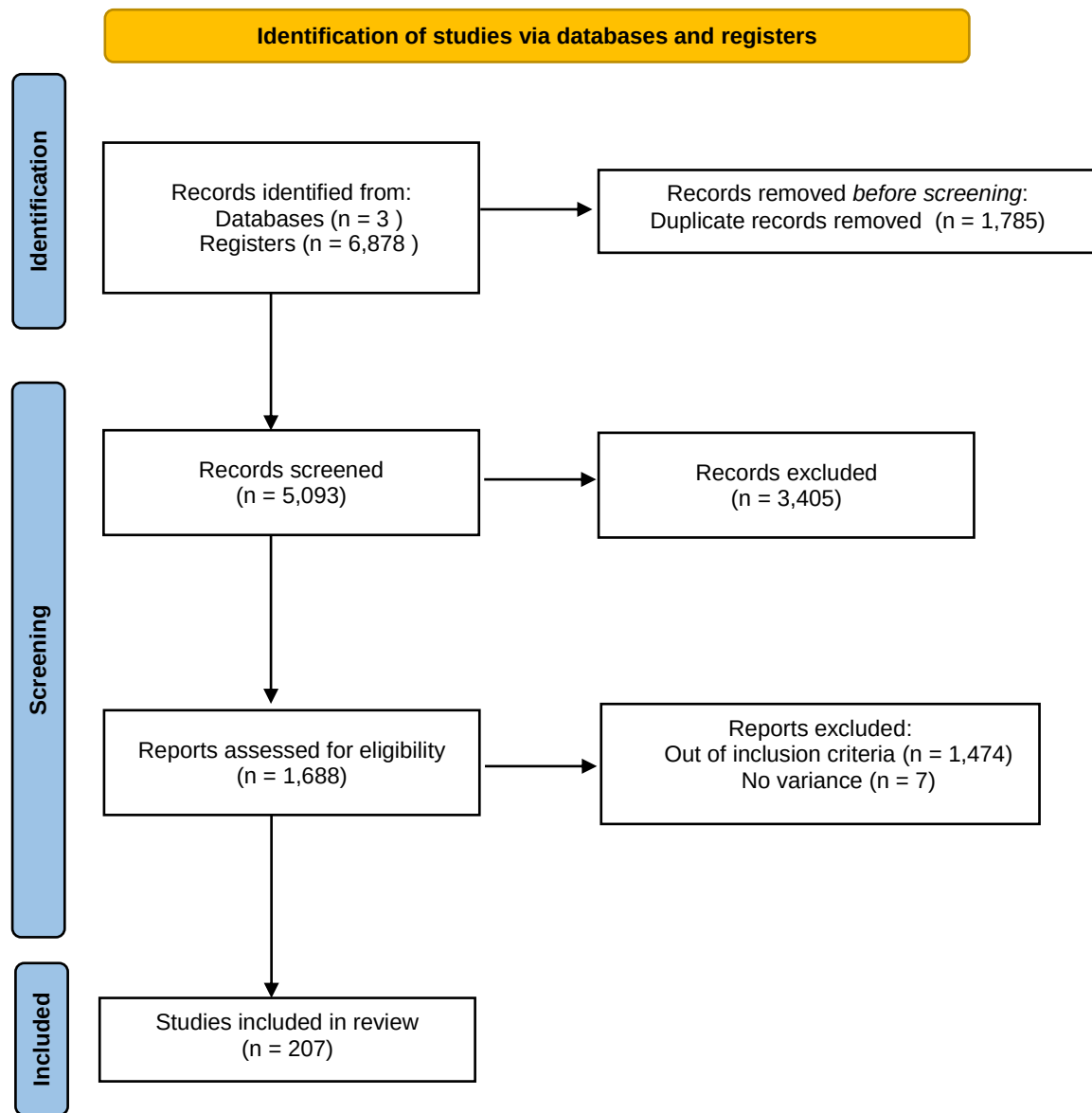


Loss of pollinator diversity consistently reduces reproductive success for wild and cultivated plants

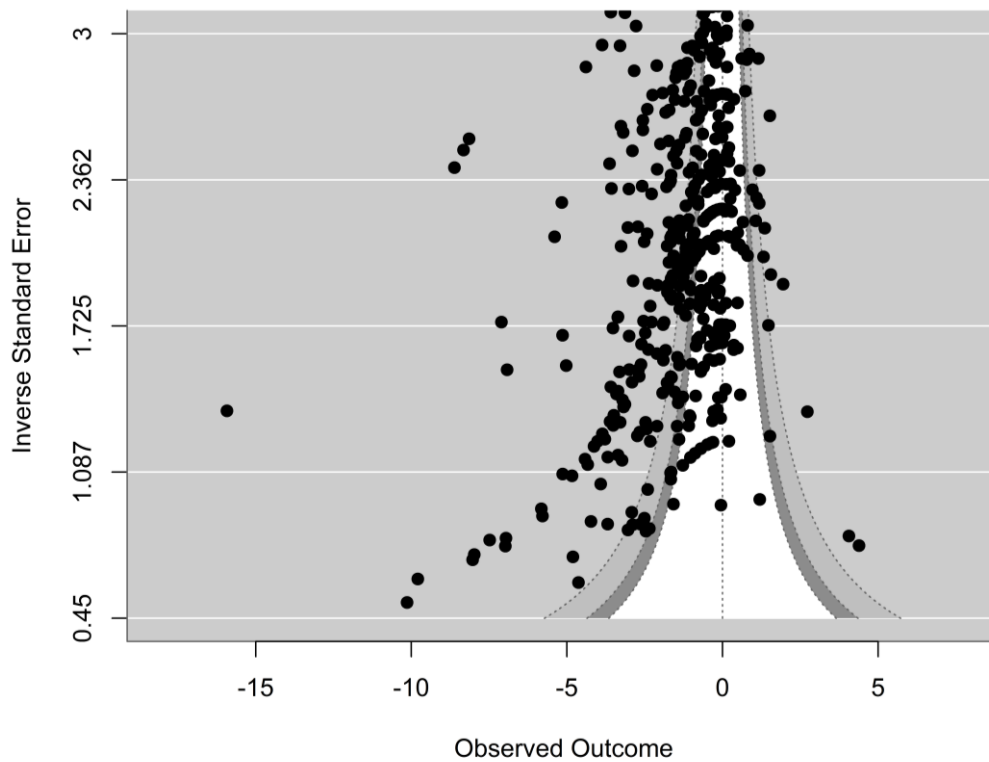
In the format provided by the
authors and unedited

SUPPLEMENTARY MATERIAL

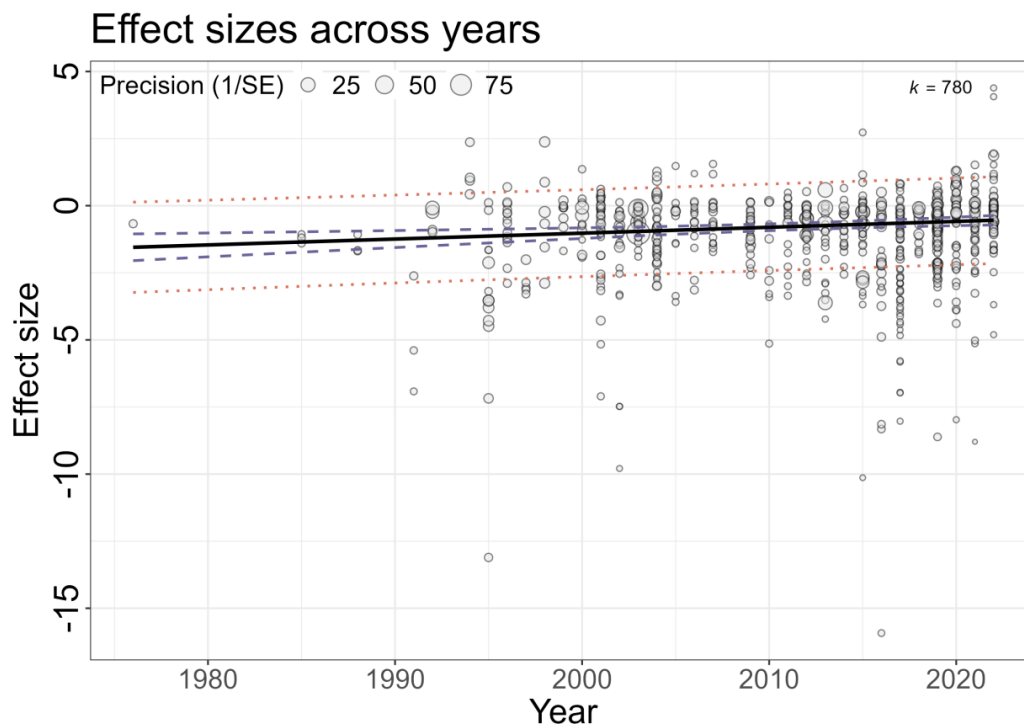


From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ* 2021;372:n71. doi: 10.1136/bmj.n71

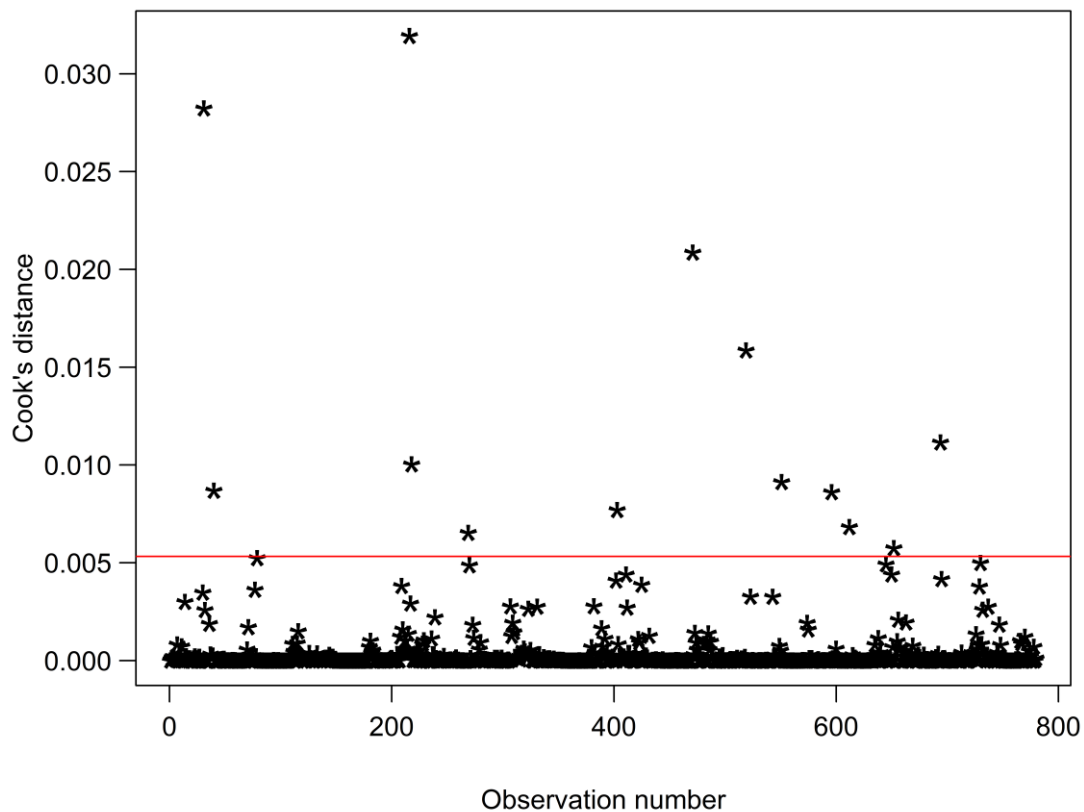
Supplementary Figure 1 – Modified PRISMA flow diagram. Sequence of information in the different phases of a systematic review using the PRISMA protocol (Preferred Reporting Items for Systematic Reviews and Meta-Analyses), conducted on October 2022. For the full search string refer to Methodology in the main text.



Supplementary Figure 2– Contour-enhanced funnel plots of the residuals from the null models. Studies that are more precise are located at the top of the plot and less precise studies are located at the bottom.



Supplementary Figure 3 – Time lag bias for the effect of losing pollinator diversity on plant reproductive success. Purple dotted lines indicate 95% confidence intervals and orange dotted lines indicate 95% prediction intervals. (estimate=0.02, $p=0.001$, $N=780$ observations). It is a meta-analytical two-sided Q statistic model.



Supplementary Figure 4 – Cook's distance of each effect size for plant reproductive success measures. Red lines indicate the thresholds for considering an observation as influential. This method was used to identify the most influential observations

Supplementary Table 1– Summary of the random effects tested to identify the best null model. The optimal random effect structure was identified using AIC, the lowest being highlighted in bold.

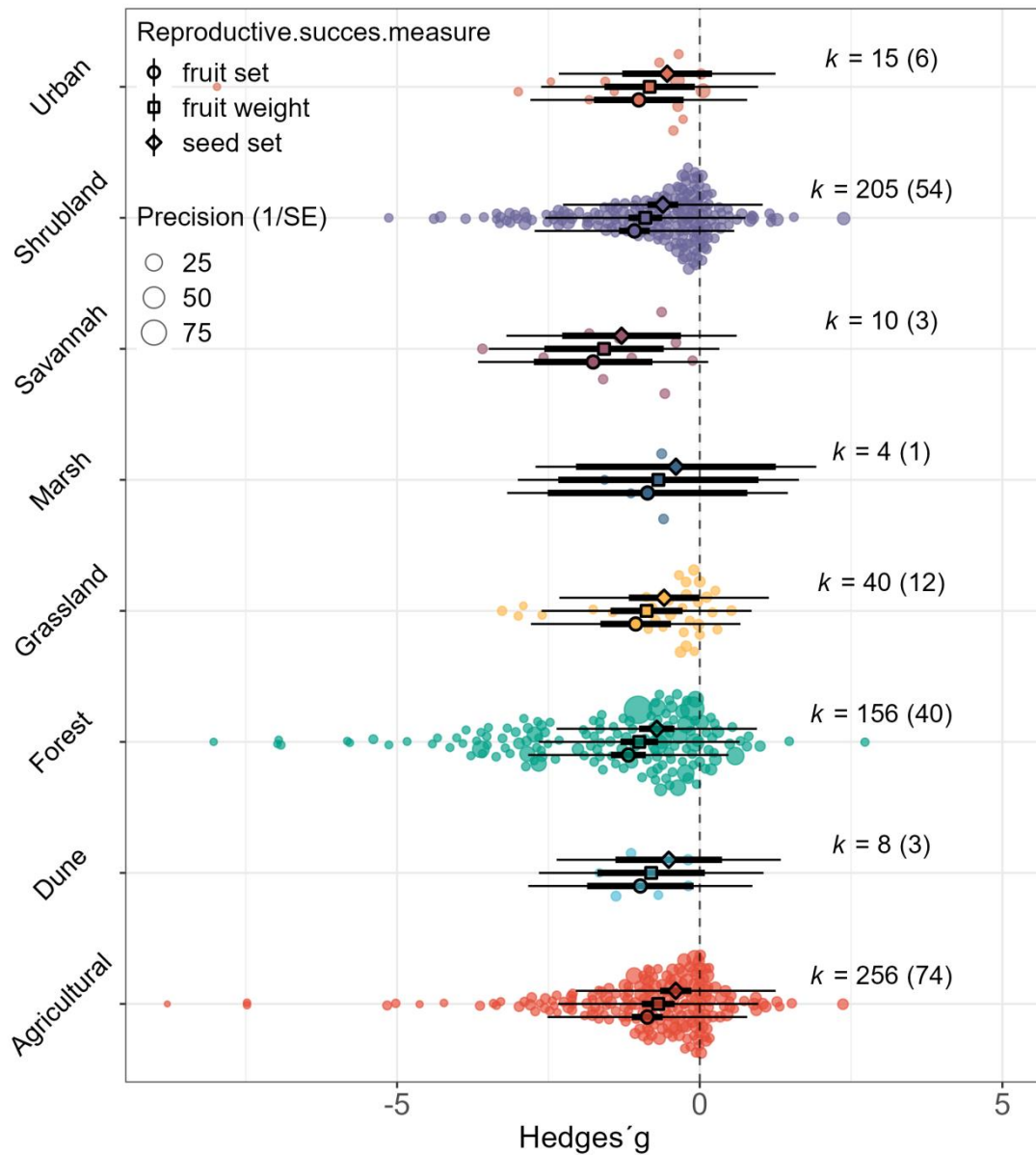
Random effects	null model (AIC)
~1 Title	24573.6
~1 Country	32211.65
~1 Year	27685.03
~1 Title, ~1 Country	24575.5
~1 Title, ~1 Year	24573.5
~1 Title, ~1 Year, ~1 Country	24575.49
~1 Title/Year	24575.6
~1 Year/Country	25170.7
~1 Country/Title	24575.5

Supplementary Table 2 – Results of the sensitivity analyses on overall plant reproductive success. Sensitivity analyses were performed comparing a) the original model included in the main text with b) a model leaving out influential studies detected with Cook's distance (sensitivity model 1), and with c) a model clustering effect sizes at the level of individual studies in the construction of variance-covariance matrices (sensitivity model 2). Three of the models showed significant negative effects of losing pollinator diversity ($p < 0.0001$). All models are meta-analytical two-sided Q statistic models.

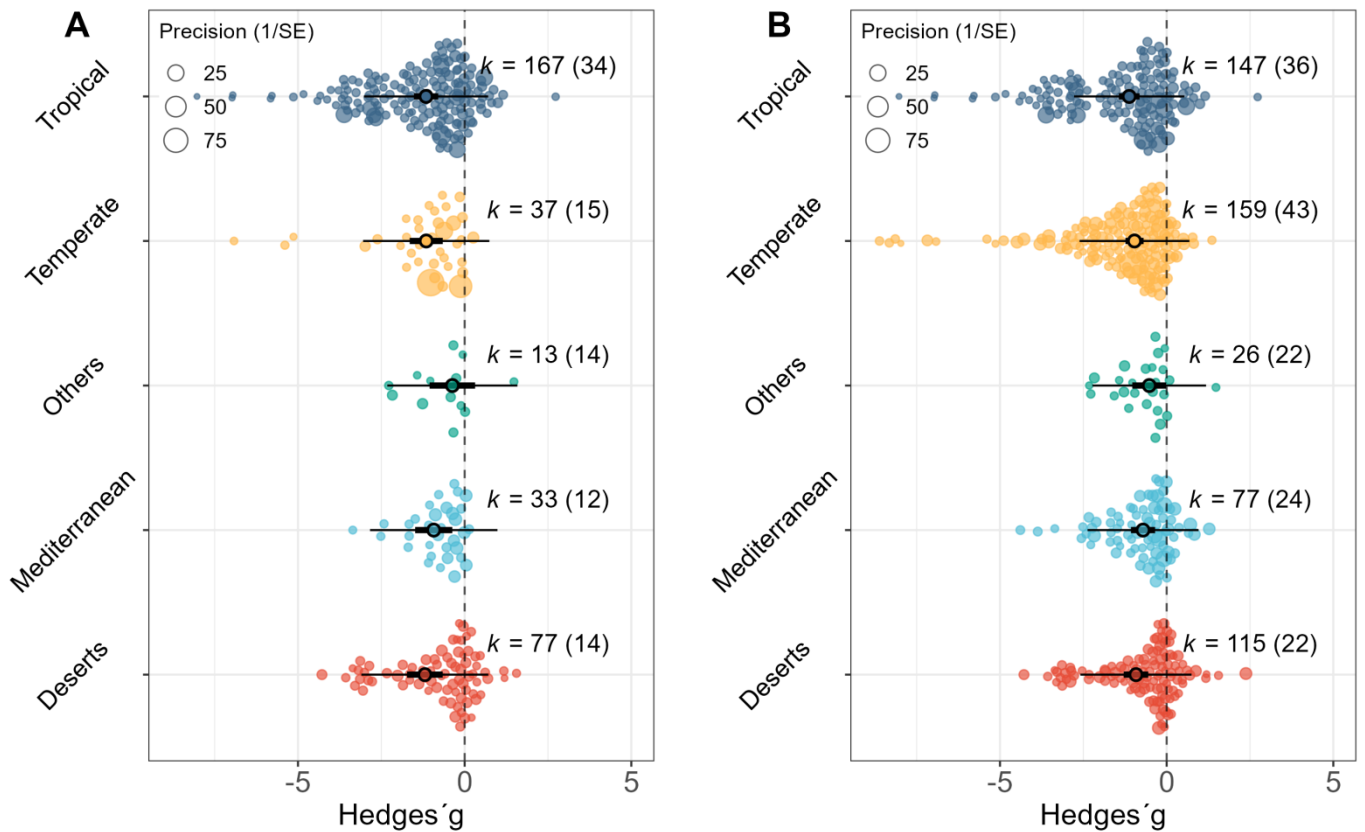
	Hedges'g effect size	95% CI	N
Original model	-0.83	-1 / -0.67	780
Sensitivity model 1	-0.91	-1.15 / -0.68	766
Sensitivity model 2	-0.57	-0.7 / -0.44	780

Supplementary Table 3 – Results of moderators models for the effect of pollinator species diversity loss. All models are meta-analytical two-sided Q statistic models.

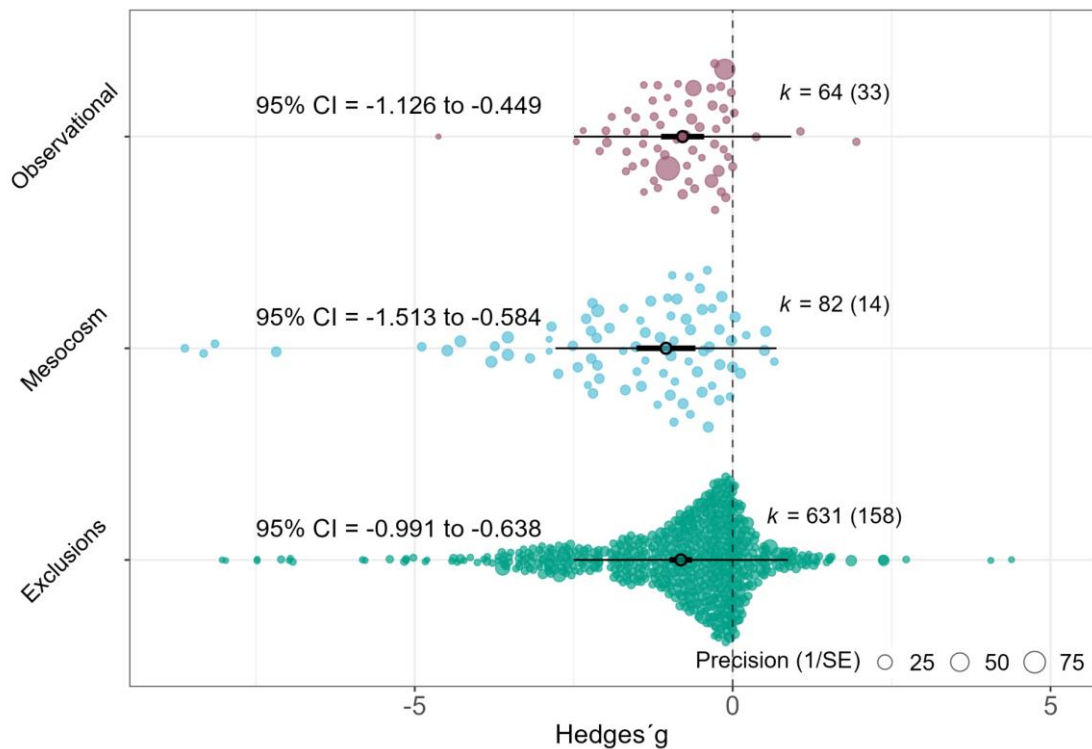
		Hedges'g effect size	CI	N	p value	effect size according to Cohen
	Original model	-0.83	-1 / -0.67	780	< 0.0001	large
Crop or No crop	Crop	-0.64	-0.88 / -0.4	256	<0.0001	medium
	Wild Plants	-0.91	-1.09 / -0.73	524	<0.0001	large
Reproductive success measures	Fruit set	-1.05	-1.2 / -0.89	318	<0.0001	large
	Fruit weight	-0.85	-1.04 / -0.66	48	<0.0001	large
	Seed set	-0.6	-0.77 / -0.44	306	<0.0001	medium
Compatible plants	Fruit set	-0.99	-1.61 / -0.38	37	0.0016	large
	Fruit weight	-1.04	-1.66 / -0.42	27	0.0011	large
	Seed set	-1.21	-1.83 / -0.59	38	0.0001	large
Plant species compatibility	Partially compatible	-0.09	-0.4 / 0.23	28	0.59	neutral
	Self compatible	-0.68	-0.98 / -0.38	130	<0.0001	medium
	Self incompatible	-1.03	-1.33 / -0.73	80	<0.0001	large
Nocturnal or Diurnal pollinators	Nocturnal pollinators	-1.63	-1.96 / -1.36	133	<0.0001	large
	Diurnal pollinators	-0.59	-0.86 / -0.31	285	<0.0001	medium
Vertebrate or Invertebrate	Vertebrate pollinators	-0.5	-0.74 / -0.26	215	<0.0001	medium
	Invertebrate pollinators	-1.38	-1.62 / -1.14	277	<0.0001	large
Wild or Managed pollinators	Wild pollinators	-0.87	-1.03 / -0.71	697	<0.0001	large
	Managed pollinators	-0.32	-0.52 / -0.11	83	0.0023	small
Study type	Exclusions	-0.81	-0.99 / -0.64	631	<0.0001	medium
	Observational	-0.79	-1.13 / -0.45	64	<0.0001	medium
	Mesocosm	-1.05	-1.51 / -0.58	82	<0.0001	large



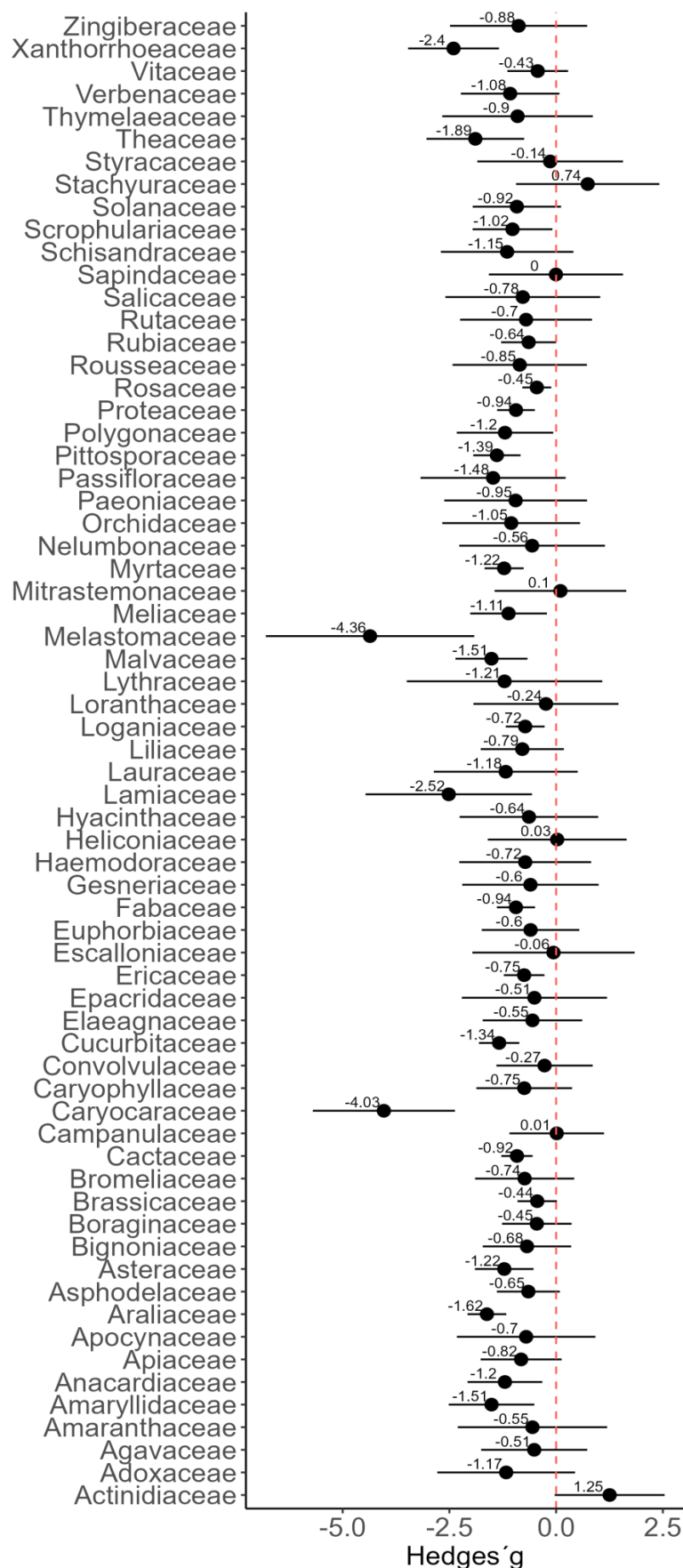
Supplementary Figure 5 – Effect of pollinator diversity loss on the main plant reproductive success measures across different landscapes and habitats. Large points refer to the summary effect size (Hedges'g = -0.73, -0.8, -1.67, -0.79, -0.61, -1.05, 1.05 and -0.62, respectively for urban, shrubland, savannah, marsh, grassland, forest, dune and agricultural habitats), thicker bars around them represent the 95% confidence intervals, and the thinner bars the 95% prediction intervals. Smaller, semi-transparent points represent individual comparisons. The vertical dashed line represents where the effect size is equal to zero (i.e. where there is no difference between control and treatment groups). Mesocosm experimental studies have been excluded as they were not categorized as a landscape type, and mangroves have also been removed due to their unique observation. k indicates the number of comparisons and in parentheses is the number of studies from which they are derived. Precision indicates the weight of each study, studies with the lowest standard error (SE) are more precise and therefore have bigger precision circles.



Supplementary Figure 6 – A) Effect of vertebrate pollinator diversity loss across different biomes and B) effect of pollinator diversity loss for wild plants across different biomes. To compare climate zones, we grouped those corresponding to temperate zones, such as mixed forests, grasslands and coniferous forests, and did the same for tropical zones, including subtropical zones. We also grouped less studied zones together as the 'other' category, which includes mangroves, tundra, marshes, and high mountains. Large points refer to the summary effect size (A- Hedges' $g = -1.16, -1.15, -0.37, -0.93$ and -1.19 , respectively for Tropical climatic zones, Temperate climatic zones, other climatic zones, Mediterranean climatic zones and Deserts; B- Hedges' $g = -1.12, -0.96, -0.52, -0.71$ and -0.92 , respectively for Tropical climatic zones, Temperate climatic zones, other climatic zones, Mediterranean climatic zones and Deserts), thicker bars around them represent the 95% confidence intervals, and the thinner bars the 95% prediction intervals. Smaller, semi-transparent points represent individual comparisons. Differences in their size refer to the weight they supply to the analysis. The vertical dashed line represents where the effect size is equal to zero (i.e. where there is no difference between control and treatment groups). k indicates the number of comparisons and in parentheses is the number of studies from which they are derived. Precision indicates the weight of each study, being studies with lowest SE more precise and therefore with bigger precision circles (1/SE).



Supplementary Figure 7 – Effect of pollinator diversity loss on different study types. Large points refer to the summary effect size (Hedges' $g = -0.79, -1.05$ and -0.81 , respectively for observational, mesocosm and exclusion studies), thicker bars around them represent the 95% confidence intervals, and the thinner bars the 95% prediction intervals. Smaller, semi-transparent points represent individual comparisons. The vertical dashed line represents where the effect size is equal to zero (i.e. where there is no difference between control and treatment groups). k indicates the number of comparisons and in parentheses is the number of studies from which they are derived. Precision indicates the weight of each study, studies with the lowest standard error (SE) are more precise and therefore have bigger precision circles.

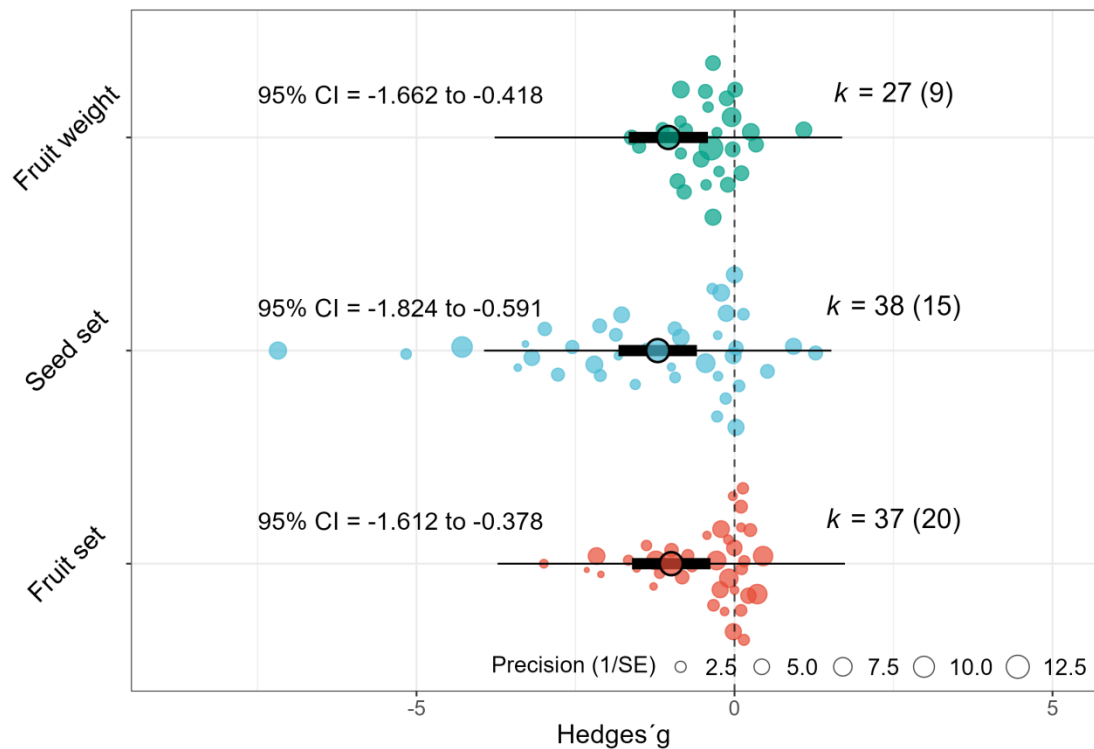


Supplementary Figure 8 – Effect of pollinator diversity loss on plant families reproductive success. Large points refer to the summary effect size, and lines indicate 95% CI. The vertical dashed line represents where the effect size is equal to zero (i.e. where there is no difference between control and treatment groups). N total = 777, ranging from N=148 in Cactaceae family to N=1 in Styracaceae (see Supplementary Table 4). The model did not include three observations of the whole plant community.

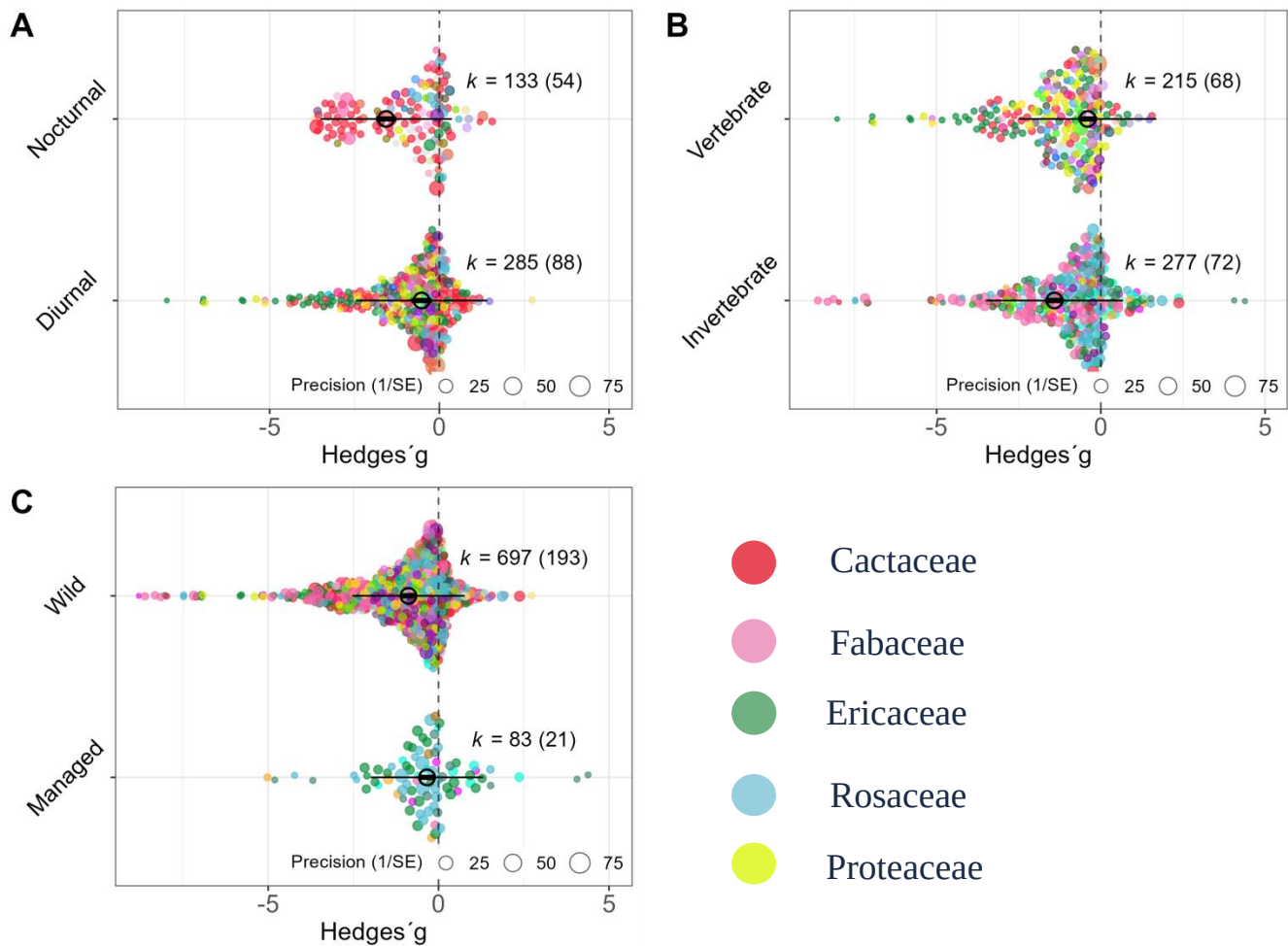
Supplementary Table 4 – Number of observations for plant species families.

Observations that include data of the entire plant community are not included.

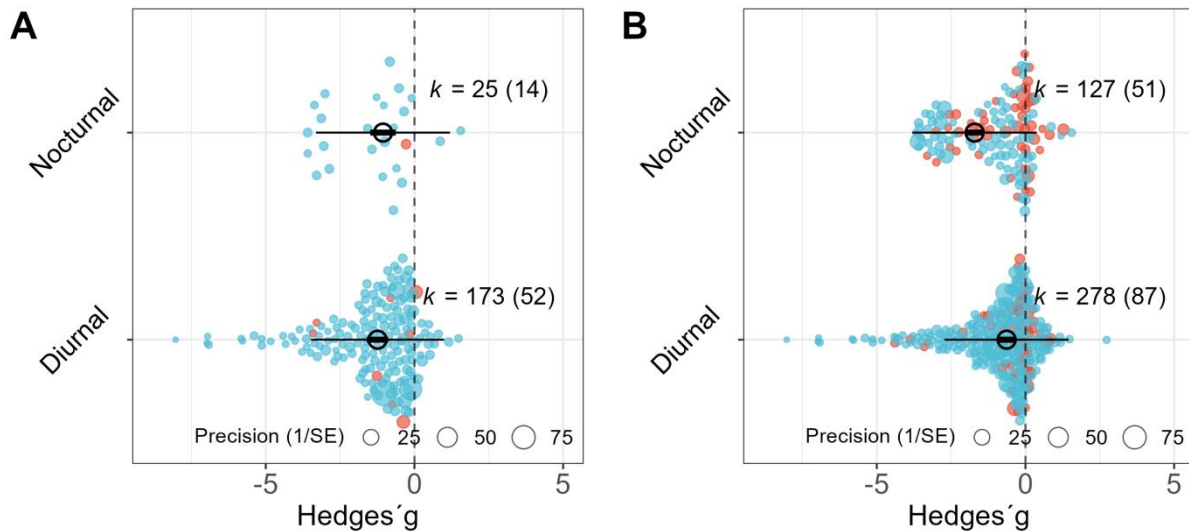
Plant species family	n	Plant species family	n	Plant species family	n
Cactaceae	148	Malvaceae	7	Paeoniaceae	2
Ericaceae	95	Scrophulariaceae	7	Passifloraceae	2
Fabaceae	75	Verbenaceae	7	Rutaceae	2
Rosaceae	67	Elaeagnaceae	6	Salicaceae	2
Proteaceae	34	Campanulaceae	5	Sapindaceae	2
Boraginaceae	24	Liliaceae	5	Thymelaeaceae	2
Brassicaceae	24	Pittosporaceae	5	Vitaceae	2
Asphodelaceae	22	Xanthorrhoeaceae	5	Zingiberaceae	2
Asteraceae	20	Apocynaceae	4	Araliaceae	1
Cucurbitaceae	17	Loranthaceae	4	Bignoniaceae	1
Rubiaceae	17	Hyacinthaceae	3	Caryocaraceae	1
Solanaceae	17	Meliaceae	3	Gesneriaceae	1
Agavaceae	15	Theaceae	3	Heliconiaceae	1
Anacardiaceae	13	Actinidiaceae	2	Lauraceae	1
Myrtaceae	12	Adoxaceae	2	Loganiaceae	1
Amaryllidaceae	11	Amaranthaceae	2	Lythraceae	1
Apiaceae	10	Epacridaceae	2	Melastomaceae	1
Caryophyllaceae	10	Escalloniaceae	2	Nelumbonaceae	1
Euphorbiaceae	10	Haemodoraceae	2	Rousseaceae	1
Bromeliaceae	8	Lamiaceae	2	Schisandraceae	1
Convolvulaceae	8	Mitrastemonaceae	2	Stachyuraceae	1
Polygonaceae	8	Orchidaceae	2	Styracaceae	1



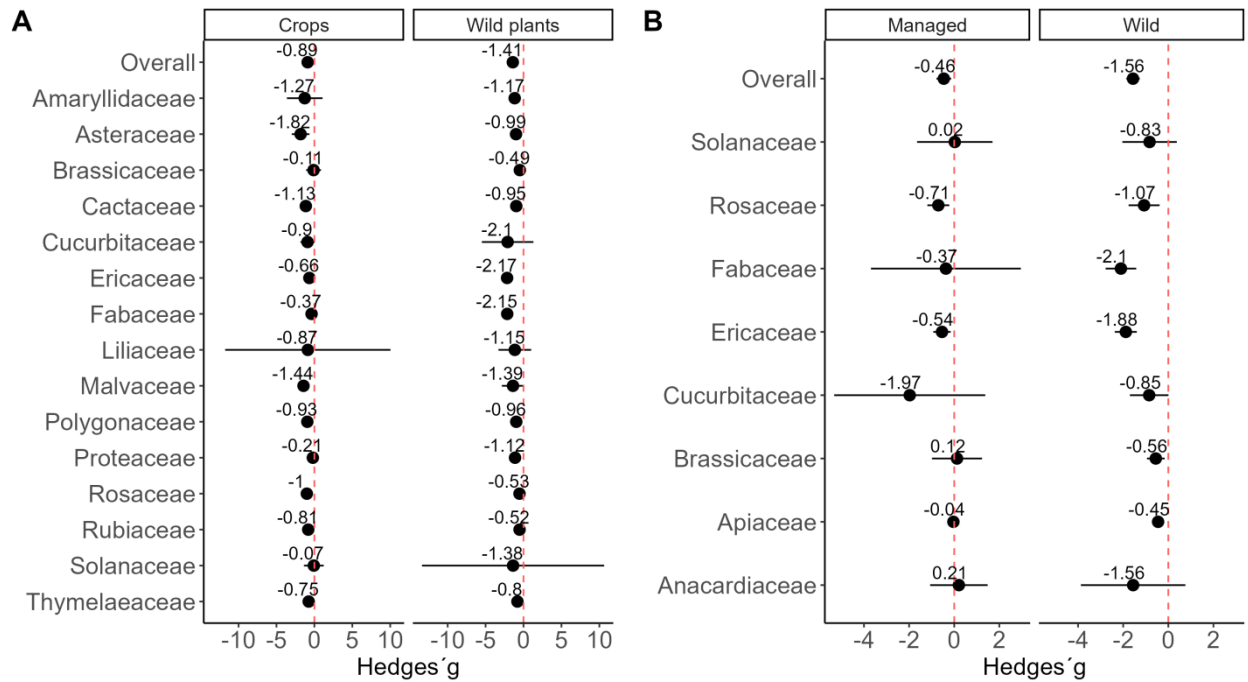
Supplementary Figure 9- Effect of pollinator diversity loss for self-compatible plants. Large points refer to the summary effect size ($Hedges' g = -1.07, -1.23$ and -1.03 , respectively for fruit weight, seed set and fruit set), thicker bars around them represent the 95% confidence intervals, and the thinner bars the 95% prediction intervals. Smaller, semi-transparent points represent individual comparisons. The vertical dashed line represents where the effect size is equal to zero (i.e. where there is no difference between control and treatment groups). k indicates the number of comparisons and in parentheses is the number of studies from which they are derived. Precision indicates the weight of each study, studies with the lowest standard error (SE) are more precise and therefore have bigger precision circles.



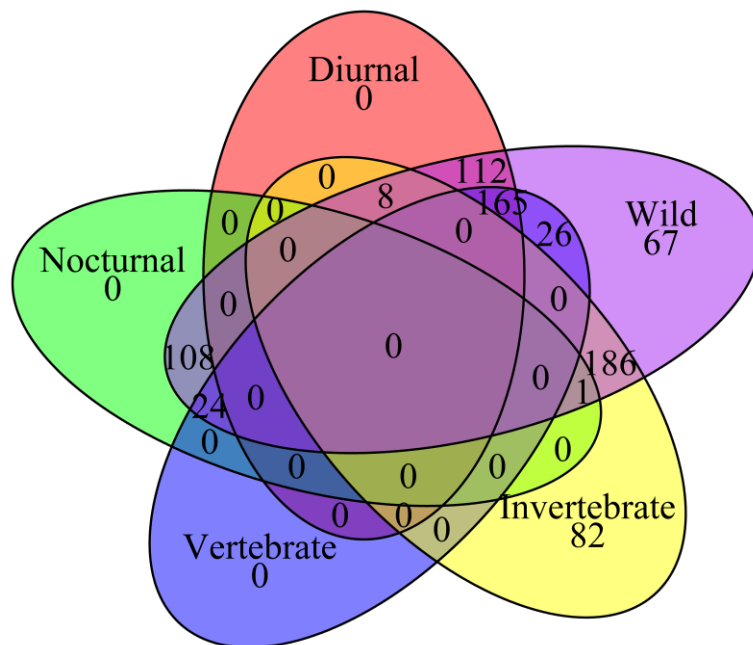
Supplementary Figure 10- Effect on reproductive success of plant families according to the type of pollinator excluded. Large points refer to the summary effect size (Hedges'g = -1.57 for nocturnal pollinators, -0.52 for diurnal pollinators, -0.4 for vertebrate pollinators, -1.41 for invertebrate pollinators, -0.88 for wild pollinators and -0.34 for managed pollinators), thicker bars around them represent the 95% confidence intervals, and the thinner bars the 95% prediction intervals. Smaller, semi-transparent points represent individual comparisons. The vertical dashed line represents where the effect size is equal to zero (i.e. where there is no difference between control and treatment groups). k indicates the number of comparisons and in parentheses is the number of studies from which they are derived. Colours indicate the plant family studied. Precision indicates the weight of each study, studies with the lowest standard error (SE) are more precise and therefore have bigger precision circles. This model includes nocturnal/diurnal pollinator and plant species family as moderators, as compared to the one shown in Figure 6.



Supplementary Figure 11- Effect of nocturnal and diurnal pollinator diversity loss on plant reproductive success, blue points representing vertebrate pollinators and red points invertebrate ones. Figure A depicts data from studies that exclusively exclude vertebrates by caging. Figure B depicts all data, which, despite including diurnal or nocturnal full exclusions, investigate the effect of specific pollinators (bats, birds, moths, bees, or diptera). Large points refer to the summary effect size (Fig. A Hedges'g = -1.06 and -1.24, respectively for nocturnal and diurnal pollinators and Fig. B Hedges'g = -1.71 for nocturnal pollinators and -0.63 for diurnal pollinators), thicker bars around them represent the 95% confidence intervals, and the thinner bars the 95% prediction intervals. Smaller points represent individual comparisons. The vertical dashed line represents where the effect size is equal to zero (i.e. where there is no difference between control and treatment groups). *k* indicates the number of comparisons and in parentheses is the number of studies from which they are derived. Colours indicate the excluded pollinator type. Precision indicates the weight of each study, studies with the lowest standard error (SE) are more precise and therefore have bigger precision circles.



Supplementary Figure 12- Forest plots for sharing plant families between A) crops and wild plants and B) managed and wild pollinators. Large points refer to the summary effect size, and lines indicate 95% CI. The vertical dashed line represents where the effect size is equal to zero (i.e. where there is no difference between control and treatment groups). Figure A, N=547 and Figure B, N=318.



Supplementary Figure 13- Venn diagram illustrating the number of observations for each variable and combination.