

A GLOBAL SYNTHESIS OF FIRE EFFECTS ON POLLINATORS. *Global Ecology and Biogeography*

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Supporting Information

Table S1. Synopsis of models used in the different hierarchical mixed effects meta-analyses, expressed in R language syntax, using the *metafor* package (Viechtbauer, 2010). *d*= Hedges' *d*. *Vd* = variance of Hedges' *d*. *id*= study identify.

Test for overall effect
<pre>rma.mv(d, Vd, data=abundance, method="REML", random=list(~1 id))</pre>
Test for predictor variable (fire frequency, postfire age, fire type, pollinator taxa, biome, physiognomy, etc.)
<pre>rma.mv(d, Vd, data=abundance, mods=~predictor_variable, method="REML", random=list(~1 id))</pre>

Table S2. Summary of the all fire effects (a) and wildfires effects only (b) on abundance and richness of pollinators showing tests of moderator variables from the meta-analysis. Significant influence of moderators is indicated in bold (when $p \leq 0.05$ and 95% CI does not include zero).

Response variable	Moderators	Category	n	Hedges' <i>d</i>	<i>P</i>	CI
a. All fire effects						
Abundance	Overall	-	293	0.16	0.058	-0.005 - 0.320
	Fire frequency	once burned-unburned	259	0.17	0.060	-0.078 - 0.338
		repeated burned-unburned	24	-0.32	0.108	-0.746 - 0.071
	Postfire time	early	162	0.32	0.0006	0.138 - 0.499
		late	111	-0.05	0.614	-0.239 - 0.141
	Fire type	prescribed fires	127	0.05	0.672	-0.191 - 0.296
		wildfires	165	0.25	0.027	0.029 - 0.470
	Pollinator taxa	birds	13	-0.22	0.538	-0.902 - 0.471
		Coleoptera	12	0.40	0.083	-0.058 - 0.855
		Diptera	25	0.17	0.120	-0.043 - 0.378
		Hymenoptera	174	0.18	0.048	0.001 - 0.368
		Lepidoptera	59	0.03	0.776	-0.198 - 0.266
	Sociality system	social	37	0.22	0.037	0.014 - 0.436
		solitary	52	0.16	0.085	-0.022 - 0.342
	Nest location	aboveground	33	0.17	0.064	-0.010 - 0.356
		belowground	38	0.18	0.050	0.001 - 0.361
	Pollination	generalist	54	0.11	0.222	-0.064 - 0.275
		specialist	27	0.04	0.689	-0.172 - 0.261
Richness	Overall	-	99	0.19	0.172	-0.084 - 0.469
	Fire frequency	once burned-unburned	65	0.27	0.099	-0.050 - 0.581
		repeated burned-unburned	18	-0.16	0.468	-0.590 - 0.271
	Postfire time	early	34	0.39	0.019	0.064 - 0.700
		late	45	0.04	0.787	-0.275 - 0.363
	Fire type	prescribed fires	30	-0.05	0.834	-0.526 - 0.425
		wildfires	69	0.31	0.066	-0.021 - 0.647

	Pollinator taxa	birds	2	-1.13	0.068	-2.356 - 0.086
		Coleoptera	3	0.01	0.981	-0.719 - 0.737
		Diptera	9	0.29	0.257	-0.214 - 0.799
		Hymenoptera	49	0.19	0.250	-0.134 - 0.514
		Lepidoptera	23	-0.08	0.706	-0.511 - 0.346
b. Wildfires only						
Abundance	Pollinator taxa	birds	9	-0.052	0.909	-0.947 - 0.843
		Coleoptera	4	0.03	0.935	-0.594 - 0.645
		Diptera	9	0.48	0.069	-0.037 - 0.989
		Hymenoptera	110	0.41	0.003	0.143 - 0.678
		Lepidoptera	26	-0.39	0.034	-0.754 - -0.030
Richness	Pollinator taxa	Coleoptera	2	0.07	0.879	-0.779 - 0.911
		Diptera	6	0.33	0.336	-0.340 - 0.996
		Hymenoptera	38	0.45	0.039	0.022 - 0.876
		Lepidoptera	11	-0.40	0.238	-1.068 - 0.266

Table S3. Summary table showing tests of moderators and heterogeneities from the meta-analysis of all fire effects (a) and wildfires effects only (b) on pollinator abundance and richness datasets. Significant influence of moderators is indicated in bold (when 95% CI does not include zero). The categories of the moderator variables are shown in Table S2.

Effect	Response variable	Moderators	d.f.	Q^*	P
a. All fire effects	Abundance	Overall	292	$Q_t=1300.39$	<0.0001
		Fire frequency	1, 281	$Q_b=6.503$	0.011
		Postfire time	1, 271	$Q_b=34.596$	<0.0001
		Fire type	1, 290	$Q_b=1.380$	0.240
		Pollinator taxa	4, 278	$Q_b=4.406$	0.354
		Sociality system	1, 87	$Q_b=0.411$	0.521
		Nest location	1, 69	$Q_b=0.005$	0.946
		Pollination specialization	1, 79	$Q_b=0.334$	0.563
		Biome	9, 283	$Q_b=7.988$	0.535
		Physiognomy	2, 286	$Q_b=4.936$	0.085
	Richness	Overall	98	$Q_t=294.98$	<0.0001
		Fire frequency	1, 81	$Q_b=4.873$	0.027
		Postfire time	1, 77	$Q_b=4.081$	0.043
		Fire type	1, 97	$Q_b=1.509$	0.219
		Pollinator taxa	4, 81	$Q_b=5.771$	0.217
		Biome	8, 90	$Q_b=8.584$	0.379
		Physiognomy	2, 96	$Q_b=0.315$	0.854
b. Wildfire effects	Abundance	Pollinator taxa	4, 152	$Q_b=24.034$	<0.0001
	Richness	Pollinator taxa	4, 53	$Q_b=9.463$	0.092

*Note that Q_{total} (Q_t) is reported for overall effect, and $Q_{between}$ (Q_b) for categorical moderator variables.

Table S4. References and effect sizes extracted from studies analysing effect of fire on pollinator abundance. Vd = variance of Hedges' d . In pollinator taxa column, "insect" indicates several orders. Biome abbreviations are indicated in Fig. S5 legend.

In separate attachment.

Table S5. References and effect sizes extracted from studies analysing effect of fire on pollinator richness. Vd = variance of Hedges' d . In pollinator taxa column, "insect" indicates several orders. Biome abbreviations are indicated in Fig. S5 legend.

In separate attachment.

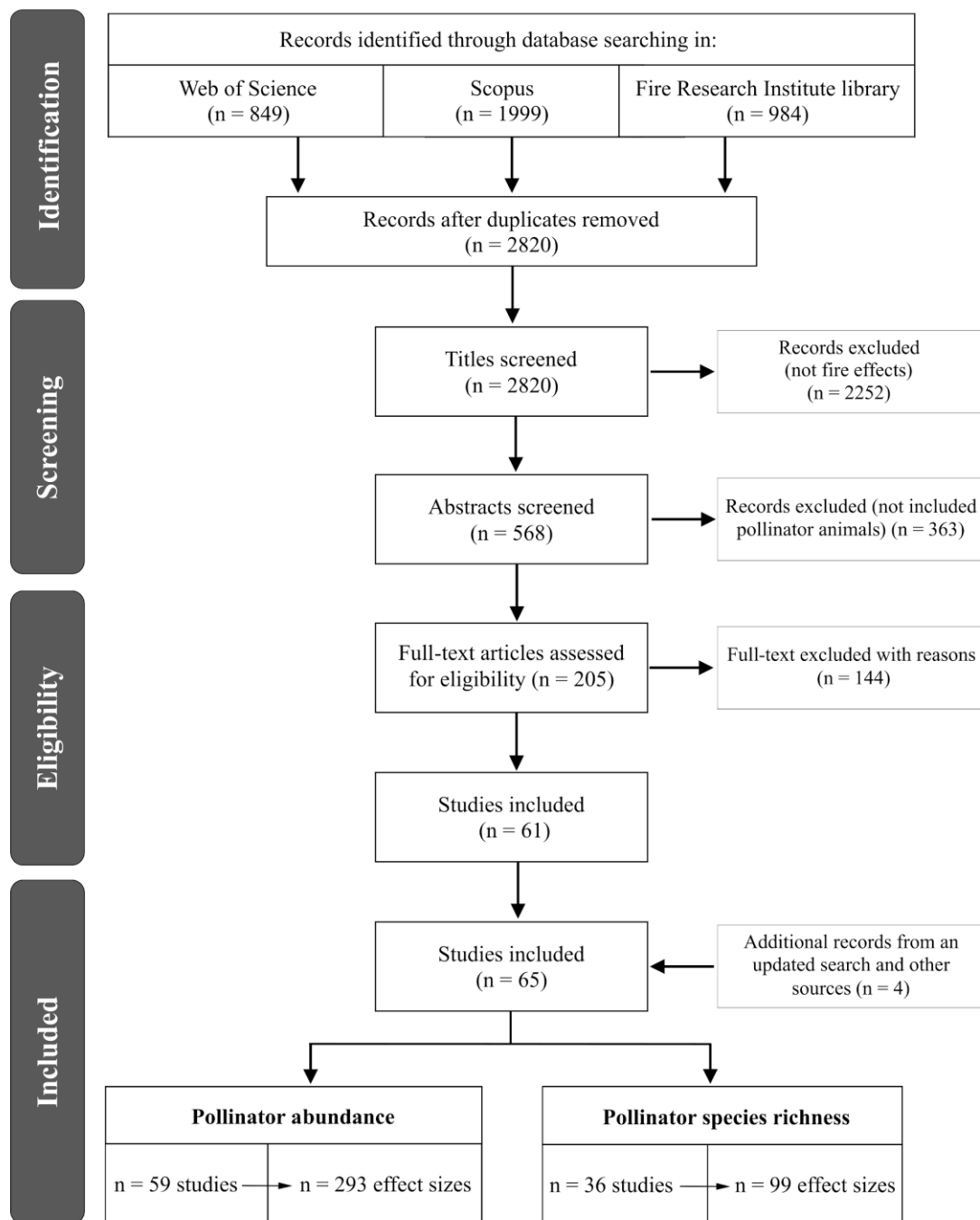


Figure S1. PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses) diagram representing the flow of information through the decision process (*i.e.*, the number of studies identified, rejected, and accepted). Based in: www.prisma-statement.org.

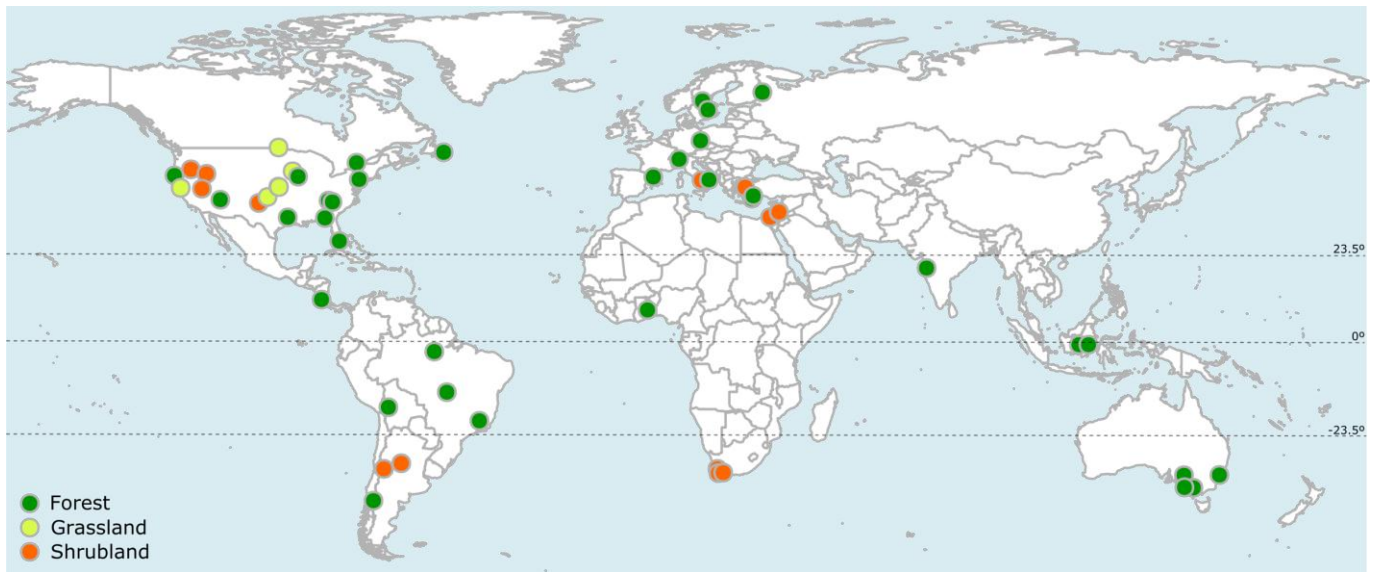


Figure S2. Location of studies evaluating fire effects on pollinators. The vegetation physiognomy (forest, grassland and shrubland) is indicating in different colours. Note that in some cases there are overlapped data points.

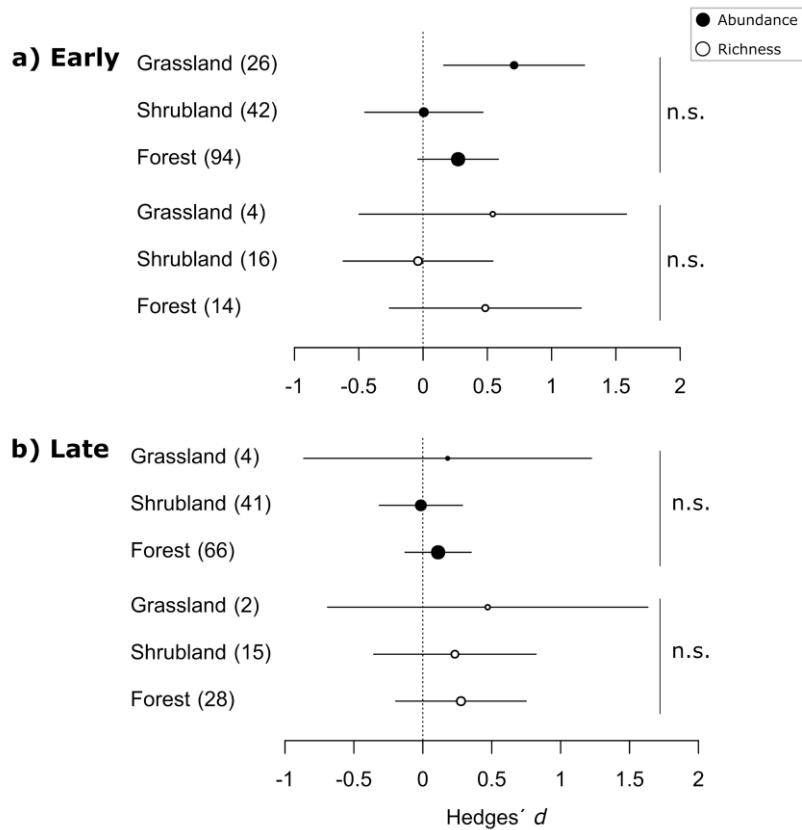


Figure S3. Weighted-mean effect sizes (Hedges' d) and 95% bias-corrected confidence intervals of fire on the abundance (closed circles) and richness (open circles) of pollinators in different postfire age (a: early, b: late) and physiognomies (grassland, shrubland and forest). Parameters with confidence intervals that do not overlap the vertical dotted line (Hedge's $d = 0$) are considered to have a significant positive or negative effect. Sample sizes for each category are shown in parentheses. The size of each symbol is proportional to its weight or contribution to the overall mean calculation. None of the effect sizes differ between predictor variables ("n. s.", $P > 0.05$) according to heterogeneity test.

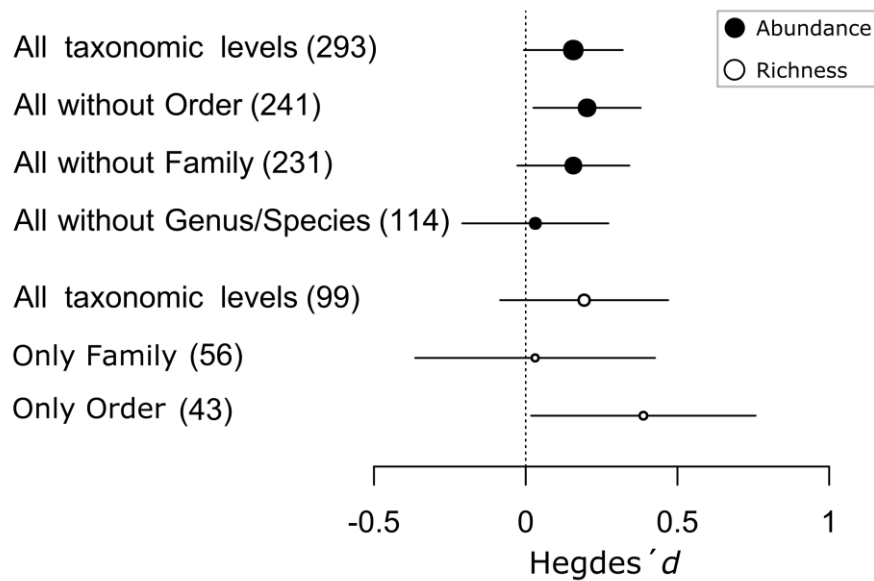


Figure S4. Weighted-mean effect sizes (Hedges' d) and 95% bias-corrected confidence intervals of fire on the abundance (closed circles) and richness (open circles) of pollinators at different taxonomic levels. These sensitivity analyses re-calculate the overall effect size after eliminating one taxonomic level at a time. Parameters with confidence intervals that do not overlap the vertical dotted line (Hedge's $d = 0$) are considered to have a significant positive or negative effect. Sample sizes for each category are shown in parentheses. The size of each symbol is proportional to its weight or contribution to the overall mean calculation.

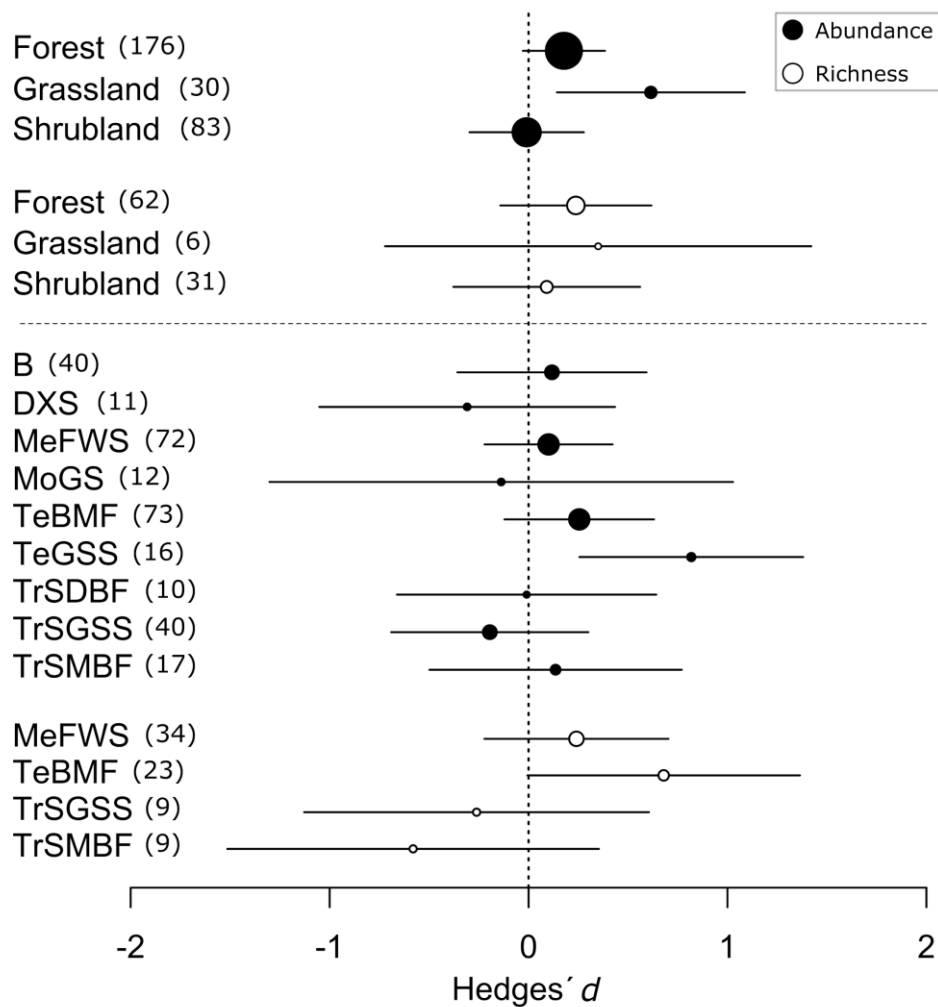
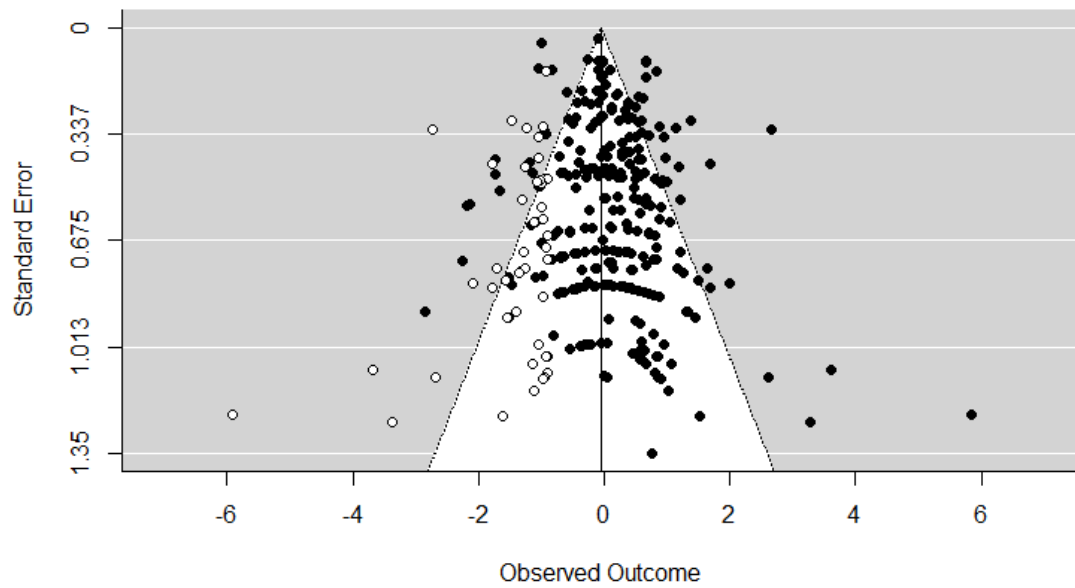


Figure S5. Weighted-mean effect sizes and 95% bias-corrected confidence intervals of fire on the abundance (closed circles) and richness (open circles) of pollinators in different physiognomies (forest, grassland, shrubland) and biomes (B, boreal; DXS, deserts and xeric shrublands; MeFWS, Mediterranean forest, woodlands and scrubland; MoGS, montane grasslands and shrublands; TeBMF, temperate broadleaf and mixed forests; TeGSS, temperate grasslands, savannas and shrublands; TrSDBF, tropical and subtropical dry broadleaf forests; TrSGSS, tropical and subtropical grasslands, savannas, and shrublands; TrSMBF, tropical and subtropical moist broadleaf forests). Parameters with confidence intervals that do not overlap the vertical dotted line (Hedge's $d = 0$) are considered to have a significant positive or negative effect. Sample sizes for each category are shown in parentheses. The size of each symbol is proportional to its weight or contribution to the overall mean calculation. The categories with very few sample size were omitted of this plot.

a



b

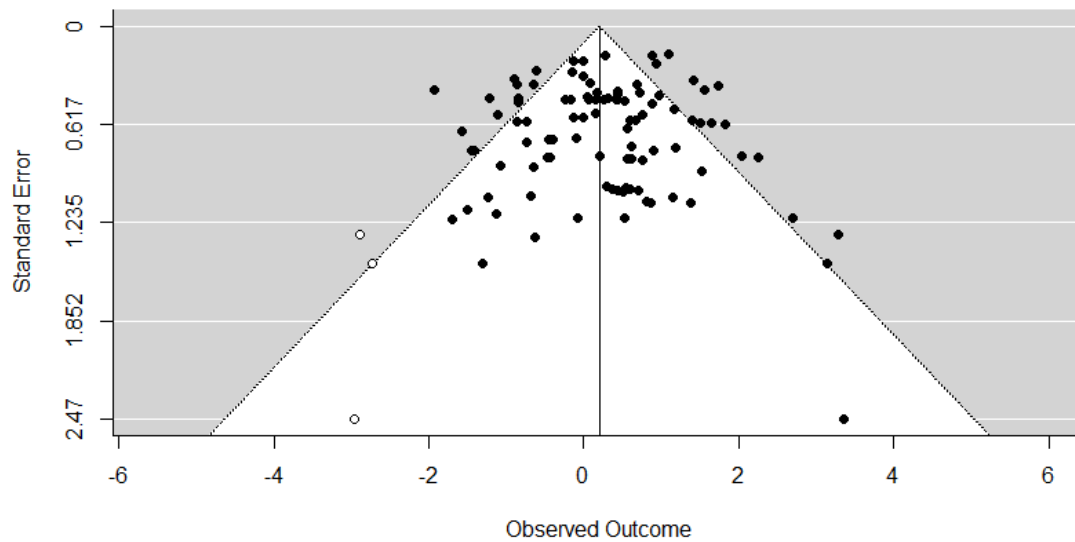


Figure S6. Trim and Fill plots showing the relationship between effect sizes (observed outcome) and standard errors of (a) pollinator abundance and (b) species richness. The number of missing studies imputed (open circles) was 45 and 3 on the left side for abundance and richness datasets, respectively.