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Supplementary Materials for

A global synthesis reveals biodiversity-mediated benefits for crop production

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The PDF file includes:

Table S2. Model output for richness–ecosystem service relationships.
Table S3. Model output for path models testing direct and indirect effects (mediated by changes in abundance) of richness on ecosystem services.
Table S4. Model output for path models testing direct and indirect effects (mediated by changes in evenness) of richness on ecosystem services.
Table S5. Model output for path models testing direct and indirect effects (mediated by changes in richness) of landscape simplification on ecosystem services.
Table S6. Model output for path models testing the direct and cascading landscape simplification effects on ecosystem services via changes in richness and abundance.
Table S7. Model output for path models testing the direct and cascading landscape simplification effects on ecosystem services via changes in richness and evenness.
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Table S9. Model output for path models testing the direct and cascading landscape simplification effects on final crop production via changes in richness, abundance, and ecosystem services.
Table S10. Model output for path models testing direct and indirect effects of pollinator richness, abundance, and evenness (with honey bees) on pollination.
Table S11. Results of pairwise comparison of richness–ecosystem service relationships according to the methods used to sample pollinators and natural enemies.
Table S12. Results of pairwise comparison of richness–ecosystem service relationships according to the methods used to quantify pollination and pest control services.
References (*66–111*)

Other Supplementary Material for this manuscript includes the following:

(available at advances.sciencemag.org/cgi/content/full/5/10/eaax0121/DC1)

Database S1 (Microsoft Excel format). Data on pollinator and natural enemy diversity and associated ecosystem services compiled from 89 studies and 1475 locations around the world.

Supplementary Text

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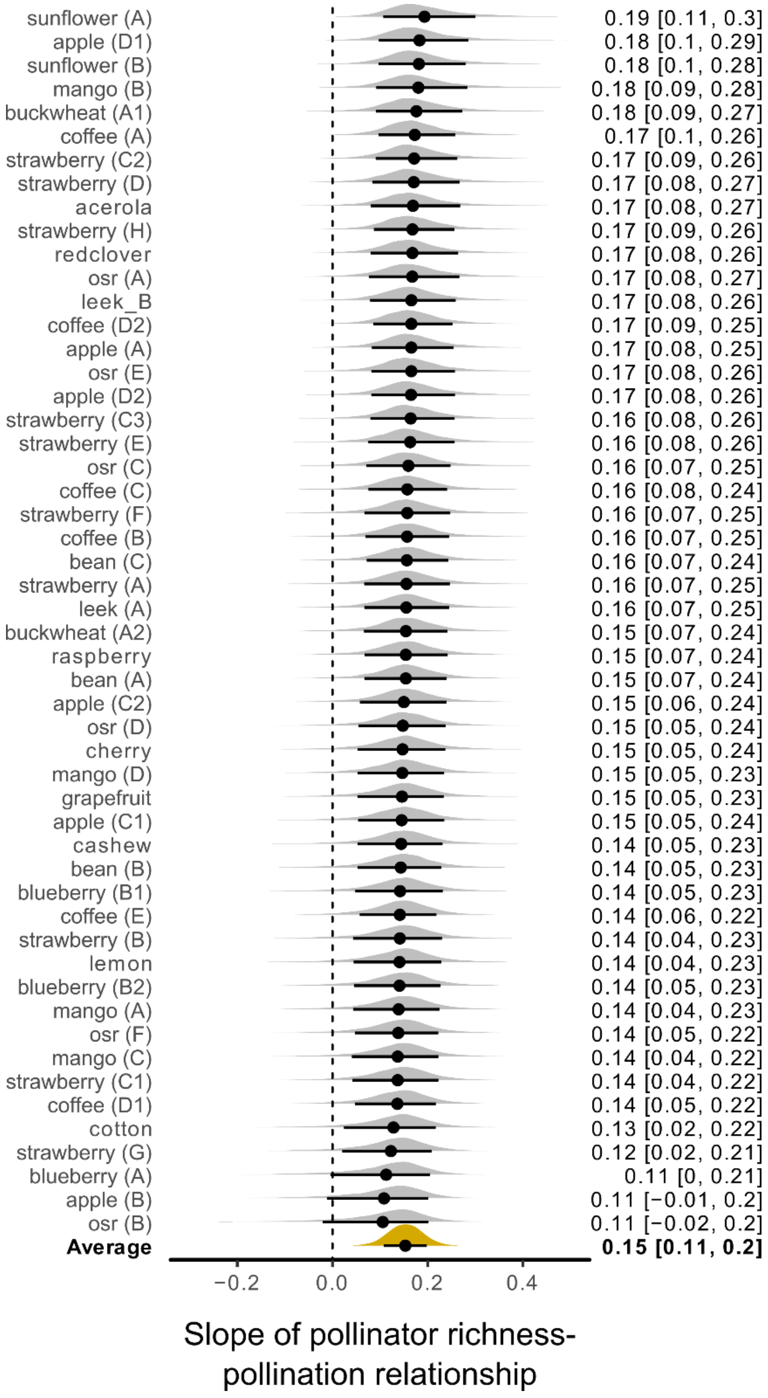

Fig. S1. Forest plot of the effect of pollinator richness on pollination for individual studies. Each posterior distribution represents medians (symbol centres) and 90% density intervals (black lines).

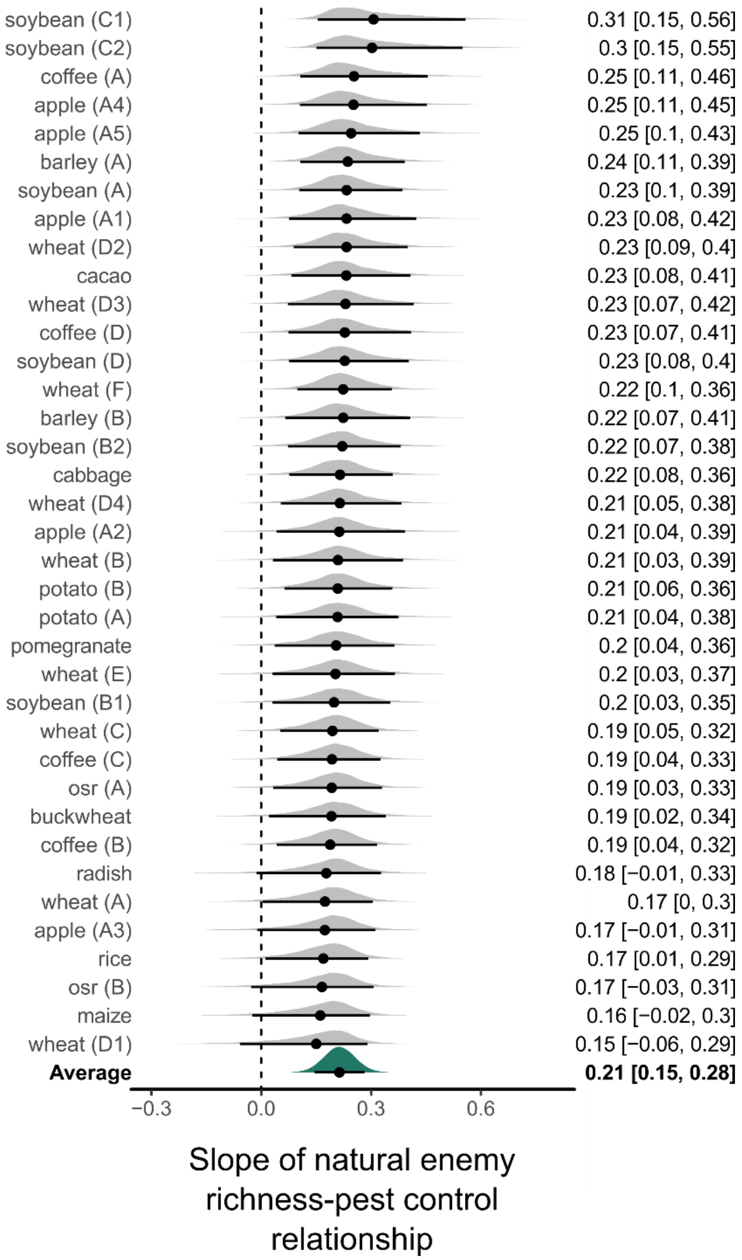

Fig. S2. Forest plot of the effect of natural enemy richness on pest control for individual studies. Each posterior distribution represents medians (symbol centres) and 90% density intervals (black lines).

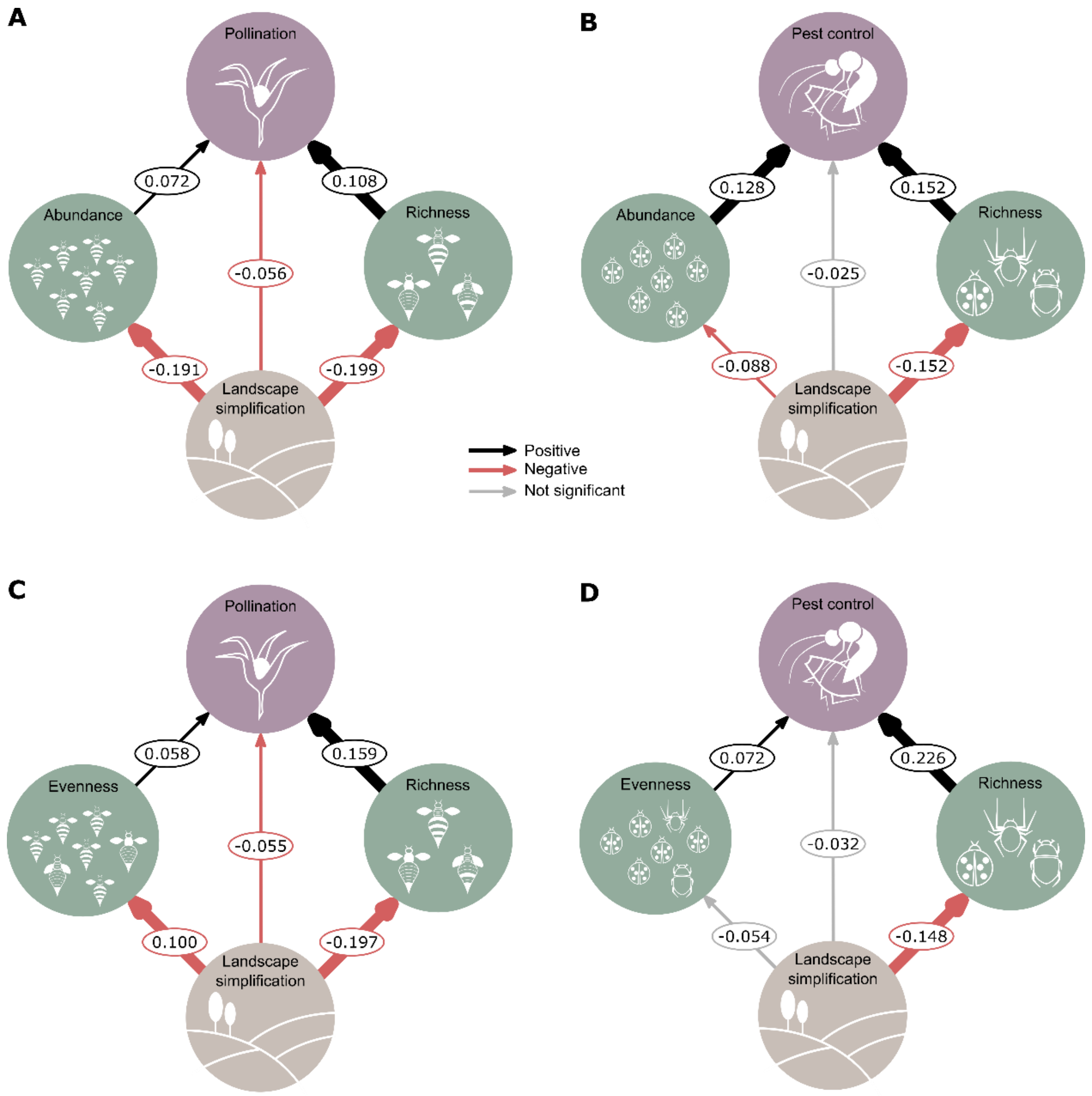

Fig. S3. Direct and indirect landscape simplification effects on ecosystem services via changes in richness and abundance or richness and evenness. (**A**) Path model representing direct and indirect effects of landscape simplification on pollination through changes in pollinator richness and abundance. (**B**) Path model representing direct and indirect effects of landscape simplification on pest control services through changes in natural enemy richness and abundance. (**C**) Path model representing direct and indirect effects of landscape simplification on pollination through changes in pollinator richness and evenness. (**D**) Path model representing direct and indirect effects of landscape simplification on pest control services through changes in natural enemy richness and evenness. Pollination models: *n* = 821 fields of 52 studies. Pest control models: *n* = 654 fields of 37 studies. Path coefficients are effect sizes estimated from the median of the posterior distribution of the model. Black and red arrows represent positive or negative effects, respectively. Arrow widths are proportional to highest density intervals (HDIs). Grey arrows represent non-evident effects (HDIs overlapped zero).

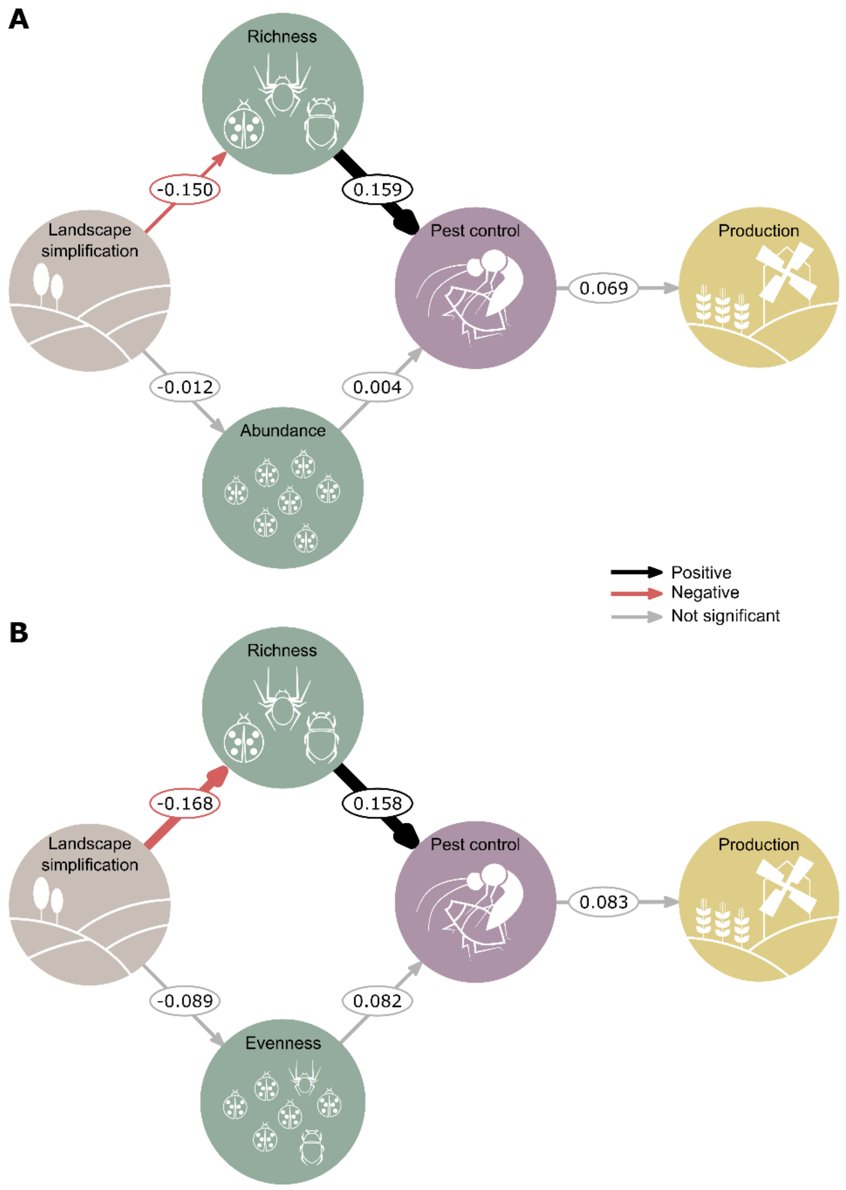

Fig. S4. Direct and cascading landscape simplification effects on final crop production via changes in natural enemy richness, abundance evenness, and pest control (all sites together, with and without insecticide application). (**A**) Path model representing direct and indirect effects of landscape simplification on final crop production through changes in natural enemy richness, abundance and pest control. (**B**) Path model representing direct and indirect effects of landscape simplification on final crop production through changes in natural enemy richness, evenness and pest control. Path coefficients are effect sizes estimated from the median of the posterior distribution of the model (*n* = 236 fields of 15 studies). Black and red arrows represent positive or negative effects, respectively. Arrow widths are proportional to highest density intervals (HDIs). Grey arrows represent non-significant effects (HDIs overlapped zero).

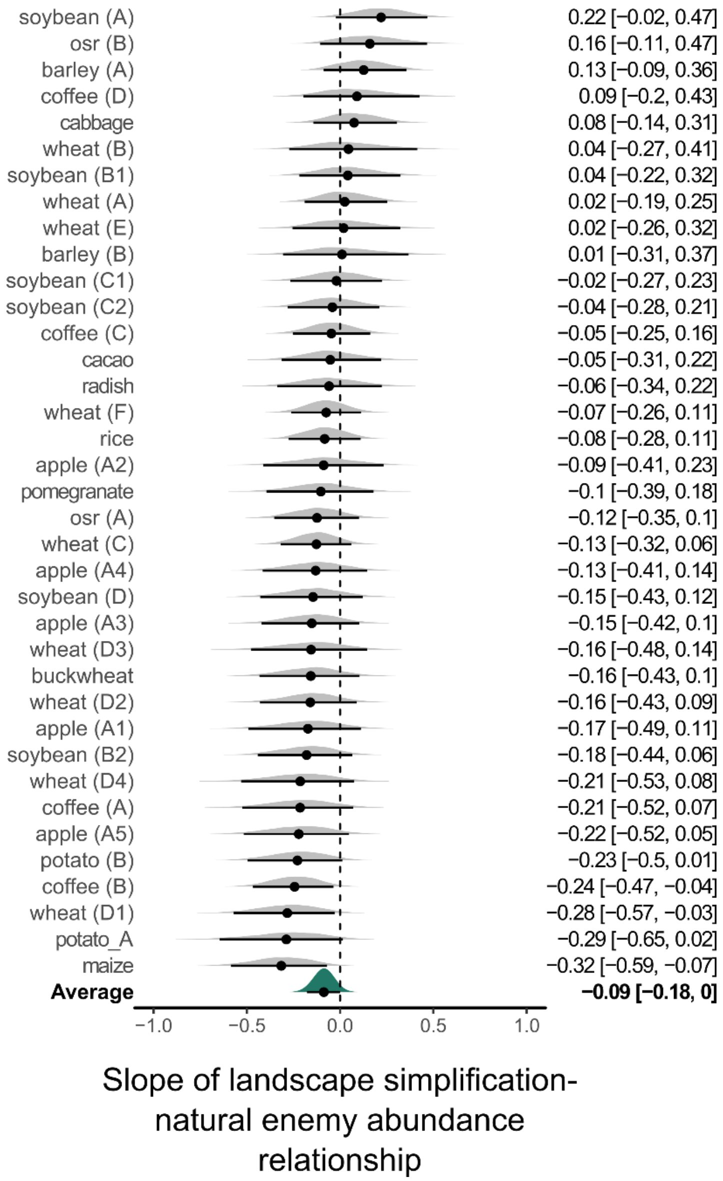

Fig. S5. Forest plot of the effect of landscape simplification on natural enemy abundance for individual studies. Each posterior distribution represents medians (symbol centres) and 90% density intervals (black lines).

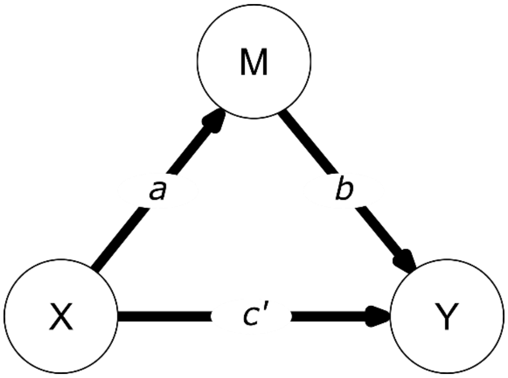

Fig. S6. Mediation model. Mediation analysis is a statistical procedure to test whether the effect of an independent variable X on a dependent variable Y (X → Y) is at least partly explained via the inclusion of a third hypothetical variable, the mediator variable M (X → M → Y). The three causal paths *a*, *b*, and *c'* represent X's effect on M, M's effect on Y, and X's effect on Y while accounting for M, respectively. The three causal paths correspond to parameters from two regression models, one in which M is the outcome and X the predictor, and one in which Y is the outcome and X and M the simultaneous predictors.

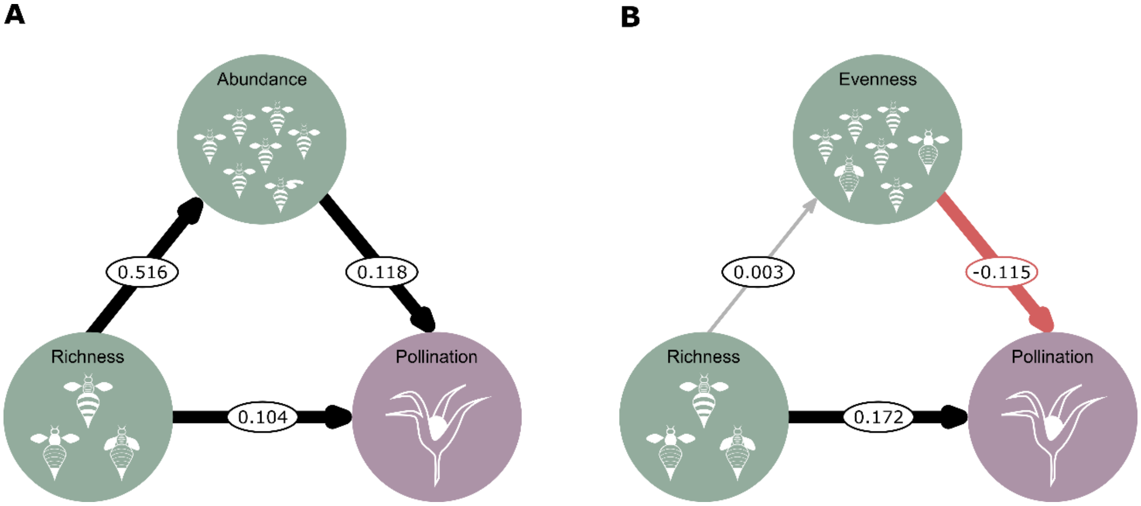

Fig. S7. Direct and indirect effects of pollinator richness, abundance, and evenness (with honey bees) on pollination. (**A**) Path model of pollinator richness as a predictor of pollination, mediated by pollinator abundance. (**B**) Path model of pollinator richness as a predictor of pollination, mediated by pollinator evenness. *n* = 821 fields of 52 studies. Coefficients of the three causal paths (*a*, *b*, *c'*) correspond to the median of the posterior distribution of the model. The proportion mediated is the mediated effect (*a* × *b*) divided by the total effect (*c*).

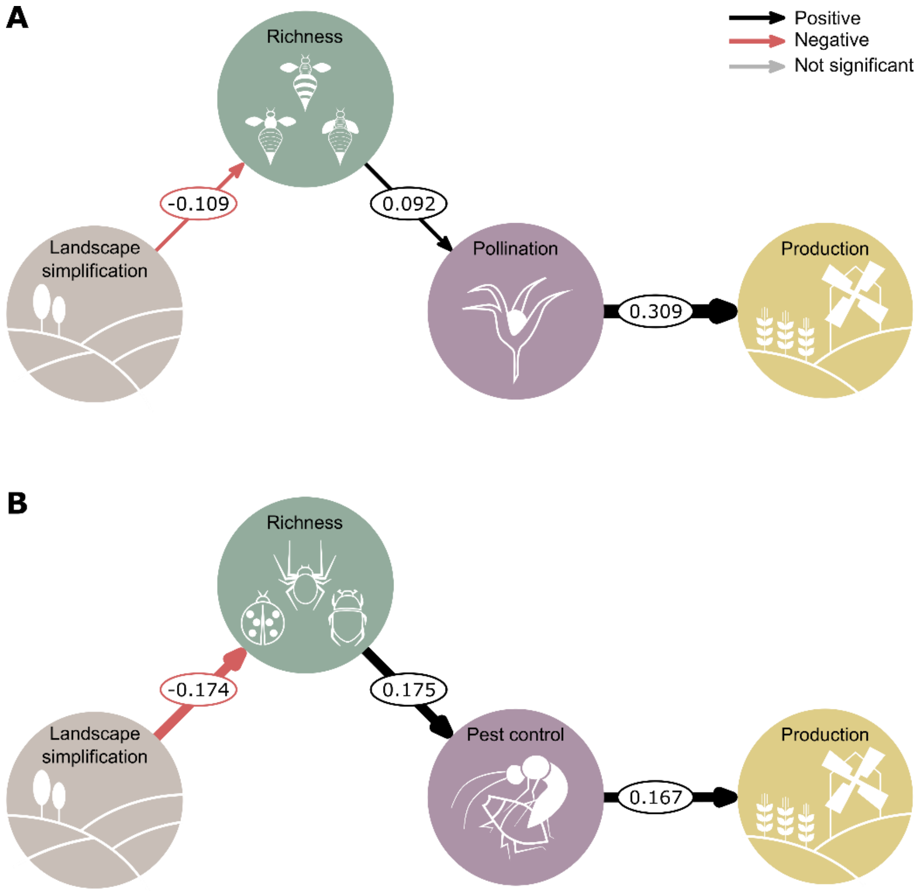

Fig. S8. Direct and cascading landscape simplification effects on area-based yield via changes in richness and ecosystem services. (**A**) Path model representing direct and indirect effects of landscape simplification on final area-based yield through changes in pollinator richness and pollination (*n* = 203 fields of 13 studies). (**B**) Path model representing direct and indirect effects of landscape simplification on final area-based yield through changes in natural enemy richness and pest control (*n* = 93 fields of 7 studies). Path coefficients are effect sizes estimated from the median of the posterior distribution of the model. Black and red arrows represent positive or negative effects, respectively. Arrow widths are proportional to highest density intervals (HDIs). Grey arrows represent non-significant effects (HDIs overlapped zero).

Table S1. List of 89 studies considered in our analyses.

Study code	Reference and (or) data holder contact	Crop species	Country, region	Study year	Sites (with yield)	Sampling methods	Taxa	Functions	Production
Pollination studies									
acerola	(*43*) Freitas, freitas@ufc.br	*Malpighia emarginata*	Brazil, Ceará	2011	8	active	bees	fruit set	-
apple (A)	(*65*) Boreux, virginie.boreux@nature.uni-freiburg.de	*Malus domestica*	Germany, Lake Constance	2015	25	active	bees	fruit set	-
apple (B)	(*66*) Garratt, m.p.garratt@reading.ac.uk	*Malus domestica*	UK, Kent	2011	8	active, passive	bees	fruit set	-
apple (C1)	(*67*) de Groot, g.a.degroot@wur.nl	*Malus domestica*	Netherlands, Betuwe	2013	8 (4)	active	bees, hoverflies	fruit set	crop yield
apple (C2)	(*67*) de Groot, g.a.degroot@wur.nl	*Malus domestica*	Netherlands, Betuwe	2014	10 (9)	active	bees, hoverflies	fruit set	crop yield
apple (D1)	(*68*) Mallinger, rachel.mallinger@ars.usda.gov	*Malus domestica*	USA, Wisconsin	2012	17	passive	bees	fruit set	-
apple (D2)	(*68*) Mallinger, rachel.mallinger@ars.usda.gov	*Malus domestica*	USA, Wisconsin	2013	19	passive	bees	fruit set	-
bean (A)	Ekroos, johan.ekroos@cec.lu.se	*Vicia faba*	Sweden, Scania	2016	16 (16)	active	bees	seed set	plant yield
bean (B)	(*69*) Garratt, m.p.garratt@reading.ac.uk	*Vicia faba*	UK, Berkshire	2011	8	active, passive	bees	seed set	-
bean (C)	(*70*) Ramos, Silva davilramos91@gmail.com felipe.silva@bag.ifmt.edu.br	*Phaseolus vulgaris*	Brazil, Goias/DF	2015/2016	22 (22)	active	bees	seed set	crop yield
blueberry (A)	Cavigliasso, pablo.cavigliaso@gmail.com	*Vaccinium corymbosum*	Argentina, Espinal-Ñandubay	2016	13	active	bees, wasps, hoverflies	fruit set	-
blueberry (B1)	(*67*) de Groot, g.a.degroot@wur.nl	*Vaccinium corymbosum*	Netherlands, Limburg/Overijssel	2013	10 (9)	active	bees	fruit set	crop yield
blueberry (B2)	(*67*) de Groot, g.a.degroot@wur.nl	*Vaccinium corymbosum*	Netherlands, Limburg/Overijssel	2014	15 (13)	active	bees	fruit set	crop yield
buckwheat (A1)	(*71*, *72*) Taki, htaki@affrc.go.jp	*Fagopyrum esculentum*	Japan, Ibaraki	2007	15	active	bees, butterflies, flies, wasps	seed set	-
buckwheat (A2)	(*71*, *72*) Taki, htaki@affrc.go.jp	*Fagopyrum esculentum*	Japan, Ibaraki	2008	17	active	bees, butterflies, flies, wasps	seed set	-
cashew	(*21*) Freitas, freitas@ufc.br	*Anacardium occidentale*	Brazil, Ceará	2012	10 (10)	active	bees	fruit set	crop yield
cherry	(*73*) Holzschuh, andrea.holzschuh@uni-wuerzburg.de	*Prunus avium*	Germany, Hesse	2008	7	active	bees	fruit set	-
coffee (A)	(*46*, *74*, *75*) Boreux,	*Coffea canephora*	India, Kodagu	2008	53 (51)	active	bees	fruit set	plant yield

	virginie.boreux@nature.uni-freiburg.de								
coffee (B)	(*76*) Classen, alice.classen@uni-wuerzburg.de	*Coffea arabica*	Tanzania, Kilimanjaro	2011/2012	11 (6)	active, passive	bees	fruit set	plant yield
coffee (C)	(*77*) Hipólito, jhdsousa@yahoo.com	*Coffea arabica*	Brazil, Chapada Diamantina	2013	30 (28)	active	bee, flies, butterflies, beetles, wasps	fruit set	crop yield
coffee (D1)	(*74*, *78*, *79*) Krishnan, smithakrishnan@gmail.com	*Coffea canephora*	India, Kodagu	2007	35	active	bees	fruit set	-
coffee (D2)	(*74*, *78*, *79*) Krishnan, smithakrishnan@gmail.com	*Coffea canephora*	India, Kodagu	2008	37	active	bees	fruit set	
coffee (E)	(*80*) Krishnan, Nesper, smithakrishnan@gmail.com maike.nesper@gmail.com	*Coffea canephora*	India, Kodagu	2014	49 (49)	active	bees	fruit set	crop yield
cotton	(*81*) Cusser, sarah.cusser@gmail.com	*Gossypium hirsutum*	USA, Gulf Coast Texas	2014	11	active	bee, hoverflies, butterflies, beetles	fruit set	-
grapefruit	(*82*, *83*) Chacoff, nchacoff@gmail.com	*Citrus paradisi*	Argentina, Yungas	2000	6	active	bee, flies, butterflies, wasps	fruit set	
leek (A)	(*36*) Fijen, thijs.fijen@wur.nl	*Allium porrum*	France, Loire	2016	18 (18)	active	bees, wasps, hoverflies	seed set	plant yield
leek (B)	(*36*) Fijen, thijs.fijen@wur.nl	*Allium porrum*	Italy, South Italy	2016	18 (18)	active	bees, wasps, hoverflies	seed set	plant yield
lemon	Chacoff, nchacoff@gmail.com	*Citrus limon*	Argentina, Yungas	2015	9	active	bee, flies, butterflies, wasps	fruit set	-
mango (A)	(*84*) Carvalheiro, lgcarvalheiro@gmail.com	*Mangifera indica*	South Africa, Limpopo	2008	8	active	bee, flies, butterflies, beetles, wasps	fruit set	-
mango (B)	(*85*) Carvalheiro, lgcarvalheiro@gmail.com	*Mangifera indica*	South Africa, Limpopo	2009	14 (10)	active	bee, flies, butterflies, beetles, wasps	fruit set	plant yield
mango (C)	Rader, rrader@une.edu.au	*Mangifera indica*	Australia, Queensland	2014	10	active	bees, flies, hoverflies, beetles, moths, butterflies	fruit set	-
mango (D)	Willcox, bwillcox@myune.edu.au	*Mangifera indica*	Australia, Queensland	2016	7	active	bees, flies, hoverflies, beetles, moths, butterflies	fruit set	-
osr (A)	Andersson,	*Brassica napus*	Sweden, Scania	2010	6	active	bees,	seed set	-

	gandersson@unrn.edu.ar						hoverflies		
osr (B)	(*86*) Bartomeus, Gagic, nacho.bartomeus@gmail.com vesna.gagic@bio.bg.ac.rs	*Brassica napus*	Sweden, Västergötland	2013	12 (9)	active	bees, butterflies	seed set	crop yield
osr (C)	(*69*) Garratt, m.p.garratt@reading.ac.uk	*Brassica napus*	UK, Yorkshire	2012	8	active, passive	bees	seed set	-
osr (D)	(*87*, *88*) Stanley, dara.stanley@ucd.ie	*Brassica napus*	Ireland, South-East	2010	3	active	bees, hoverflies	seed set	-
osr (E)	Sutter, louis.sutter@agroscope.admin.ch	*Brassica napus*	Switzerland, Zurich	2014	18 (18)	active	bees, hoverflies	seed set	crop yield
osr (F)	(*89*) Zou Yi, yi.zou.1@hotmail.com	*Brassica napus*	China, Jiangxi	2015	18	passive	bees, hoverflies, butterflies	fruit set	-
raspberry	(*42*) Saez, agustinsaez@live.com.ar	*Rubus idaeus*	Argentina, Comarca Andina	2014	16 (16)	active	bees	fruit set	crop yield
red clover	Rundlöf, maj.rundlof@biol.lu.se	*Trifolium pratense*	Sweden, Scania	2013	6 (6)	active	bees	seed set	crop yield
strawberry (A)	Andersson, gandersson@unrn.edu.ar	*Fragaria × ananassa*	Sweden, Scania	2009	11	passive	bees, hoverflies	fruit set	-
strawberry (B)	Baensch, Tscharntke, Westphal, svenja.baensch@agr.uni-goettingen.de cwestph@gwdg.de ttschar@gwdg.de	*Fragaria × ananassa*	Germany, Lower Saxony,	2015	8 (8)	active	bees	Δ fruit weight	plant yield
strawberry (C1)	(*90*) Grab, hlc66@cornell.edu	*Fragaria × ananassa*	USA, New York	2012	11 (10)	active, passive	bees	Δ fruit weight	plant yield
strawberry (C2)	Grab, hlc66@cornell.edu	*Fragaria × ananassa*	USA, New York	2014	27 (27)	active	bees	seed set	plant yield
strawberry (C3)	(*91*) Grab, hlc66@cornell.edu	*Fragaria × ananassa*	USA, New York	2015	14 (14)	active	bees	seed set	plant yield
strawberry (D)	Garratt, m.p.garratt@reading.ac.uk	*Fragaria × ananassa*	UK, Yorkshire	2011	7 (7)	active, passive	bees	Δ fruit weight	plant yield
strawberry (E)	Klatt, klattbk@googlemail.com	*Fragaria × ananassa*	Germany, Lower Saxony	2010	8 (8)	active	bees	fruit set	plant yield
strawberry (F)	Krewenka, kristin.marie.krewenka@uni-hamburg.de	*Fragaria × ananassa*	Germany, Lower Saxony	2005	10 (10)	active	bees	fruit set	crop yield
strawberry (G)	Sciligo, amber.sciligo@berkeley.edu	*Fragaria × ananassa*	USA, California	2012	15 (15)	active, passive	bees	Δ fruit weight	plant yield
strawberry (H)	(*92*) Stewart, rebecca.stewart@cec.lu.se	*Fragaria × ananassa*	Sweden, Scania	2014	27 (27)	active	hoverflies	fruit set	plant yield
sunflower (A)	(*45*) Carvalheiro, lgcarvalheiro@gmail.com	*Helianthus annuus*	South Africa, Limpopo	2009	28	active	bee, flies, butterflies, beetles, wasps	seed set	-
sunflower (B)	Scheper, jeroen.scheper@wur.nl	*Helianthus annuus*	France, Poitou-Charentes	2015	24	active	bees, hoverflies	seed set	-
Pest control studies									
apple (A1)	(*93*, *94*) Lavigne, claire.lavigne@inra.fr	*Malus domestica*	France, Provence-Alpes-Côte d'Azur	2006	9	active	parasitoids	sentinel exp. (enemy	-

								activity)	
apple (A2)	(*93*, *94*) Lavigne, claire.lavigne@inra.fr	*Malus domestica*	France, Provence-Alpes-Côte d'Azur	2007	6	active	parasitoids	sentinel exp. (enemy activity)	-
apple (A3)	(*93*, *94*) Lavigne, claire.lavigne@inra.fr	*Malus domestica*	France, Provence-Alpes-Côte d'Azur	2008	17	active	parasitoids	sentinel exp. (enemy activity)	-
apple (A4)	(*93*, *94*) Lavigne, claire.lavigne@inra.fr	*Malus domestica*	France, Provence-Alpes-Côte d'Azur	2009	12	active	parasitoids	sentinel exp. (enemy activity)	-
apple (A5)	(*93*, *94*) Lavigne, claire.lavigne@inra.fr	*Malus domestica*	France, Provence-Alpes-Côte d'Azur	2010	14	active	parasitoids	sentinel exp. (enemy activity)	-
barley (A)	(*95*) Caballero-Lopez, bcaballerolo@bcn.cat	*Hordeum vulgare*	Sweden, Scania	2007	20	active, passive	carabids, ladybugs, parasitoids	sentinel exp. (enemy activity)	-
barley (B)	(*96–98*) Tamburini, giovanni.tamburini@slu.se	*Hordeum vulgare*	Italy, Friuli Venezia-Giulia	2014	5 (5)	passive	carabids	cage exp. (infestation)	crop yield
buckwheat	(*99*) Taki, htaki@affrc.go.jp	*Fagopyrum esculentum*	Japan, Ibaraki	2008	15	passive	ladybugs, lacewings	sentinel exp. (enemy activity)	-
cabbage	(*100*) Letourneau, dletour@ucsc.edu	*Brassica oleracea*	USA, Monterey Bay Area	2006	33	passive	parasitoids	sentinel exp. (enemy activity)	-
cacao	(*101*) Maas, beamaas@gmx.at	*Theobroma cacao*	Indonesia, Sulawesi	2010	15 (15)	active	spiders	cage exp. (crop damage)	plant yield
coffee (A)	Schleuning, Schmack, Matthias.Schleuning@senckenberg.de juliaschmack@gmx.de	*Coffea arabica*	Tanzania, Kilimanjaro	2011/2012	11 (6)	passive	bats, birds	cage exp. (crop damage)	plant yield
coffee (B)	Iverson, iverson@umich.edu	*Coffea arabica*	Mexico, Soconusco	2012	37 (35)	passive	parasitoids	sentinel exp. (enemy activity)	crop yield
coffee (C)	Iverson, iverson@umich.edu	*Coffea arabica*	Puerto Rico, Utuado	2013	36	passive	parasitoids, wasps	cage exp. (crop damage)	-
coffee (D)	Martinez-Salinas, amartinez@catie.ac.cr	*Coffea arabica*	Costa Rica, Turrialba	2013	10	passive	birds	cage exp. (crop damage)	-
maize	(*102*) O’Rourke, megorust@vt.edu	*Zea mays*	USA, New York	2006	26	passive	ladybugs	pest damage	-
osr (A)	(*103*) Jonsson, mattias.jonsson@slu.se	*Brassica napus*	New Zealand, Canterbury	2007	26	active	hoverflies, ladybugs, lacewings	pest damage	-
osr (B)	Sutter, louis.sutter@agroscope.admin.ch	*Brassica napus*	Switzerland, Zurich	2014	18 (18)	passive	carabids	sentinel exp. (enemy activity)	crop yield
pomegranate	(*104*) Keasar, tkeasar@research.haifa.ac.il	*Punica granatum*	Israel, Hefer Valley	2014	10	active	spiders, parasitoids	pest damage	-
potato (A)	(*105*) Martin,	*Solanum tuberosum*	South Korea, Haean	2009	6 (2)	active,	birds,	pest damage	plant yield

	emily.martin@uni-wuerzburg.de					passive	carabids, hoverflies, parasitoids, rove beetles, wasps		
potato (B)	(*106*) Poveda, kap235@cornell.edu	*Solanum tuberosum*	Colombia, Cundinamarca	2007	11 (11)	active, passive	carabids, hoverflies, ladybugs, lacewings, parasitoids	pest damage	crop yield
radish	(*105*) Martin, emily.martin@uni-wuerzburg.de	*Raphanus raphanistrum* subsp. *sativus*	South Korea, Haean	2009	8 (5)	active, passive	birds, carabids, hoverflies, parasitoids, rove beetles, wasps	pest damage	plant yield
rice	(*107*) Takada, mayura@isas.a.u-tokyo.ac.jp	*Oryza sativa*	Japan, Miyagi	2008	44	active	spiders	pest damage	-
soybean (A)	(*37*) Kim, tkim@glbrc.wisc.edu	*Glycine max*	USA, Upper Midwest	2012	35 (33)	passive	flower bugs, ladybugs	cage exp. (infestation)	plant yield
soybean (B1)	(*108*) Mitchell, matthew.mitchell@ubc.ca	*Glycine max*	Canada, Montérégie	2010	15 (15)	active	hoverflies, ladybugs, lacewings, true bugs	pest damage	crop yield
soybean (B2)	(*108*) Mitchell, matthew.mitchell@ubc.ca	*Glycine max*	Canada, Montérégie	2011	19 (19)	active	hoverflies, ladybugs, lacewings, true bugs	pest damage	crop yield
soybean (C1)	Molina, gonzalormolina@agro.uba.ar	*Glycine max*	Argentina, North Buenos Aires	2011	20	active	parasitoids	sentinel exp. (enemy activity)	-
soybean (C2)	Molina, gonzalormolina@agro.uba.ar	*Glycine max*	Argentina, North Buenos Aires	2012	20	active	parasitoids	sentinel exp. (enemy activity)	-
soybean (D)	(*105*) Martin, emily.martin@uni-wuerzburg.de	*Glycine max*	South Korea, Haean	2009	8 (6)	active, passive	birds, carabids, hoverflies, parasitoids, rove beetles, wasps	pest damage	plant yield
wheat (A)	(*109*) Bommarco, riccardo.bommarco@slu.se	*Triticum aestivum*	Sweden, Scania	2007	31 (31)	passive	carabids	sentinel exp. (enemy activity)	crop yield
wheat (B)	(*95*) Caballero-Lopez, bcaballerolo@bcn.cat	*Triticum aestivum*	Sweden, Scania	2007	4	active, passive	carabids, ladybugs,	sentinel exp. (enemy	-

							parasitoids	activity)	
wheat (C)	Kim, tkim@glbrc.wisc.edu	*Triticum aestivum*	USA, Upper Midwest	2012	24 (24)	active, passive	flower bugs, ladybugs	cage exp. (infestation)	plant yield
wheat (D1)	(*110*) Plećaš, mplecas@bio.bg.ac.rs	*Triticum aestivum*	Serbia, Pacevacki Rit	2008	18	active	parasitoids	sentinel exp. (enemy activity)	-
wheat (D2)	(*110*) Plećaš, mplecas@bio.bg.ac.rs	*Triticum aestivum*	Serbia, Pacevacki Rit	2009	17	active	parasitoids	sentinel exp. (enemy activity)	-
wheat (D3)	(*110*) Plećaš, mplecas@bio.bg.ac.rs	*Triticum aestivum*	Serbia, Pacevacki Rit	2010	8	active	parasitoids	sentinel exp. (enemy activity)	-
wheat (D4)	(*110*) Plećaš, mplecas@bio.bg.ac.rs	*Triticum aestivum*	Serbia, Pacevacki Rit	2011	10	active	parasitoids	sentinel exp. (enemy activity)	-
wheat (E)	(*96–98*) Tamburini, giovanni.tamburini@slu.se	*Triticum aestivum*	Italy, Friuli Venezia-Giulia	2014	11 (11)	passive	carabids	cage exp. (infestation)	crop yield
wheat (F)	(*111*) Tschumi, matthias.tschumi@vogelwarte.ch	*Triticum aestivum*	Switzerland, Central Plateau	2012	25	active, passive	carabids, ladybugs, true bugs	pest damage	-

Table S2. Model output for richness–ecosystem service relationships. (**A**) Richness was calculated as the number of unique taxa sampled per study. (**B**) Richness was calculated considering only organisms classified at the fine taxonomy level (i.e. species- or morphospecies-levels). Posterior samples were summarized based on the Bayesian point estimate (median), standard error (median absolute deviation), and 80%, 90% and 95% highest density intervals (HDIs). HDIs that do not include zero are reported in bold.

(**A**)

Parameter	**Estimate**	**SE**	**HDI (80%)**	**HDI (90%)**	**HDI (95%)**
Pollination					
Intercept	0.0004	0.0311	[-0.0419, 0.0411]	[-0.0531, 0.0544]	[-0.0670, 0.0622]
Pollinator richness	0.1532	0.0353	**[0.1062, 0.1962]**	**[0.0951, 0.2110]**	**[0.0865, 0.2266]**
Pest control					
Intercept	-0.0003	0.0353	[-0.0434, 0.0485]	[-0.0579, 0.0589]	[-0.0724, 0.0657]
Natural enemy richness	0.2093	0.0417	**[0.1551, 0.2618]**	**[0.1415, 0.2779]**	**[0.1283, 0.2932]**

(**B**)

Parameter	**Estimate**	**SE**	**HDI (80%)**	**HDI (90%)**	**HDI (95%)**
Pollination					
Intercept	0.0010	0.0333	[-0.0409, 0.0421]	[-0.0536, 0.0537]	[-0.0662, 0.0617]
Pollinator richness	0.1535	0.0356	**[0.1096, 0.2006]**	**[0.0967, 0.2141]**	**[0.0848, 0.2256]**
Pest control					
Intercept	0.0001	0.0401	[-0.0536, 0.0514]	[-0.0712, 0.0646]	[-0.0834, 0.0775]
Natural enemy richness	0.2264	0.0484	**[0.1638, 0.2861]**	**[0.1475, 0.3065]**	**[0.1254, 0.3199]**

Table S3. Model output for path models testing direct and indirect effects (mediated by changes in abundance) of richness on ecosystem services. Posterior samples were summarized based on the Bayesian point estimate (median), standard error (median absolute deviation), and 80%, 90% and 95% highest density intervals (HDIs). HDIs that do not include zero are reported in bold.

Effect	Estimate	SE	HDI (80%)	HDI (90%)	HDI (95%)
Pollination					
Richness → Pollination	0.1058	0.0428	**[0.0511, 0.1635]**	**[0.0326, 0.1779]**	**[0.0199, 0.1933]**
Richness → Abundance	0.5701	0.0379	**[0.5222, 0.6212]**	**[0.5044, 0.6319]**	**[0.4900, 0.6449]**
Abundance → Pollination	0.0804	0.0460	**[0.0232, 0.1401]**	**[0.0057, 0.1564]**	[-0.0140, 0.1665]
Pest control					
Richness → Pest control	0.1413	0.0434	**[0.0832, 0.1951]**	**[0.0684, 0.2105]**	**[0.0564, 0.2275]**
Richness → Abundance	0.4447	0.0494	**[0.3782, 0.5070]**	**[0.3646, 0.5315]**	**[0.3467, 0.5452]**
Abundance → Pest control	0.1481	0.0553	**[0.0772, 0.2170]**	**[0.0612, 0.2406]**	**[0.0467, 0.2619]**

Table S4. Model output for path models testing direct and indirect effects (mediated by changes in evenness) of richness on ecosystem services. Posterior samples were summarized based on the Bayesian point estimate (median), standard error (median absolute deviation), and 80%, 90% and 95% highest density intervals (HDIs). HDIs that do not include zero are reported in bold.

Effect	Estimate	SE	HDI (80%)	HDI (90%)	HDI (95%)
Pollination					
Richness → Pollination	0.1580	0.0361	**[0.1105, 0.2033]**	**[0.0978, 0.2175]**	**[0.0863, 0.2287]**
Richness → Evenness	0.0900	0.0578	**[0.0171, 0.1653]**	[-0.0095, 0.1804]	[-0.0269, 0.1991]
Evenness → Pollination	-0.0719	0.0390	**[-0.1238, -0.0240]**	**[-0.1419, -0.0127]**	[-0.1525, 0.0006]
Pest control					
Richness → Pest control	0.2298	0.0415	**[0.1748, 0.2832]**	**[0.1619, 0.3041]**	**[0.1444, 0.3153]**
Richness → Evenness	0.2358	0.0767	**[0.1345, 0.3313]**	**[0.1011, 0.3560]**	**[0.0804, 0.3854]**
Evenness → Pest control	-0.0844	0.0430	**[-0.1393, -0.0302]**	**[-0.1587, -0.0165]**	[-0.1683, 0.0027]

Table S5. Model output for path models testing direct and indirect effects (mediated by changes in richness) of landscape simplification on ecosystem services. Posterior samples were summarized based on the Bayesian point estimate (median), standard error (median absolute deviation), and 80%, 90% and 95% highest density intervals (HDIs). HDIs that do not include zero are reported in bold.

Effect	Estimate	SE	HDI (80%)	HDI (90%)	HDI (95%)
Pollination					
Landscape → Pollination	-0.0573	0.0409	**[-0.1083, -0.0041]**	[-0.1203, 0.0147]	[-0.1374, 0.0229]
Landscape → Richness	-0.1984	0.0453	**[-0.2593, -0.1430]**	**[-0.2750, -0.1263]**	**[-0.2909, -0.1119]**
Richness → Pollination	0.1543	0.0362	**[0.1060, 0.1992]**	**[0.0937, 0.2148]**	**[0.0815, 0.2278]**
Causal mediation analysis					
Direct effect	-0. 0573		**[-0.1083, -0.0041]**	[-0.1203, 0.0147]	[-0.1374, 0.0229]
Indirect effect	-0.0293		**[-0.0425, -0.0168]**	**[-0.0465, -0.0136]**	**[-0.0515, -0.0117]**
Total effect	-0.0859		**[-0.1391, -0.0361]**	**[-0.1560, -0.0239]**	**[-0.1642, -0.0074]**
Proportion mediated	34.0%				
					-
Pest control					
Landscape → Pest control	-0.0285	0.0442	[-0.0864, -0.0289]	[-0.1043, 0.0461]	[-0.1248, 0.0570]
Landscape → Richness	-0.1510	0.0479	**[-0.2123, -0.0886]**	**[-0.2299, -0.0706]**	**[-0.2491, -0.0581]**
Richness → Pest control	0.2114	0.0418	**[0.1609, 0.2682]**	**[0.1429, 0.2810]**	**[0.1315, 0.2962]**
Causal mediation analysis					
Direct effect	-0.0285		[-0.0864, -0.0289]	[-0.1043, 0.0461]	[-0.1248, 0.0570]
Indirect effect	-0.0311		**[-0.0460 -0.0149]**	**[-0.0523, -0.0118]**	**[-0.0578, -0.0083]**
Total effect	-0.0610		**[-0.1214, -0.0060]**	[-0.1378, 0.0120]	[-0.1511, 0.0301]
Proportion mediated	50.9%				

Table S6. Model output for path models testing the direct and cascading landscape simplification effects on ecosystem services via changes in richness and abundance. Posterior samples were summarized based on the Bayesian point estimate (median), standard error (median absolute deviation), and 80%, 90% and 95% highest density intervals (HDIs). HDIs that do not include zero are reported in bold.

Effect	Estimate	SE	HDI (80%)	HDI (90%)	HDI (95%)
Pollination					
Landscape → Richness	-0.1991	0.0458	**[-0.2593, -0.1431]**	**[-0.2779, -0.1269]**	**[-0.2918, -0.1109]**
Landscape → Abundance	-0.1914	0.0462	**[-0.2503, -0.1302]**	**[-0.2721, -0.1167]**	**[-0.2812, -0.0955]**
Landscape → Pollination	-0.0559	0.0390	**[-0.1043, -0.0035]**	[-0.1223, 0.0078]	[-0.1351, 0.0215]
Richness → Pollination	0.1082	0.0430	**[0.0517, 0.1629]**	**[0.0366 0.1810]**	**[0.0197, 0.1924]**
Abundance → Pollination	0.0721	0.0444	**[0.0155, 0.1313]**	[-0.0017, 0.1479]	[-0.0229, 0.1558]
Pest control					
Landscape → Richness	-0.1515	0.0471	**[-0.2160, -0.0939]**	**[-0.2322, -0.0730]**	**[-0.2430, -0.0471]**
Landscape → Abundance	-0.0880	0.0511	**[-0.1617, -0.0240]**	[-0.1727, 0.0044]	[-0.1968, 0.0148]
Landscape → Pest control	-0.0250	0.0436	[-0.0785, 0.0316]	[-0.0971, 0.0451]	[-0.1128, 0.0559]
Richness → Pest control	0.1524	0.0436	**[0.0928, 0.2049]**	**[0.0822, 0.2272]**	**[0.0642, 0.2385]**
Abundance → Pest control	0.1282	0.0540	**[0.0597, 0.1967]**	**[0.0398, 0.2146]**	**[0.0323, 0.2403]**

Table S7. Model output for path models testing the direct and cascading landscape simplification effects on ecosystem services via changes in richness and evenness. Posterior samples were summarized based on the Bayesian point estimate (median), standard error (median absolute deviation), and 80%, 90% and 95% highest density intervals (HDIs). HDIs that do not include zero are reported in bold.

Effect	Estimate	SE	HDI (80%)	HDI (90%)	HDI (95%)
Pollination					
Landscape → Richness	-0.1973	0.0461	**[-0.2527, -0.1345]**	**[-0.2739, -0.1220]**	**[-0.2894, -0.1091]**
Landscape → Evenness	0.1006	0.0447	**[0.0433, 0.1571]**	**[0.0268, 0.1723]**	**[0.0159, 0.1906]**
Landscape → Pollination	-0.0554	0.0404	**[-0.1074, -0.0024]**	[-0.1227, 0.0118]	[-0.1352, 0.0258]
Richness → Pollination	0.1591	0.0373	**[0.1117, 0.2061]**	**[0.0997, 0.2203]**	**[0.0879, 0.2316]**
Evenness → Pollination	-0.0583	0.0388	**[-0.1069, -0.0091]**	[-0.1198, 0.0073]	[-0.1346, 0.0161]
Pest control					
Landscape → Richness	-0.1480	0.0487	**[-0.2056, -0.0819]**	**[-0.2269, -0.0659]**	**[-0.2465, -0.0540]**
Landscape → Evenness	-0.0538	0.0554	[-0.1221, 0.0204]	[-0.1510, 0.0334]	[-0.1599, 0.0617]
Landscape → Pest control	-0.0319	0.0443	[-0.0869, 0.0273]	[-0.1054, 0.0416]	[-0.1182, 0.0594]
Richness → Pest control	0.2260	0.0431	**[0.1704, 0.2803]**	**[0.1563, 0.2979]**	**[0.1440, 0.3135]**
Evenness → Pest control	-0.0717	0.0433	**[-0.1299, -0.0196]**	[-0.1419, 0.0009]	[-0.1537, 0.0152]

Table S8. Model output for path models testing the direct and cascading landscape simplification effects on final crop production via changes in richness, evenness, and ecosystem services. Posterior samples were summarized based on the Bayesian point estimate (median), standard error (median absolute deviation), and 80%, 90% and 95% highest density intervals (HDIs). HDIs that do not include zero are reported in bold.

Effect	Estimate	SE	HDI (80%)	HDI (90%)	HDI (95%)
Pollination					
Landscape → Richness	-0.1709	0.0589	**[-0.2431, -0.892]**	**[-0.2697, -0.0696]**	**[-0.2984, -0.0494]**
Landscape → Evenness	0.0837	0.0549	**[0.0117, 0.1540]**	[-0.0163, 0.1710]	[-0.0306, 0.1956]
Richness → Pollination	0.1829	0.0504	**[0.1205, 0.2495]**	**[0.1011, 0.2665]**	**[0.0818, 0.2799]**
Evenness → Pollination	-0.0714	0.0515	**[-0.1415, -0.0075]**	[-0.1607, 0.0116]	[-0.1744, 0.0326]
Pollination → Production	0.3344	0.0862	**[0.2279, 0.4536]**	**[0.2012, 0.4901]**	**[0.1707, 0.5178]**
Pest control					
Landscape → Richness	-0.2225	0.0881	**[-0.3406, -0.1075]**	**[-0.3771, -0.0697]**	**[-0.4019, -0.0223]**
Landscape → Evenness	-0.0287	0.0992	[-0.1680, 0.0950]	[-0.2045, 0.1477]	[-0.2484, 0.1874]
Richness → Pest control	0.2145	0.0797	**[0.1123, 0.3174]**	**[0.0790, 0.3447]**	**[0.0614, 0.3798]**
Evenness → Pest control	-0.1251	0.0808	**[-0.2346, -0.0248]**	[-0.258, 0.0134]	[-0.2959, 0.0341]
Pest control → Production	0.1483	0.0823	**[0.0377, 0.2488]**	**[0.0133, 0.2877]**	[-0.0094, 0.3213]

Table S9. Model output for path models testing the direct and cascading landscape simplification effects on final crop production via changes in richness, abundance, and ecosystem services. Posterior samples were summarized based on the Bayesian point estimate (median), standard error (median absolute deviation), and 80%, 90% and 95% highest density intervals (HDIs). HDIs that do not include zero are reported in bold.

Effect	Estimate	SE	HDI (80%)	HDI (90%)	HDI (95%)
Pollination					
Landscape → Richness	-0.1870	0.0571	**[-0.2631, -0.1128]**	**[-0.2876, -0.0926]**	**[-0.3067, -0.0722]**
Landscape → Abundance	-0.1988	0.0542	**[-0.2680, -0.1270]**	**[-0.2915, -0.1069]**	**[-0.3103, -0.0884]**
Richness → Pollination	0.1477	0.0638	**[0.0645, 0.2281]**	**[0.0485, 0.2568]**	**[0.0212, 0.2712]**
Abundance → Pollination	0.0104	0.0667	[-0.0742, 0.0961]	[-0.0951, 0.1243]	[-0.1250, 0.1373]
Pollination → Production	0.3388	0.0868	**[0.2268, 0.4509]**	**[0.1910, 0.4813]**	**[0.1549, 0.5070]**
Pest control					
Landscape → Richness	-0.2073	0.0840	**[-0.3197, -0.0977]**	**[-0.3502, -0.0554]**	**[-0.3915, -0.0216]**
Landscape → Abundance	-0.0304	0.1060	[-0.1759, 0.1106]	[-0.2242, 0.1587]	[-0.2745, 0.1938]
Richness → Pest control	0.2255	0.0786	**[0.1201, 0.3236]**	**[0.0932, 0.3573]**	**[0.0730, 0.3905]**
Abundance → Pest control	0.0040	0.0793	[-0.1016, 0.1064]	[-0.1331, 0.1413]	[-0.1572, 0.1769]
Pest control → Production	0.1395	0.0786	**[0.0404, 0.2451]**	**[0.0151 0.2822]**	[-0.0257, 0.3011]

Table S10. Model output for path models testing direct and indirect effects of pollinator richness, abundance, and evenness (with honey bees) on pollination. Posterior samples were summarized based on the Bayesian point estimate (median), standard error (median absolute deviation), and 80%, 90% and 95% highest density intervals (HDIs). HDIs that do not include zero are reported in bold.

Effect	Estimate	SE	HDI (80%)	HDI (90%)	HDI (95%)
Model 1					
Richness → Pollination	0. 1043	0.0419	**[0.0524, 0.1588]**	**[0.0356, 0.1715]**	**[0.0250, 0.1878]**
Richness → Abundance	0.5160	0.0377	**[0.4682, 0.5659]**	**[0.4511, 0.5784]**	**[0.4328, 0.5882]**
Abundance → Pollination	0.1183	0.0452	**[0.0617, 0.1768]**	**[0.0430, 0.1903]**	**[0.0278, 0.2038]**
Model 2					
Richness → Pollination	0.1722	0.0370	**[0.1272, 0.2199]**	**[0.1110, 0.2294]**	**[0.1009, 0.2420]**
Richness → Evenness	0.0027	0.0551	[-0.0633, 0.0788]	[-0.0941, 0.0886]	[-0.1067, 0.1101]
Evenness → Pollination	-0.1148	0.0365	**[-0.1598, -0.0647]**	**[-0.1759, -0.0544]**	**[-0.1890, -0.0438]**

Table S11. Results of pairwise comparison of richness–ecosystem service relationships according to the methods used to sample pollinators and natural enemies. A Bayesian hypothesis testing was used to assess the relative statistical evidence in favor of the null hypothesis versus the alternative hypothesis.

Hypothesis	Estimate difference	Estimate Error	CI lower	CI upper	Evidence Ratio
Pollination					
Active > Passive	-0.02	0.10	-0.18	Inf	0.78
Pest control					
Active > Passive	0.04	0.08	-0.01	Inf	2.17

Table S12. Results of pairwise comparison of richness–ecosystem service relationships according to the methods used to quantify pollination and pest control services. A Bayesian hypothesis testing was used to assess the relative statistical evidence in favor of the null hypothesis versus the alternative hypothesis.

Hypothesis	Estimate difference	Estimate Error	CI lower	CI upper
Pollination				
Fruit set = Δ Fruit weight	0.11	0.13	-0.15	0.37
Fruit set = Seed set	-0.10	0.08	-0.26	0.06
Δ Fruit weight = Seed set	0.22	0.15	-0.07	0.50
Pest control				
Cage (damage) = Cage (infestation)	0.09	0.18	-0.26	0.44
Cage (damage) = Pest damage	0.17	0.15	-0.12	0.47
Cage (damage) = Sentinel experiments	0.05	0.15	-0.24	0.34
Cage (infestation) = Pest damage	0.08	0.14	-0.19	0.36
Cage (infestation) = Sentinel experiments	-0.04	0.13	-0.30	0.22
Pest damage = Sentinel experiments	-0.12	0.10	-0.32	0.07