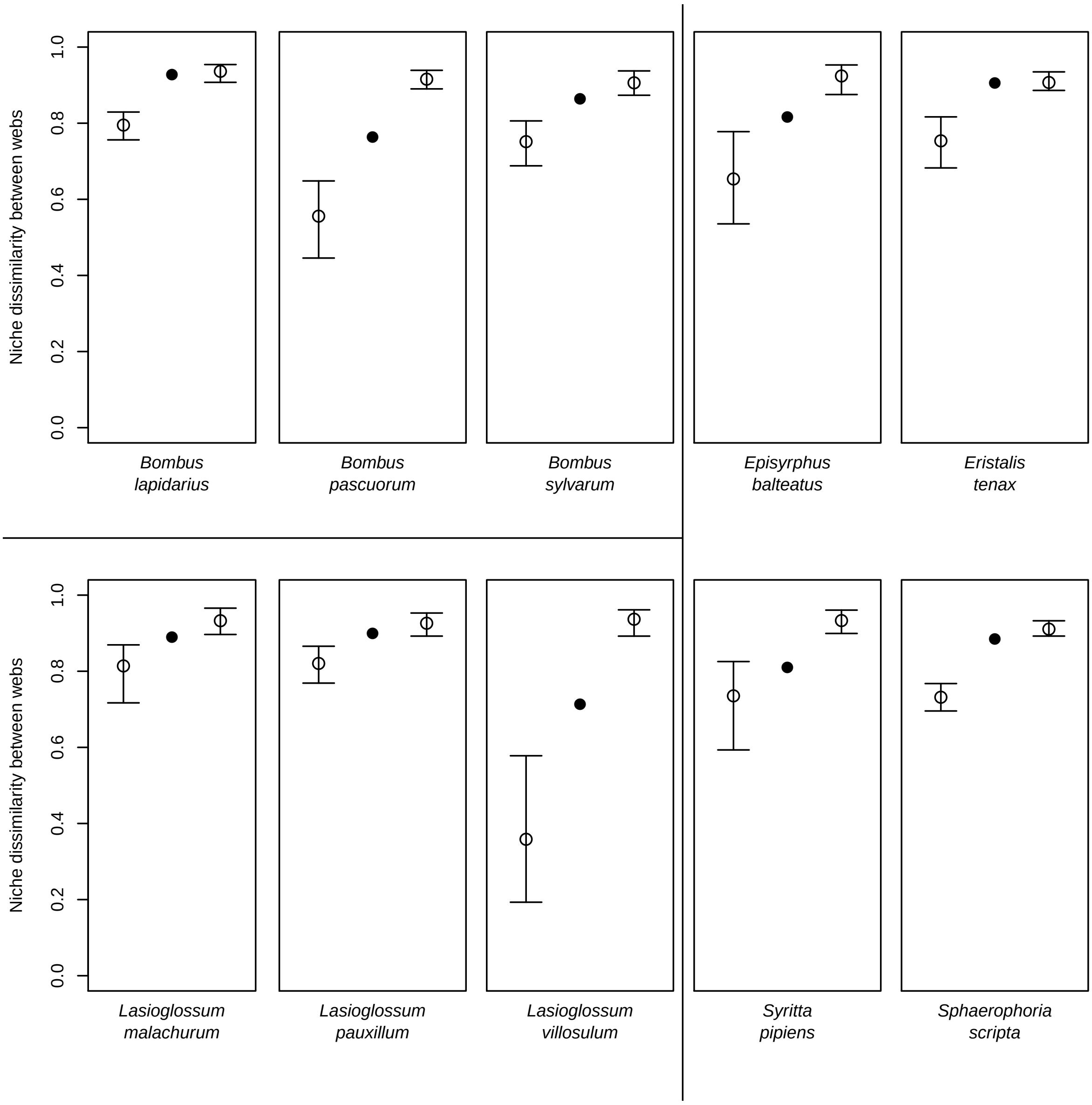

Figure 6. Differences in the flower visitation niches between networks for the most commonly observed species in our data set. Y-axis shows Bray-Curtis distance of species composition of the flowers visited at each site. Closed circles = observed values; open circles = null model values, with null model 1 left and null model 2 right of the observed value for each species. See text for further details.

More details about the pollinator community

In this Appendix section, more details are given about:

- The relative importance of different flower visitor taxa in all observations, including groups not considered in the analyzes (Fig. 7)
- a summary of all pollinator species, all flower species they interacted with, and the total number of interactions (Table 1)

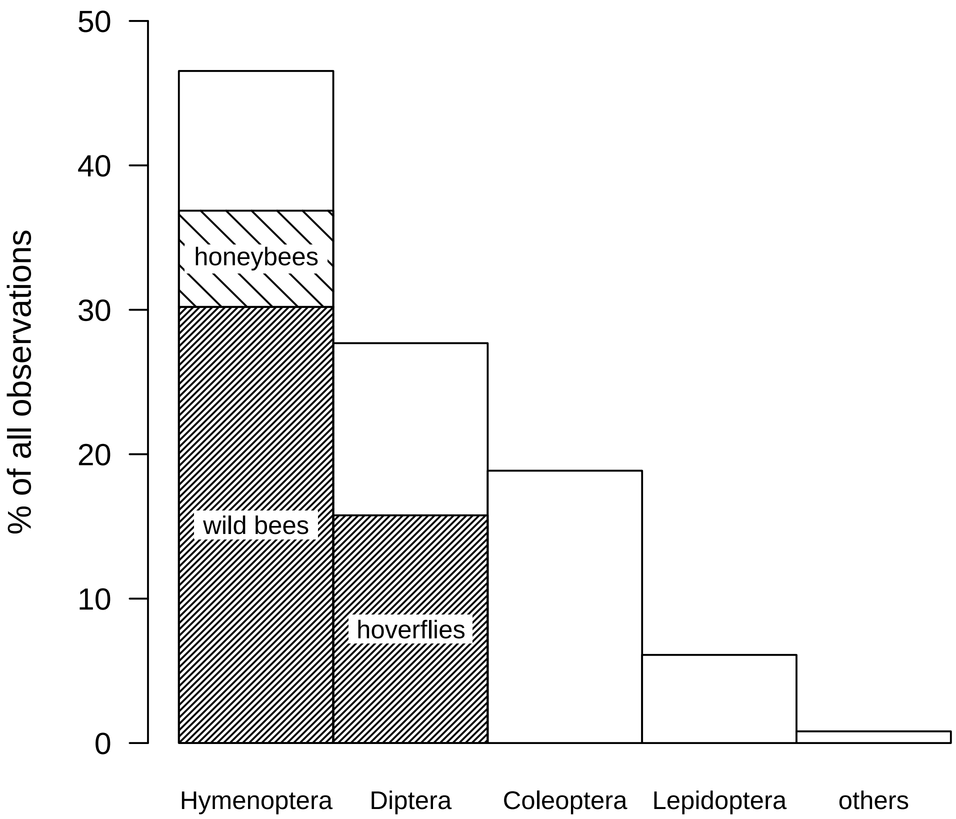

Figure 7. Relative contribution of different visitor taxa to all flower visitors observed during this study (n = 8765). Note that the taxa analyzed here (wild bees and hoverflies) comprise nearly one half of all observed individuals / interactions. Half of all individuals of wild bees and hoverflies (n = 2010) were captured, identified to species level and analyzed in this study. All other visitors were not considered in our analyses, and are shown here only as a background information.

Table 1. Summary of all observed interactions across all study sites. The numbers indicate the observed frequency of interaction between bee or syrphid (rows) and plant (columns) species. Members of and interactions within the proposed "*Campanula*-Compartment" are highlighted in light blue: 32 of 37 visits to *Campanula*, i. e. 86%, were from bee species either oligolectic on or with a strong preference for *Campanula* (Westrich 1989, Kleijn and Raemakers 2008). Note that only flower species that were part of the networks (i.e. at least one visit) are included, but not species only counted in quadrats. Flower species for which compact inflorescences rather than individual flowers were counted are indicated by asterisks.

	TOTAL	Achillea millefolium*	Agrimonia eupatoria	Anthemis tinctoria*	Anthriscus sylvestris*	Astragalus glycophyllos	Bellis perennis*	Calamintha acinos	Calamintha clinopodium	Calystegia sepium	Campanula cf. rapunculus	Campanula rotundifolia	Carduus cf. crispus*	Centaurea jacea*	Centaurea scabiosa*	Cichorium intybus*	Cirsium arvense*	Cirsium vulgare*	Convolvulus arvensis	Crepis biennis*	Crepis capillaris*	Daucus carota*	Dianthus deltoides	Dipsacus sylvestris*	Erigeron strigosus*	Falcaria vulgaris*	Foeniculum vulgare*
Andrena agilissima	2																										
Andrena alfkenella	3	1																				1					
Andrena chrysosceles	1																										
Andrena dorsata	2																					2					
Andrena flavipes	40	7												2								9			6		
Andrena fulvicornis	2																					2					
Andrena labialis	2																										
Andrena minutula	2																					1					
Andrena minutuloides	4																					2					
Andrena nana	2																					2					
Andrena ovatula group	11																										
Andrena polita	2																										
Anthidium byssinum	2																										
Anthidium lituratum	1													1													
Anthidium manicatum	1																										
Anthidium oblongatum	1																										
Anthidium strigatum	2																										
Anthophora aestivalis	1																										
Bombus cf. lucorum s.l.	29											1		2			2		1	1		2					
Bombus cf. terrestris	20												2				2		1	1		1		1			
Bombus hortorum	9																			1							
Bombus humilis	32													2			1										
Bombus hypnorum	2					1													1								
Bombus lapidarius	112											1	6	20	1		6	2	1	3							
Bombus pascuorum	167					1							1	4				1		2							
Bombus pratorum	3	1												1													
Bombus soroeensis	6											2		3					1								
Bombus subterraneus	2																										
Bombus sylvarum	97					1			1	1			8	5	1			2									
Ceratina cyanea	1																										
Cheilosia latifrons	2																										
Cheilosia pagana	2	1																									
Cheilosia soror	10																					6					1
Cheilosia variabilis	1																					1					
Cheilosia vernalis agg.	12	8																									
Cheilosia vulpina	2																					2					
Chelostoma campanularum	17										5	11															
Chelostoma rapunculi	7										1	5															
Chrysogaster solstitialis	2																					2					
Chrysotoxum bicinctum	3																										
Chrysotoxum festivum	1																										
Colletes similis	1	1																									
Dasypoda hirtipes	2																			1							
Didea intermedia	1																										
Episyrphus balteatus	77	2	1										1						6			3					
Eristalinus aeneus	3	2																									
Eristalinus sepulchralis	3	1															2										
Eristalis arbustorum	34	4			1																	8					
Eristalis interrupta	13	4																				6					
Eristalis pertinax	7																			1		3					
Eristalis tenax	74	6															4		2	7		9					1
Eumerus ornatus	1																										
Eupeodes corollae	1																										
Eupeodes lapponicus	1																										
Eupeodes latifasciatus	5																										
Halictus cf. simplex	32	2											3	9					1						2		
Halictus maculatus	6	3												2													
Halictus rubicundus	1																										
Halictus scabiosae	2													1						1							
Halictus subauratus	6	3												1													
Halictus tumulorum	45	11						1						1					2			1					
Helophilus pendulus	2																										
Helophilus trivittatus	9																										
Heriades truncorum	6	2																		2							
Hylaeus annularis	5	1													1							2					
Hylaeus brevicornis	1																					1					
Hylaeus communis	5	1																		1							
Hylaeus confusus	2																					1					
Hylaeus difformis	1																1										
Hylaeus gredleri	15	1															1					8					
Hylaeus hyalinatus	1																					1					
Hylaeus punctatus	1																					1					
Hylaeus sinuatus	1																					1					
Hylaeus variegatus	2																					1				1	
Lasioglossum calceatum	12	1		1															3								

	Galium mollugo	Galium verum*	Geranium cf. dissectum	Geranium pratense	Geum urbanum	Heracleum sphondylium*	Hypericum perforatum	Hypochoeris radicata*	Knautia arvensis*	Lactuca serriola	Lathyrus latifolius	Lathyrus pratensis	Lathyrus tuberosus	Leontodon autumnalis*	Leontodon hispidus*	Lotus corniculatus	Medicago lupulina*	Medicago sativa	Melampyrum arvense	Myosotis cf. arvensis	Onobrychis viciifolia	Ononis spinosa	Pastinaca sativa*	Picris hieracoides*	Pimpinella cf. saxifraga*	Plantago lanceolata*
Andrena agilissima																										
Andrena alfkenella																								1		
Andrena chrysosceles																										
Andrena dorsata																										
Andrena flavipes														1				2						2		
Andrena fulvicornis																										
Andrena labialis																		1								
Andrena minutula																	1									
Andrena minutuloides						1											1									
Andrena nana																										
Andrena ovatula group																										
Andrena polita																								2		
Anthidium byssinum													1								1					
Anthidium lituratum																										
Anthidium manicatum				1																						
Anthidium oblongatum																1										
Anthidium strigatum														1		1										
Anthophora aestivalis																										
Bombus cf. lucorum s.l.				1			1						1	5		3			1							
Bombus cf. terrestris														1		1										
Bombus hortorum																										
Bombus humilis				1								1				2		6						1		
Bombus hypnorum																										
Bombus lapidarius				2										14		7		3						5		
Bombus pascuorum				5					2					14		2		15						1		
Bombus pratorum																										
Bombus soroeensis																										
Bombus subterraneus																										
Bombus sylvarum				5	1								1	1		9		21						6		
Ceratina cyanea															1											
Cheilosia latifrons														1										1		
Cheilosia pagana																							1			
Cheilosia soror																							2		1	
Cheilosia variabilis																										
Cheilosia vernalis agg.														2										1		
Cheilosia vulpina																										
Chelostoma campanularum														1												
Chelostoma rapunculi				1																						
Chrysogaster solstitialis																										
Chrysotoxum bicinctum								1															2			
Chrysotoxum festivum																										
Colletes similis																										
Dasypoda hirtipes														1												
Didea intermedia														1												
Episyrphus balteatus	2													3			1	1					2	41		2
Eristalinus aeneus														1												
Eristalinus sepulchralis																										
Eristalis arbustorum						6								1				1					7			
Eristalis interrupta														2												
Eristalis pertinax																							3			
Eristalis tenax								1						25				4					3	3		
Eumerus ornatus																										
Eupeodes corollae																								1		
Eupeodes lapponicus																									1	
Eupeodes latifasciatus														1									2			
Halictus cf. simplex				1														3						6		1
Halictus maculatus																										
Halictus rubicundus																									1	
Halictus scabiosae																										
Halictus subauratus																								1		1
Halictus tumulorum														2		2	3	3		1				3	1	
Helophilus pendulus														1										1		
Helophilus trivittatus														3									1	1		
Heriades truncorum														1												
Hylaeus annularis																							1			
Hylaeus brevicornis																										
Hylaeus communis						1												1								
Hylaeus confusus						1																				
Hylaeus difformis																										
Hylaeus gredleri						3																			1	
Hylaeus hyalinatus																										
Hylaeus punctatus																										
Hylaeus sinuatus																										
Hylaeus variegatus																										
Lasioglossum calceatum														2										3		

	Plantago media*	Prunella vulgaris*	Ranunculus acris	Reseda lutea	Rhinanthus minor	Rumex crispus	Sanguisorba officinalis*	Securigera varia	Senecio jacobea*	Silaum silaus*	Silene latifolia	Sinapis arvensis	Taraxacum cf. officinale*	Thlaspi arvense	Thymus cf. serpyllum	Trifolium campestre*	Trifolium dubium*	Trifolium hybridum*	Trifolium pratense*	Trifolium repens*	Tripleurospermum perforatum*	Veronica cf. agrestis	Vicia cracca	Vicia sepium	Vicia tetrasperma
Andrena agilissima												2													
Andrena alfkenella																									
Andrena chrysosceles														1											
Andrena dorsata																									
Andrena flavipes								3								2			2	4					
Andrena fulvicornis																									
Andrena labialis								1																	
Andrena minutula																									
Andrena minutuloides																									
Andrena nana																									
Andrena ovatula group																		1		10					
Andrena polita																									
Anthidium byssinum																									
Anthidium lituratum																									
Anthidium manicatum																									
Anthidium oblongatum																									
Anthidium strigatum																									
Anthophora aestivalis																			1						
Bombus cf. lucorum s.l.	1						1	1												5					
Bombus cf. terrestris								2				1							5				2		
Bombus hortorum																			8						
Bombus humilis																			14	1			2	1	
Bombus hypnorum																									
Bombus lapidarius	1							6				2						1	9	22					
Bombus pascuorum		1										1							91	19			5	2	
Bombus pratorum																		1							
Bombus soroeensis																									
Bombus subterraneus																			2						
Bombus sylvarum																4			24	4			2		
Ceratina cyanea																									
Cheilosia latifrons																									
Cheilosia pagana																									
Cheilosia soror																									
Cheilosia variabilis																									
Cheilosia vernalis agg.																					1				
Cheilosia vulpina																									
Chelostoma campanularum																									
Chelostoma rapunculi																									
Chrysogaster solstitialis																									
Chrysotoxum bicinctum																									
Chrysotoxum festivum							1																		
Colletes similis																									
Dasypoda hirtipes																									
Didea intermedia																									
Episyrphus balteatus	2						3					2							1		3	1			
Eristalinus aeneus																									
Eristalinus sepulchralis																									
Eristalis arbustorum										6															
Eristalis interrupta			1																						
Eristalis pertinax																									
Eristalis tenax			1							3		3	1								1				
Eumerus ornatus																						1			
Eupeodes corollae																									
Eupeodes lapponicus																									
Eupeodes latifasciatus							1													1					
Halictus cf. simplex	1																			2	1				
Halictus maculatus			1																						
Halictus rubicundus																									
Halictus scabiosae																									
Halictus subauratus																									
Halictus tumulorum			1													5			1	7					1
Helophilus pendulus																									
Helophilus trivittatus							1			2									1						
Heriades truncorum									1																
Hylaeus annularis																									
Hylaeus brevicornis																									
Hylaeus communis																				1					
Hylaeus confusus																									
Hylaeus difformis																									
Hylaeus gredleri										1															
Hylaeus hyalinatus																									
Hylaeus punctatus																									
Hylaeus sinuatus																									
Hylaeus variegatus																									
Lasioglossum calceatum			1				1																		

Table 1. (continued)

	TOTAL	Achillea millefolium*	Agrimonia eupatoria	Anthemis tinctoria*	Anthriscus sylvestris*	Astragalus glycophyllos	Bellis perennis*	Calamintha acinos	Calamintha clinopodium	Calystegia sepium	Campanula cf. rapunculus	Campanula rotundifolia	Carduus cf. crispus*	Centaurea jacea*	Centaurea scabiosa*	Cichorium intybus*	Cirsium arvense*	Cirsium vulgare*	Convolvulus arvensis	Crepis biennis*	Crepis capillaris*
Lasioglossum costulatum	6											5		1							
Lasioglossum glabriusculum	42	6		1												1				1	
Lasioglossum interruptum	4													1							
Lasioglossum laticeps	3																				
Lasioglossum lativentre	3	1																			
Lasioglossum leucopus	1																				
Lasioglossum leucozonium	24	3																		1	
Lasioglossum malachurum	84	7		1			1							9		9	1		1	2	
Lasioglossum morio	10	1																			
Lasioglossum pauxillum	54	14					1				2					1			3	1	
Lasioglossum politum	12																				
Lasioglossum puncticolle	1																				
Lasioglossum sp.	1																				
Lasioglossum villosulum	65																			2	
Lasioglossum xanthopus	1																				
Megachile centuncularis	2																				
Megachile ericetorum	4																				
Megachile pilidens	1																				
Megachile rotundata	1																				
Megachile versicolor	1																				
Megachile willughbiella	4																				
Melanostoma mellinum	10																				
Melitta haemorrhoidalis	3											3									
Melitta leporina	9																				
Myathropa florea	17	3																			
Neoascia podagrica	1																				
Nomada flavopicta	1																				
Osmia claviventris	1																				
Osmia spinulosa	5												1		1						
Osmia tridentata	3																				
Panurgus calcaratus	37																			1	
Paragus albifrons	1																				
Paragus haemorrhous	6	2																		1	
Paragus tibialis	1																				
Pipiza noctiluca agg.	1																				
Pipizella viduata	40	1																			
Platycheirus albimanus	2																				
Platycheirus peltatus	1																				
Psithyrus barbutellus	1														1						
Psithyrus bohemicus	2														2						
Psithyrus rupestris	16												1	4			4	1			
Rhophitoides canus	3																		1		
Scaeva pyrastri	5																				
Sphaeophoria taeniata	6	1																			
Sphaerophoria batava	1																				
Sphaerophoria scripta	164	39		1							1					1			5	6	1
Sphecodes cf. longulus	1																				
Sphecodes cf. puncticeps	1																				
Sphecodes ephippius	1																				
Sphecodes gibbus	2	2																			
Sphecodes rufiventris	1																				
Syritta pipiens	73	32			1															1	
Syrphus ribesii	4																				
Syrphus torvus	2																				
Syrphus vitripennis	16																				
Xanthogramma pedissequum	3																				

	Daucus carota*	Dianthus deltoides	Dipsacus sylvestris*	Erigeron strigosus*	Falcaria vulgaris*	Foeniculum vulgare*	Galium mollugo	Galium verum*	Geranium cf. dissectum	Geranium pratense	Geum urbanum	Heracleum sphondylium*	Hypericum perforatum	Hypochoeris radicata*	Knautia arvensis*	Lactuca serriola	Lathyrus latifolius	Lathyrus pratensis	Lathyrus tuberosus	Leontodon autumnalis*	Leontodon hispidus*
Lasioglossum costulatum																					
Lasioglossum glabriusculum	6								1			5			1						
Lasioglossum interruptum	1			1								1									
Lasioglossum laticeps	1																				
Lasioglossum lativentre																					
Lasioglossum leucopus																				1	
Lasioglossum leucozonium														1						8	1
Lasioglossum malachurum	2			9																1	
Lasioglossum morio	1			3																	
Lasioglossum pauxillum	3									1		1	1			1				1	
Lasioglossum politum	5			5																	
Lasioglossum puncticolle																					
Lasioglossum sp.																					
Lasioglossum villosulum																2				7	4
Lasioglossum xanthopus																					
Megachile centuncularis																					
Megachile ericetorum																	1		3		
Megachile pilidens																					
Megachile rotundata																					
Megachile versicolor																			1		
Megachile willughbiella																	1		3		
Melanostoma mellinum											1	1									
Melitta haemorrhoidalis																					
Melitta leporina																					
Myathropa florea	2											3									
Neoascia podagrica																					
Nomada flavopicta																					
Osmia claviventris																					
Osmia spinulosa																					
Osmia tridentata																			1		
Panurgus calcaratus														8						21	1
Paragus albifrons	1																				
Paragus haemorrhous																1					
Paragus tibialis				1																	
Pipiza noctiluca agg.																					
Pipizella viduata	6						4	1				4									
Platycheirus albimanus		1																			
Platycheirus peltatus																					
Psithyrus barbutellus																					
Psithyrus bohemicus																					
Psithyrus rupestris			1												1						
Rhophitoides canus																					
Scaeva pyrastri	1																			1	
Sphaeophoria taeniata	1																				
Sphaerophoria batava																					
Sphaerophoria scripta	32			5		3	5	2												13	
Sphecodes cf. longulus																					
Sphecodes cf. puncticeps	1																				
Sphecodes ephippius	1																				
Sphecodes gibbus																					
Sphecodes rufiventris				1																	
Syritta pipiens	5			2			2	3				6								1	
Syrphus ribesii																				1	
Syrphus torvus													2								
Syrphus vitripennis							1												4	1
Xanthogramma pedissequum																					

	Lotus corniculatus	Medicago lupulina*	Medicago sativa	Melampyrum arvense	Myosotis cf. arvensis	Onobrychis viciifolia	Ononis spinosa	Pastinaca sativa*	Picris hieracioides*	Pimpinella cf. saxifraga*	Plantago lanceolata*	Plantago media*	Prunella vulgaris*	Ranunculus acris	Reseda lutea	Rhinanthus minor	Rumex crispus
Lasioglossum costulatum																	
Lasioglossum glabriusculum		1	1					4	8	1	1	1					
Lasioglossum interruptum																	
Lasioglossum laticeps									1								
Lasioglossum lativentre																	
Lasioglossum leucopus																	
Lasioglossum leucozonium									7								
Lasioglossum malachurum								2	23								
Lasioglossum morio	1		1					2								
Lasioglossum pauxillum		5						3	10	1	2			1			
Lasioglossum politum		1															
Lasioglossum puncticolle									1								
Lasioglossum sp.		1															
Lasioglossum villosulum									49								
Lasioglossum xanthopus																	
Megachile centuncularis	1		1														
Megachile ericetorum																	
Megachile pilidens							1										
Megachile rotundata	1																
Megachile versicolor																	
Megachile willughbiella																	
Melanostoma mellinum								1			6				1		
Melitta haemorrhoidalis																	
Melitta leporina			5														
Myathropa florea								8									
Neoascia podagrica																	
Nomada flavopicta																	
Osmia claviventris	1																
Osmia spinulosa									3								
Osmia tridentata	2																
Panurgus calcaratus									6								
Paragus albifrons																	
Paragus haemorrhous			1						1								
Paragus tibialis																	
Pipiza noctiluca agg.														1			
Pipizella viduata								17		4				2			
Platycheirus albimanus			1														
Platycheirus peltatus																	
Psithyrus barbutellus																	
Psithyrus bohemicus																	
Psithyrus rupestris																	
Rhophitoides canus			2														
Scaeva pyrastri								1	1								
Sphaeophoria taeniata														2			
Sphaerophoria batava									1								
Sphaerophoria scripta		1	2					8	17	3	2	2	1	2		1	1
Sphecodes cf. longulus										1							
Sphecodes cf. puncticeps																	
Sphecodes ephippius																	
Sphecodes gibbus																	
Sphecodes rufiventris																	
Syritta pipiens								7		4				1			
Syrphus ribesii								2			1					
Syrphus torvus																	
Syrphus vitripennis								6	2								
Xanthogramma pedissequum								3									

	Sanguisorba officinalis*	Securigera varia	Senecio jacobea*	Silaum silaus*	Silene latifolia	Sinapis arvensis	Taraxacum cf. officinale*	Thlaspi arvense	Thymus cf. serpyllum	Trifolium campestre*	Trifolium dubium*	Trifolium hybridum*	Trifolium pratense*	Trifolium repens*	Tripleurospermum perforatum*	Veronica cf. agrestis	Vicia cracca	Vicia sepium	Vicia tetrasperma
Lasioglossum costulatum																			
Lasioglossum glabriusculum		1							1	1									
Lasioglossum interruptum																			
Lasioglossum laticeps															1				
Lasioglossum lativentre														2					
Lasioglossum leucopus																			
Lasioglossum leucozonium			2											1					
Lasioglossum malachurum			1			4		1	7					2	1			
Lasioglossum morio					1													
Lasioglossum pauxillum	1									1									
Lasioglossum politum														1					
Lasioglossum puncticolle																			
Lasioglossum sp.																			
Lasioglossum villosulum							1											
Lasioglossum xanthopus															1				
Megachile centuncularis																			
Megachile ericetorum																			
Megachile pilidens																			
Megachile rotundata																			
Megachile versicolor																			
Megachile willughbiella																			
Melanostoma mellinum																			
Melitta haemorrhoidalis																			
Melitta leporina														4					
Myathropa florea				1														
Neoascia podagrica	1																		
Nomada flavopicta			1															
Osmia claviventris																			
Osmia spinulosa																			
Osmia tridentata																			
Panurgus calcaratus																			
Paragus albifrons																			
Paragus haemorrhous																			
Paragus tibialis																			
Pipiza noctiluca agg.																			
Pipizella viduata	1																		
Platycheirus albimanus																			
Platycheirus peltatus	1																		
Psithyrus barbutellus																			
Psithyrus bohemicus																			
Psithyrus rupestris													2	2					
Rhophitoides canus																			
Scaeva pyrastri						1													
Sphaeophoria taeniata	1							1											
Sphaerophoria batava																			
Sphaerophoria scripta	6					2	1				1									
Sphecodes cf. longulus																			
Sphecodes cf. puncticeps																			
Sphecodes ephippius																			
Sphecodes gibbus																			
Sphecodes rufiventris																			
Syritta pipiens	2			5		1													
Syrphus ribesii																			
Syrphus torvus																			
Syrphus vitripennis	1					1													
Xanthogramma pedissequum																			

Details of the preference analysis

In this Appendix section, details are given about the preference analyses for each pollinator-flower pair analyses, using four alternative analyses:

- flower species level, as presented and discussed in the main text: Table 2
- flower species level, unweighted alternative: Table 3
- flower family level, as discussed in the main text: Table 4
- flower family level, alternative approach for Asteraceae categorization: Table 5

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Table 2. Details for preferences analyses on the level of flower species, carried out for the 10 pollinator species observed most often in this study. Weighted means and sd are presented, as well as used for calculation of p-values. As weights we used the probability of non-zero visits without a preference, as a measure of data quality or information. PI = Preference Index (see methods), bounded between 0 and < 1; N co. = number of networks including the species pair (co-occurences); N linked = number of networks where species pair was observed to interact; N preferred = number of networks where flower was preferred by the pollinator species; n visits = total number of visits for the species pair

Pollinator species	Flower species	mean PI	sd PI	p of mean	p of sd	N co.	N linked	N preferred	n visits
Bombus lapidarius	*Centaurea jacea*	0.73	0.15	0	0.39	5	4	4	20
"	*Cirsium arvense*	0.49	0.3	0.08	0.21	6	2	2	6
"	*Convolvulus arvensis*	0.18	0.3	0.76	0.8	8	1	1	1
"	*Securigera varia*	0.74	0.34	0	0.33	6	4	4	6
"	*Crepis biennis*	0.29	0.35	0.46	0.29	8	2	2	3
"	*Leontodon autumnalis*	0.51	0.29	0.18	0.09	6	4	4	14
"	*Lotus corniculatus*	0.58	0.27	0.01	0.48	7	3	3	7
"	*Medicago sativa*	0.17	0.35	0.84	0.17	9	2	2	3
"	*Picris hieracoides*	0.34	0.34	0.59	0.05	9	3	3	5
"	*Trifolium pratense*	0.21	0.23	0.98	0.99	17	5	2	9
"	*Trifolium repens*	0.63	0.21	0	0.47	9	5	5	22
Bombus pascuorum	*Centaurea jacea*	0.32	0.33	0.6	0.2	6	2	1	4
"	*Crepis biennis*	0.17	0.22	0.93	0.97	9	2	1	2
"	*Leontodon autumnalis*	0.27	0.27	0.98	0.1	9	3	1	14
"	*Lotus corniculatus*	0.17	0.35	0.97	0.01	9	2	2	2
"	*Medicago sativa*	0.65	0.35	0	0.03	9	4	4	15
"	*Picris hieracoides*	0.06	0.2	1	1	11	1	1	1
"	*Trifolium pratense*	0.73	0.17	0	0.92	21	18	18	91
"	*Trifolium repens*	0.54	0.26	0.01	0.31	12	6	5	19
Bombus sylvarum	*Lotus corniculatus*	0.44	0.37	0.07	0.02	9	3	3	9
"	*Medicago sativa*	0.54	0.36	0.02	0.01	9	4	4	21
"	*Picris hieracoides*	0.11	0.26	1	0.41	11	1	1	6
"	*Trifolium pratense*	0.64	0.25	0	0.72	13	9	9	24
"	*Trifolium repens*	0.53	0.44	0	0.07	7	4	4	4
Episyrphus balteatus	*Achillea millefolium*	0.18	0.22	0.96	0.97	11	1	0	2
"	*Convolvulus arvensis*	0.61	0.2	0.01	0.9	6	4	4	6
"	*Daucus carota*	0.15	0.25	0.98	0.55	8	1	1	3
"	*Medicago sativa*	0.18	0.33	0.8	0.48	6	1	1	1
"	*Picris hieracoides*	0.58	0.23	0	0.35	11	9	8	41
"	*Plantago lanceolata*	0.21	0.41	0.44	0.17	9	2	2	2
"	*Trifolium pratense*	0.11	0.17	0.94	0.98	13	1	0	1
Eristalis tenax	*Achillea millefolium*	0.29	0.35	0.63	0.09	13	3	3	6
"	*Convolvulus arvensis*	0.51	0.5	0.01	0.03	5	2	2	2
"	*Crepis biennis*	0.6	0.27	0.02	0.48	7	3	3	7
"	*Daucus carota*	0.5	0.28	0.06	0.57	10	5	4	9
"	*Leontodon autumnalis*	0.54	0.21	0.04	0.29	8	5	4	25
"	*Medicago sativa*	0.38	0.41	0.47	0.03	5	1	1	4
"	*Pastinaca sativa*	0.24	0.23	0.89	0.6	5	2	1	3
"	*Picris hieracoides*	0.33	0.32	0.56	0.45	6	2	2	3
Lasioglossum malachurum	*Achillea millefolium*	0.41	0.25	0.33	0.72	8	4	3	7
"	*Centaurea jacea*	0.34	0.33	0.53	0.09	5	2	2	9
"	*Daucus carota*	0.17	0.25	0.97	0.69	7	2	1	2
"	*Picris hieracoides*	0.6	0.19	0	0.85	8	6	6	23
Lasioglossum pauxillum	*Achillea millefolium*	0.52	0.34	0.03	0.05	14	6	6	14
"	*Convolvulus arvensis*	0.5	0.38	0.03	0.22	8	3	3	3
"	*Crepis biennis*	0.1	0.31	0.66	0.66	6	1	1	1
"	*Daucus carota*	0.22	0.31	0.62	0.46	8	3	3	3
"	*Picris hieracoides*	0.36	0.29	0.64	0.29	9	4	2	10
"	*Plantago lanceolata*	0.37	0.51	0.02	0.01	6	1	1	2
Lasioglossum villosulum	*Crepis biennis*	0.22	0.44	0.15	0.15	5	1	1	2
"	*Picris hieracoides*	0.68	0.09	0	0.9	6	6	6	49
Syritta pipiens	*Achillea millefolium*	0.66	0.21	0	0.95	15	10	10	32
"	*Crepis biennis*	0.21	0.32	0.59	0.57	7	1	1	1
"	*Daucus carota*	0.52	0.26	0.02	0.89	11	5	5	5
"	*Galium mollugo*	0.53	0.39	0.08	0.56	5	2	2	2
"	*Leontodon autumnalis*	0.1	0.17	1	1	7	1	0	1
"	*Pastinaca sativa*	0.47	0.23	0.26	0.39	5	2	2	7
Sphaerophoria cf. scripta	*Achillea millefolium*	0.49	0.35	0.01	0	20	10	10	39
"	*Convolvulus arvensis*	0.46	0.33	0.06	0.47	9	4	3	5
"	*Crepis biennis*	0.38	0.43	0.18	0	9	3	3	6
"	*Daucus carota*	0.54	0.27	0.01	0.29	13	8	8	32
"	*Galium mollugo*	0.56	0.43	0.01	0.04	7	4	4	5
"	*Leontodon autumnalis*	0.45	0.24	0.25	0.67	9	6	5	13
"	*Medicago sativa*	0.14	0.22	0.98	0.95	10	2	1	2
"	*Pastinaca sativa*	0.39	0.23	0.6	0.52	6	4	2	8
"	*Picris hieracoides*	0.39	0.24	0.61	0.52	13	8	4	17
"	*Pimpinella cf saxifraga*	0.53	0.35	0.06	0.54	5	3	3	3
"	*Plantago lanceolata*	0.33	0.34	0.2	0.54	9	2	2	2

Table 3. As Table 2, but without using weights for calculation of mean and sd (and for p-values).

Pollinator species	Flower species	mean PI	sd PI	p of mean	p of sd	N co.	N linked	N preferred	n visits
Bombus lapidarius	*Centaurea jacea*	0.61	0.35	0.01	0.03	5	4	4	20
”	*Cirsium arvense*	0.25	0.4	0.11	0.12	6	2	2	6
”	*Convolvulus arvensis*	0.08	0.22	0.77	0.78	8	1	1	1
”	*Securigera varia*	0.6	0.47	0	0.01	6	4	4	6
”	*Crepis biennis*	0.18	0.35	0.43	0.41	8	2	2	3
”	*Leontodon autumnalis*	0.46	0.37	0.11	0.03	6	4	4	14
”	*Lotus corniculatus*	0.32	0.4	0.07	0.12	7	3	3	7
”	*Medicago sativa*	0.19	0.38	0.48	0.19	9	2	2	3
”	*Picris hieracoides*	0.22	0.33	0.52	0.42	9	3	3	5
”	*Trifolium pratense*	0.16	0.3	0.75	0.6	17	5	2	9
”	*Trifolium repens*	0.39	0.37	0.07	0.03	9	5	5	22
Bombus pascuorum	*Centaurea jacea*	0.19	0.31	0.76	0.61	6	2	1	4
”	*Crepis biennis*	0.09	0.19	0.95	0.97	9	2	1	2
”	*Leontodon autumnalis*	0.16	0.25	0.99	0.94	9	3	1	14
”	*Lotus corniculatus*	0.18	0.37	0.19	0.17	9	2	2	2
”	*Medicago sativa*	0.36	0.43	0.06	0	9	4	4	15
”	*Picris hieracoides*	0.06	0.19	1	0.99	11	1	1	1
”	*Trifolium pratense*	0.71	0.32	0	0.25	21	18	18	91
”	*Trifolium repens*	0.36	0.39	0.02	0.02	12	6	5	19
Bombus sylvarum	*Lotus corniculatus*	0.27	0.42	0.07	0.05	9	3	3	9
”	*Medicago sativa*	0.32	0.38	0.26	0.04	9	4	4	21
”	*Picris hieracoides*	0.06	0.21	1	1	11	1	1	6
”	*Trifolium pratense*	0.53	0.38	0	0.04	13	9	9	24
”	*Trifolium repens*	0.49	0.46	0.01	0.03	7	4	4	4
Episyrphus balteatus	*Achillea millefolium*	0.04	0.13	0.98	0.98	11	1	0	2
”	*Convolvulus arvensis*	0.52	0.42	0.01	0.06	6	4	4	6
”	*Daucus carota*	0.07	0.19	0.99	0.99	8	1	1	3
”	*Medicago sativa*	0.11	0.28	0.72	0.73	6	1	1	1
”	*Picris hieracoides*	0.58	0.32	0	0.09	11	9	8	41
”	*Plantago lanceolata*	0.2	0.4	0.06	0.06	9	2	2	2
”	*Trifolium pratense*	0.03	0.1	0.98	0.99	13	1	0	1
Eristalis tenax	*Achillea millefolium*	0.16	0.3	0.7	0.6	13	3	3	6
”	*Convolvulus arvensis*	0.36	0.49	0.05	0.02	5	2	2	2
”	*Crepis biennis*	0.29	0.37	0.14	0.24	7	3	3	7
”	*Daucus carota*	0.33	0.36	0.18	0.21	10	5	4	9
”	*Leontodon autumnalis*	0.37	0.31	0.32	0.1	8	5	4	25
”	*Medicago sativa*	0.15	0.33	0.57	0.38	5	1	1	4
”	*Pastinaca sativa*	0.16	0.23	0.9	0.94	5	2	1	3
”	*Picris hieracoides*	0.2	0.31	0.75	0.77	6	2	2	3
Lasioglossum malachurum	*Achillea millefolium*	0.3	0.35	0.28	0.33	8	4	3	7
”	*Centaurea jacea*	0.31	0.44	0.16	0.01	5	2	2	9
”	*Daucus carota*	0.1	0.23	0.96	0.95	7	2	1	2
”	*Picris hieracoides*	0.5	0.32	0.03	0.46	8	6	6	23
Lasioglossum pauxillum	*Achillea millefolium*	0.32	0.4	0.05	0.02	14	6	6	14
”	*Convolvulus arvensis*	0.31	0.43	0.03	0.02	8	3	3	3
”	*Crepis biennis*	0.15	0.37	0.35	0.36	6	1	1	1
”	*Daucus carota*	0.31	0.45	0.06	0.01	8	3	3	3
”	*Picris hieracoides*	0.26	0.33	0.53	0.38	9	4	2	10
”	*Plantago lanceolata*	0.16	0.39	0.16	0.16	6	1	1	2
Lasioglossum villosulum	*Crepis biennis*	0.18	0.41	0.14	0.14	5	1	1	2
”	*Picris hieracoides*	0.76	0.16	0	0.99	6	6	6	49
Syritta pipiens	*Achillea millefolium*	0.52	0.39	0	0.01	15	10	10	32
”	*Crepis biennis*	0.09	0.24	0.7	0.71	7	1	1	1
”	*Daucus carota*	0.3	0.35	0.1	0.32	11	5	5	5
”	*Galium mollugo*	0.31	0.42	0.16	0.17	5	2	2	2
”	*Leontodon autumnalis*	0.05	0.13	1	1	7	1	0	1
”	*Pastinaca sativa*	0.22	0.31	0.46	0.47	5	2	2	7
Sphaerophoria cf. scripta	*Achillea millefolium*	0.39	0.41	0.01	0	20	10	10	39
”	*Convolvulus arvensis*	0.31	0.38	0.12	0.18	9	4	3	5
”	*Crepis biennis*	0.28	0.41	0.17	0.06	9	3	3	6
”	*Daucus carota*	0.43	0.36	0.03	0.07	13	8	8	32
”	*Galium mollugo*	0.49	0.46	0	0.02	7	4	4	5
”	*Leontodon autumnalis*	0.38	0.31	0.31	0.41	9	6	5	13
”	*Medicago sativa*	0.09	0.2	0.97	0.98	10	2	1	2
”	*Pastinaca sativa*	0.34	0.3	0.51	0.45	6	4	2	8
”	*Picris hieracoides*	0.34	0.33	0.33	0.13	13	8	4	17
”	*Pimpinella cf saxifraga*	0.44	0.41	0.07	0.22	5	3	3	3
”	*Plantago lanceolata*	0.14	0.28	0.54	0.59	9	2	2	2

Table 4. As Table 2, but for the level of flower families (Asteraceae subfamilies treated separately).

Pollinator species	Flower family	mean PI	sd PI	p of mean	p of sd	N co.	N linked	N preferred	n visits
Bombus lapidarius	Carduoideae	0.69	0.17	0	0.6	11	8	8	35
”	Cichorioideae	0.4	0.31	0.4	0.01	20	9	9	22
”	Convolvulaceae	0.17	0.29	0.77	0.82	9	1	1	1
”	Fabaceae	0.44	0.3	0.32	0	20	12	11	48
”	Plantaginaceae	0.25	0.3	0.67	0.66	7	1	1	1
Bombus pascuorum	Carduoideae	0.28	0.31	0.89	0.1	11	3	2	6
”	Cichorioideae	0.17	0.23	1	0.78	24	6	2	17
”	Dipsacaceae	0.31	0.47	0.23	0.04	5	2	2	2
”	Fabaceae	0.7	0.17	0	0.7	24	22	22	135
Bombus sylvarum	Carduoideae	0.49	0.3	0.05	0.24	10	4	4	16
”	Cichorioideae	0.08	0.23	1	0.84	16	1	1	7
”	Convolvulaceae	0.11	0.31	0.73	0.56	8	1	1	1
”	Fabaceae	0.68	0.13	0	0.96	17	16	15	66
Episyrphus balteatus	Apiaceae	0.19	0.29	0.98	0.39	12	2	2	5
”	Asteroideae	0.27	0.3	0.74	0.45	13	2	1	5
”	Carduoideae	0.15	0.26	0.8	0.91	7	1	1	1
”	Cichorioideae	0.51	0.29	0.04	0.03	16	11	10	44
”	Convolvulaceae	0.6	0.22	0.01	0.88	7	4	4	6
”	Fabaceae	0.07	0.16	1	1	16	2	1	3
”	Plantaginaceae	0.5	0.39	0.08	0.04	9	3	3	4
”	Rubiaceae	0.27	0.46	0.25	0.07	5	2	2	2
Eristalis tenax	Apiaceae	0.45	0.26	0.2	0.34	14	11	8	16
”	Asteroideae	0.32	0.33	0.54	0.18	14	4	4	7
”	Carduoideae	0.44	0.4	0.19	0.03	5	1	1	4
”	Cichorioideae	0.5	0.26	0.05	0.24	16	9	9	37
”	Convolvulaceae	0.51	0.5	0.02	0.03	5	2	2	2
”	Fabaceae	0.09	0.23	1	0.98	15	1	1	4
Lasioglossum malachurum	Apiaceae	0.17	0.21	1	0.8	9	3	1	4
”	Asteroideae	0.54	0.19	0.03	0.81	10	7	6	21
”	Carduoideae	0.28	0.35	0.88	0.01	7	3	3	10
”	Cichorioideae	0.58	0.24	0	0.48	12	7	7	35
Lasioglossum pauxillum	Apiaceae	0.46	0.25	0.14	0.89	10	7	6	8
”	Asteroideae	0.49	0.36	0.06	0.01	15	6	6	15
”	Cichorioideae	0.3	0.3	0.89	0.11	16	6	3	14
”	Convolvulaceae	0.48	0.38	0.03	0.2	9	3	3	3
”	Fabaceae	0.14	0.25	1	0.94	17	3	2	6
”	Plantaginaceae	0.43	0.51	0.03	0	6	1	1	2
Lasioglossum villosulum	Cichorioideae	0.71	0.11	0	0.96	12	12	12	65
Syritta pipiens	Apiaceae	0.6	0.2	0	0.87	13	11	11	28
”	Asteroideae	0.61	0.23	0	0.61	16	10	10	34
”	Cichorioideae	0.1	0.18	1	1	16	2	1	2
”	Rubiaceae	0.63	0.37	0.01	0.25	6	3	3	5
Sphaerophoria cf. scripta	Apiaceae	0.48	0.27	0.06	0.33	19	14	11	46
”	Asteroideae	0.48	0.34	0.02	0	22	11	11	45
”	Cichorioideae	0.43	0.23	0.34	0.52	26	17	10	39
”	Campanulaceae	0.12	0.29	0.96	0.68	5	1	1	1
”	Convolvulaceae	0.45	0.33	0.06	0.45	10	4	3	5
”	Fabaceae	0.07	0.17	1	1	26	4	1	4
”	Plantaginaceae	0.38	0.33	0.21	0.31	9	2	2	4
”	Rosaceae	0.65	0.36	0.01	0.25	5	3	3	6
”	Rubiaceae	0.61	0.39	0	0.08	9	5	5	7

Table 5. As Table 4, but Asteraceae subfamilies treated as a single family (not discussed in main text).

Pollinator species	Flower family	mean PI	sd PI	p of mean	p of sd	N co.	N linked	N preferred	n visits
Bombus lapidarius	Asteraceae	0.48	0.24	0.08	0.32	21	15	14	57
”	Convolvulaceae	0.17	0.29	0.76	0.81	9	1	1	1
”	Fabaceae	0.44	0.3	0.32	0	20	12	11	48
”	Plantaginaceae	0.25	0.3	0.67	0.65	7	1	1	1
Bombus pascuorum	Asteraceae	0.17	0.22	1	0.24	25	9	3	23
”	Dipsacaceae	0.31	0.47	0.23	0.03	5	2	2	2
”	Fabaceae	0.7	0.17	0	0.71	24	22	22	135
Bombus sylvarum	Asteraceae	0.2	0.28	1	0	17	5	2	23
”	Convolvulaceae	0.11	0.31	0.74	0.57	8	1	1	1
”	Fabaceae	0.68	0.13	0	0.95	17	16	15	66
Episyrphus balteatus	Apiaceae	0.19	0.29	0.98	0.4	12	2	2	5
”	Asteraceae	0.47	0.27	0.22	0.02	17	12	10	50
”	Convolvulaceae	0.6	0.22	0.01	0.88	7	4	4	6
”	Fabaceae	0.07	0.16	1	1	16	2	1	3
”	Plantaginaceae	0.5	0.39	0.07	0.04	9	3	3	4
”	Rubiaceae	0.27	0.46	0.26	0.07	5	2	2	2
Eristalis tenax	Apiaceae	0.45	0.26	0.2	0.35	14	11	8	16
”	Asteraceae	0.49	0.24	0.1	0.19	16	11	11	48
”	Convolvulaceae	0.51	0.5	0.01	0.03	5	2	2	2
”	Fabaceae	0.09	0.23	1	0.98	15	1	1	4
Lasioglossum malachurum	Apiaceae	0.17	0.21	1	0.79	9	3	1	4
”	Asteraceae	0.59	0.11	0	0.98	13	12	12	66
Lasioglossum pauxillum	Apiaceae	0.46	0.25	0.14	0.89	10	7	6	8
”	Asteraceae	0.43	0.25	0.46	0.26	17	11	8	29
”	Convolvulaceae	0.48	0.38	0.03	0.2	9	3	3	3
”	Fabaceae	0.14	0.25	1	0.94	17	3	2	6
”	Plantaginaceae	0.43	0.51	0.03	0	6	1	1	2
Lasioglossum villosulum	Asteraceae	0.65	0.08	0	1	12	12	12	65
Syritta pipiens	Apiaceae	0.6	0.2	0	0.88	13	11	11	28
”	Asteraceae	0.4	0.25	0.74	0.14	17	11	8	36
”	Rubiaceae	0.63	0.37	0.01	0.25	6	3	3	5
Sphaerophoria cf. scripta	Apiaceae	0.48	0.27	0.06	0.33	19	14	11	46
”	Asteraceae	0.49	0.22	0.07	0.28	27	23	15	84
”	Campanulaceae	0.12	0.29	0.96	0.68	5	1	1	1
”	Convolvulaceae	0.45	0.33	0.06	0.46	10	4	3	5
”	Fabaceae	0.07	0.17	1	1	26	4	1	4
”	Plantaginaceae	0.38	0.33	0.22	0.3	9	2	2	4
”	Rosaceae	0.65	0.36	0.01	0.24	5	3	3	6
”	Rubiaceae	0.61	0.39	0	0.08	9	5	5	7