Agri-environment schemes' effects on arthropods across European farmlands - results from three meta-analyses

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Outline of the talk:

The main results based on different meta-analyses – agri-environment schemes effectiveness for arthropods.

Introduction

Agri-environment-schemes

Agri-environment schemes (AES) provide funding to farmers to farm in a way that supports biodiversity and improves the quality of water and soil.

In- vs out-production AES.

AES was initiated in a few EU Member States during the 1980s.

Since **1992** they are **mandatory** for EU Member countries.

Introduction

Why meta-analyses?

Higher level conclusions based on the earlier studies.

Hesitation vs. convince.

Interactions give new results and perspectives, however sometimes complex to interpret.

Global scale patterns.

Introduction

Testing earlier hypothesis.

Does conservation on farmland contribute to halting the biodiversity decline?

David Kleijn[1], Maj Rundlöf[2,3], Jeroen Scheper[1], Henrik G. Smith[2] and Teja Tscharntke[4]

Testing local (*ecological contrast*), landscape (*landscape stucture*) and regional scale (*land use intensity*) effects on pollinators richness under different agri-environment management options based on Kleijn et al. (2011) hypotheses.

Marja, R., Kleijn, D., Tscharntke, T., Klein, A.-M., Frank, T., Batáry, P. 2019. Effectiveness of agri-environmental management on pollinators is moderated more by ecological contrast than by landscape structure or land-use intensity. Ecology Letters, 22: 1493–1500.

Introduction

Kleijn et al. (2011).

Use of nitrogen

Organic vs conventional farming

Usually low, or none

100-200 kg/per hectare

Large ecological contrast

Introduction

Kleijn et al. (2011).

Later mowing in Holland

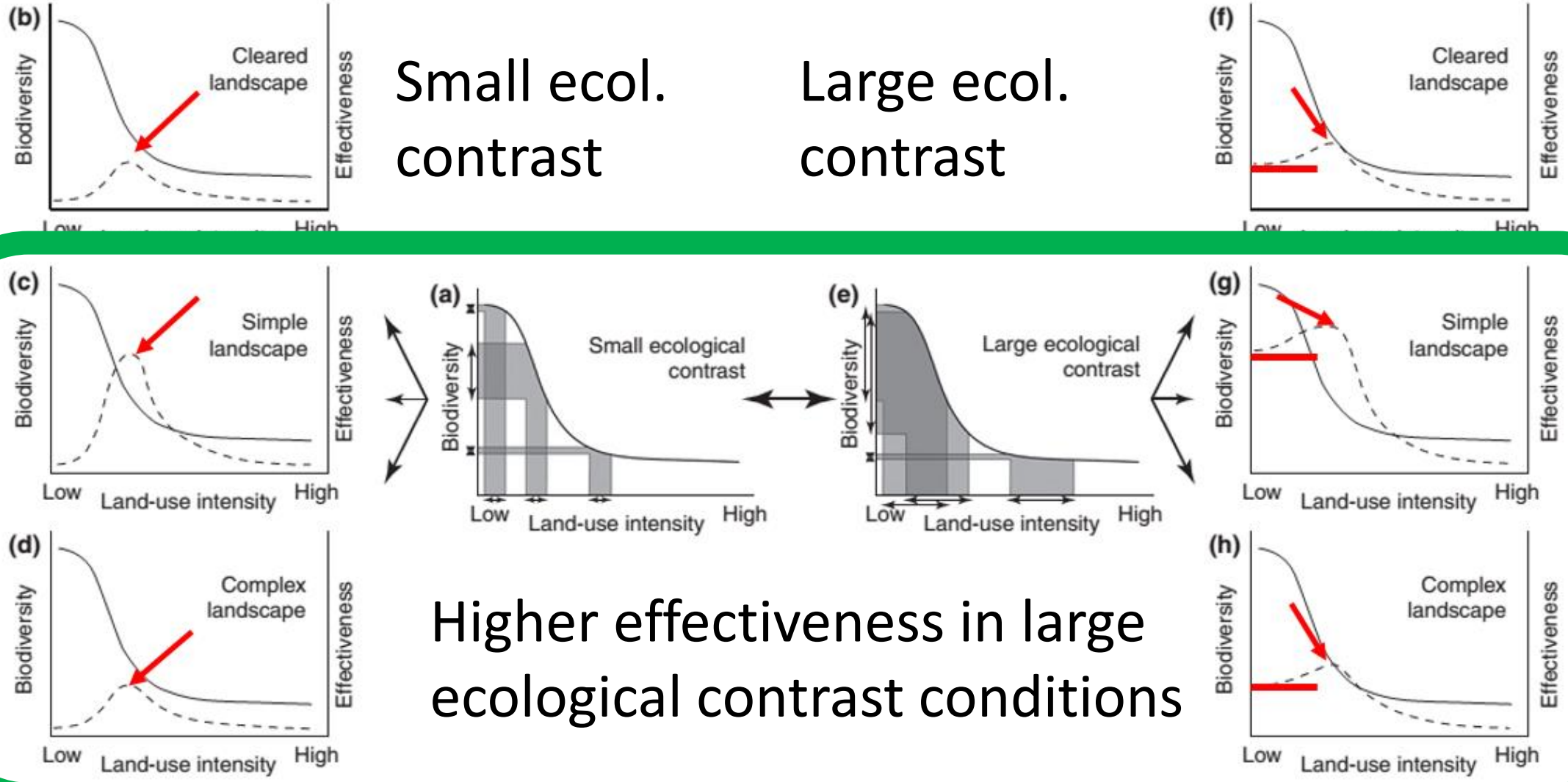
Later mowing vs normal mowing time

Small ecological contrast, because farmland birds species richness/pool there is already so/too low!

Additionally:
Simple vs complex landscapes.
Intensive vs extensive land use areas.

Introduction

Kleijn et al. (2011).



Introduction

Total 62 case studies or unpublished datasets;

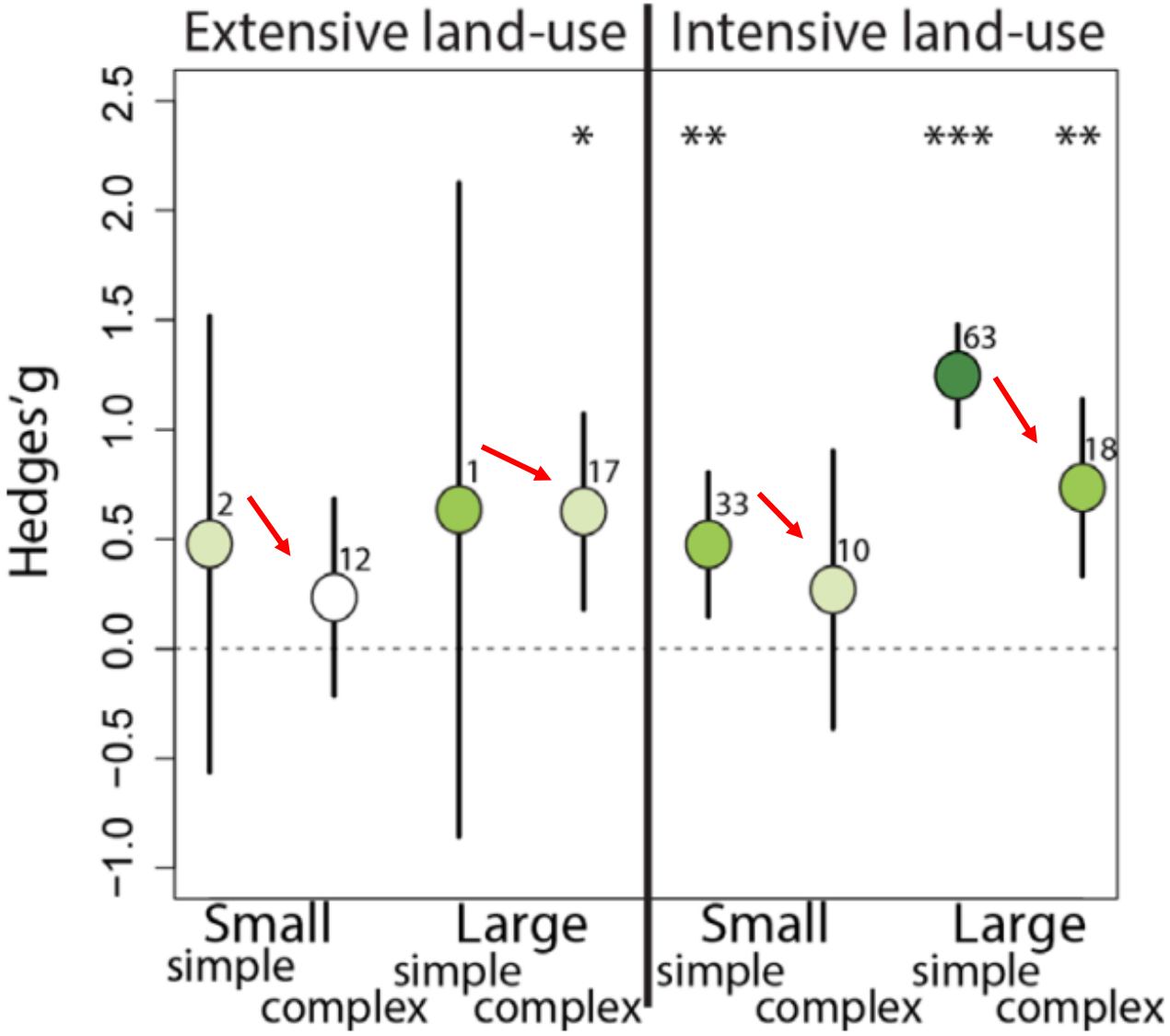
156 data points.

Only pollinators species richness (diversity).

	Extensive land use		Intensive land use	
Small contrast	Simple	Complex	Simple	Complex
Large contrast	Simple	Complex	Simple	Complex

Based on Kleijn et al., 2011

Results



AEM effectiveness was always stronger in simple than in complex landscape.

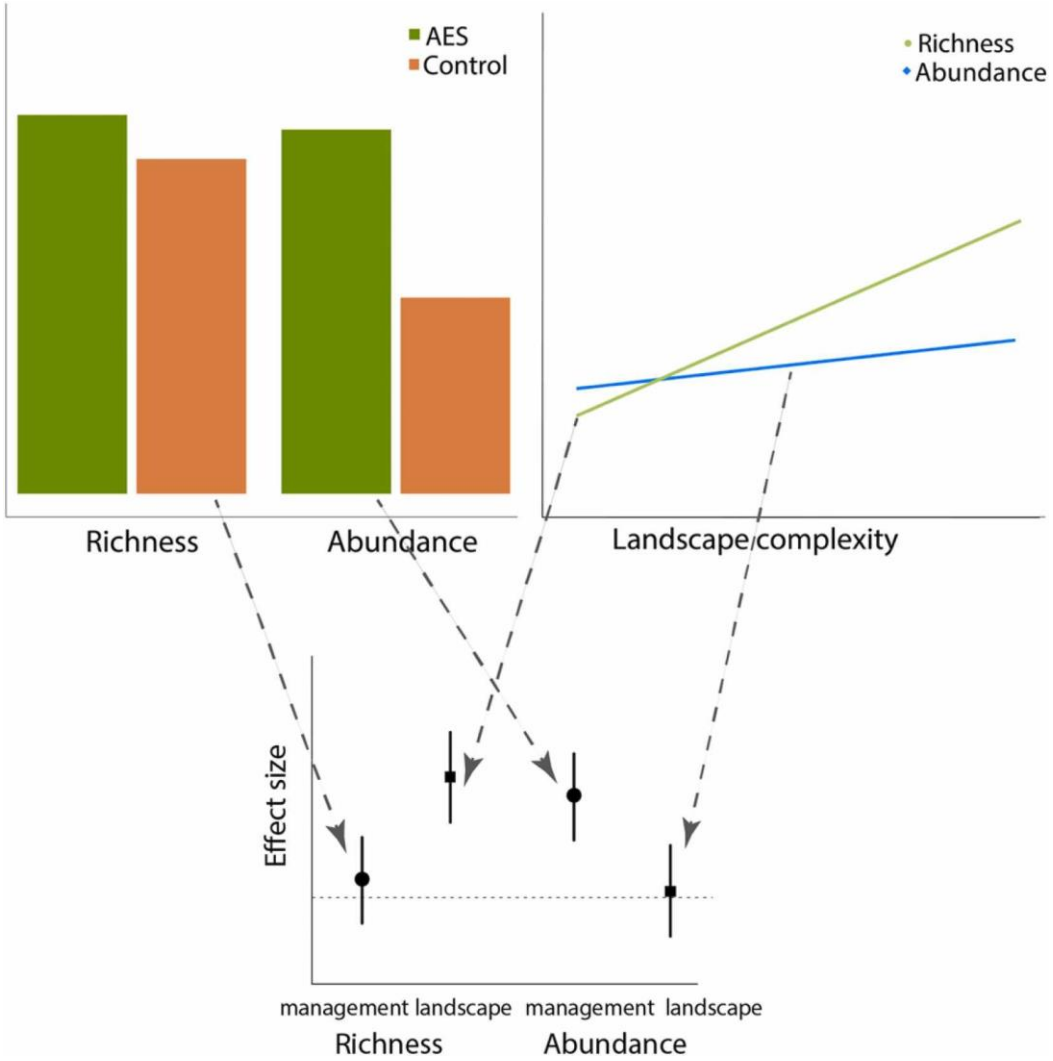
We proved David Kleijn and co-authors hypothesis.

Results

Species rich puszta, Carpathian, Alpine and alvar grasslands etc.


Photo: Edina Török

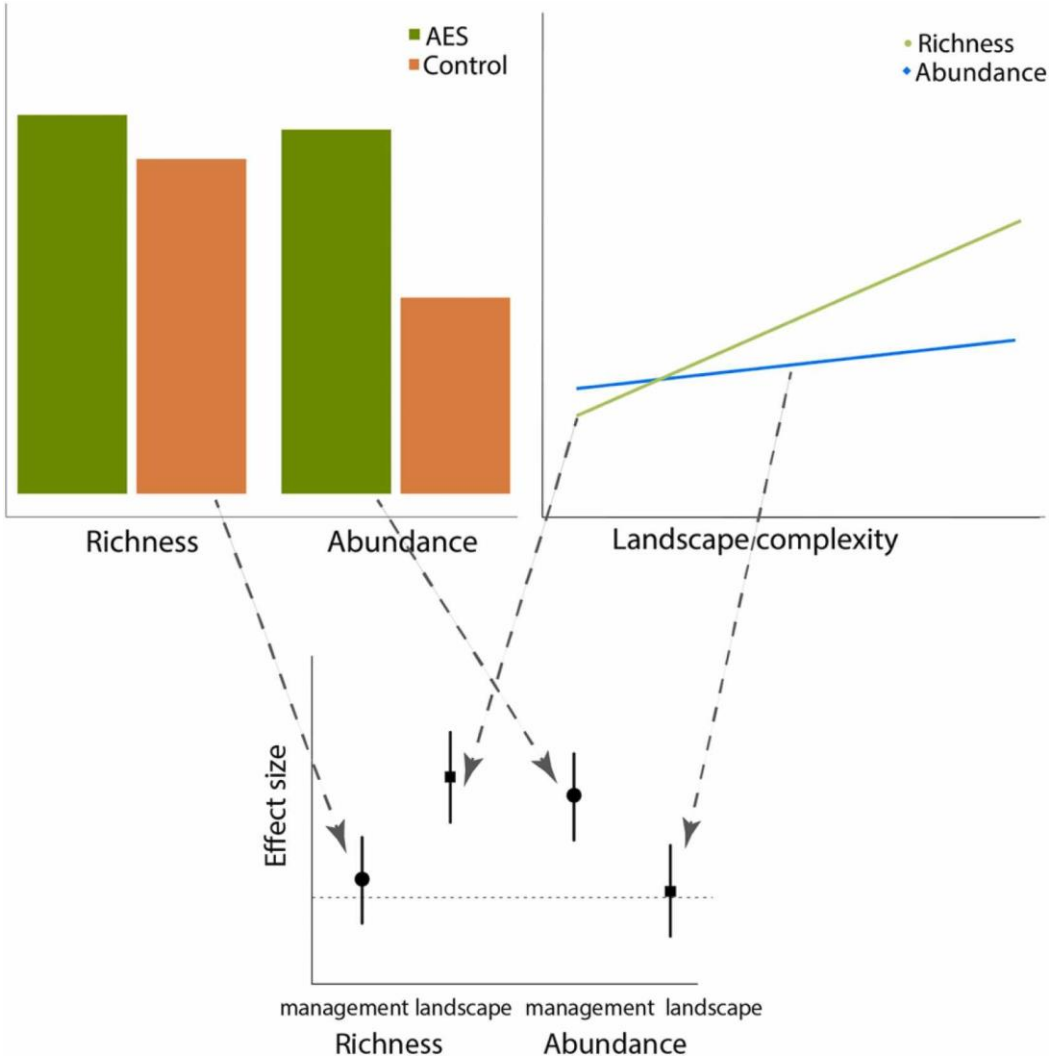
Results



Does the landscape determine the arthropod richness and the local management (only) the arthropod abundance **in cropland**?

Marja, R., Tscharntke, T., Batáry, P. 2022. Increasing landscape complexity enhances species richness of farmland arthropods, agri-environment schemes also abundance – A meta-analysis. Agriculture Ecosystems & Environment, 326: 107822.

Results

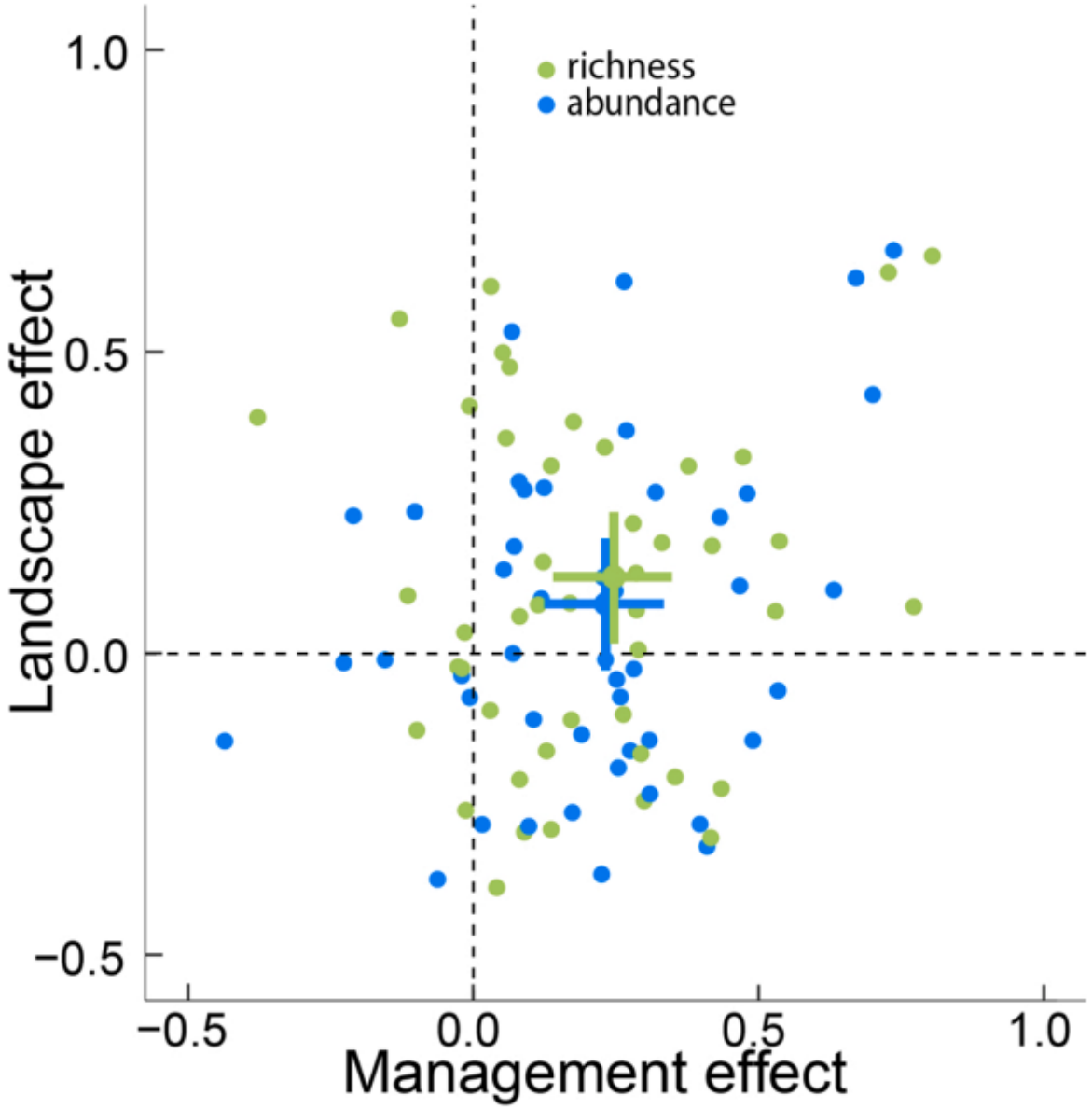


Interaction model:

1) Species richness;
2) Abundance;
3) Agri-environment schemes effectiveness
4) Landscape complexity effect.

Only cropland studies.

Results



SR – AES (–)
SR – Lands. (+)
Abu – AES (+)
Abu – Lands. (+)

Abundance drives the species richness?

Results

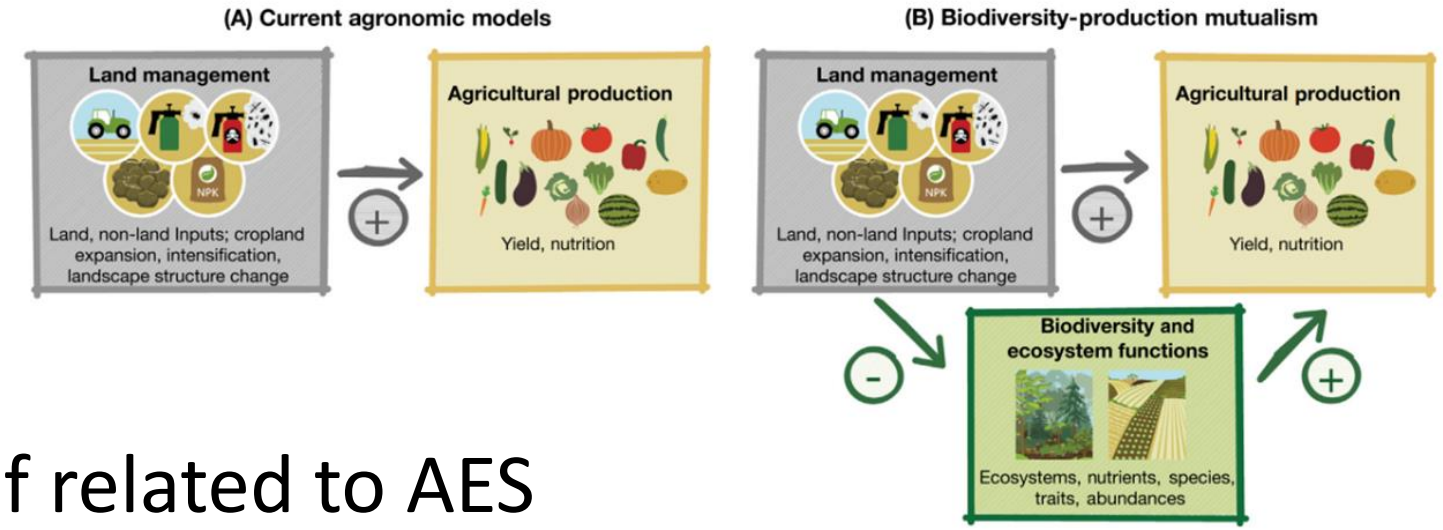
Trends in Ecology & Evolution

CellPress REVIEWS

Opinion

Deciphering the Biodiversity–Production Mutualism in the Global Food Security Debate

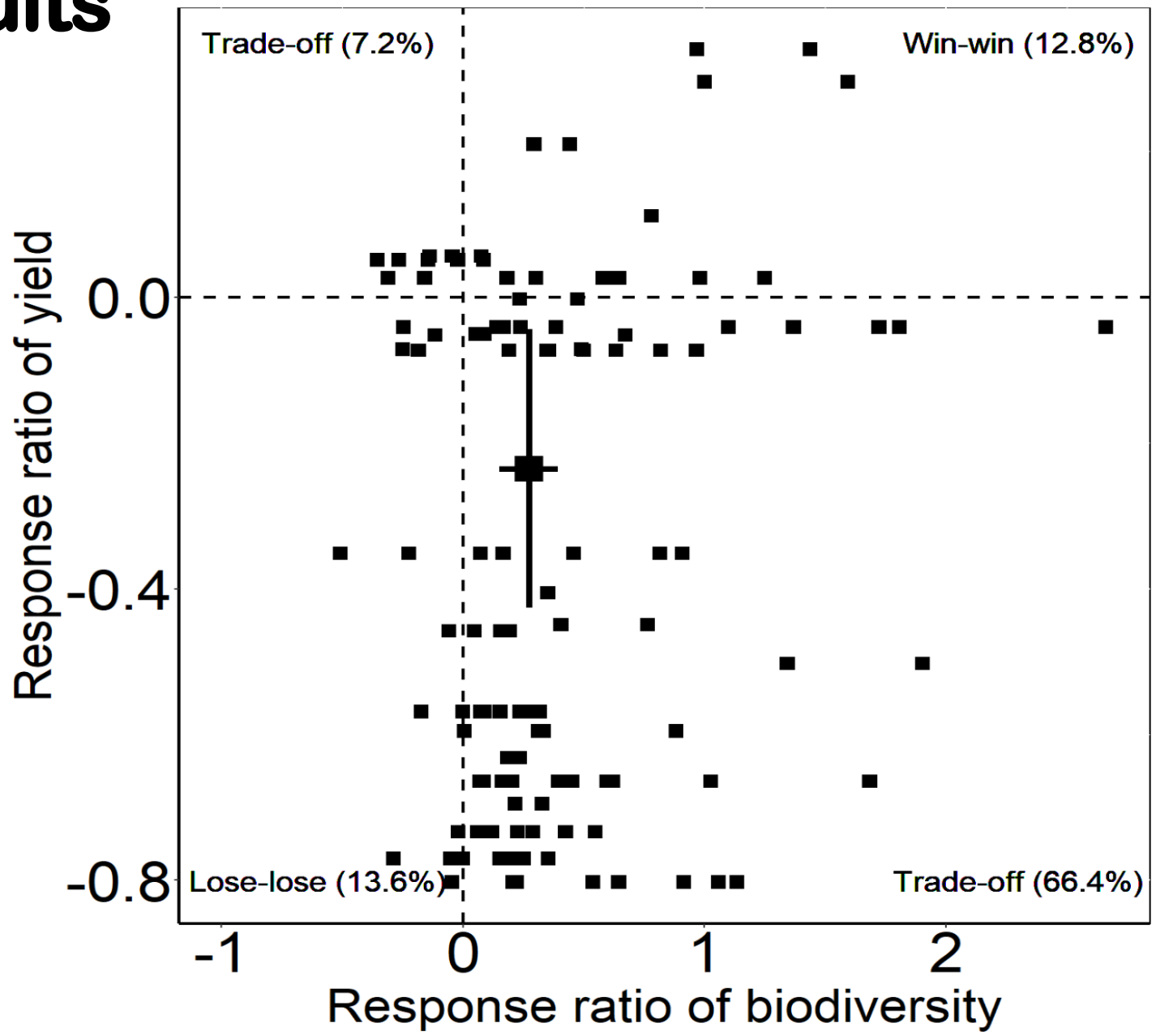
Ralf Seppelt,[1,2,*] Channing Arndt,[3] Michael Beckmann,[1] Emily A. Martin,[4] and Thomas W. Hertel[5]



Biodiversity vs. yield trade-of related to AES

Marja, R., Albrecht, M., Herzog, F., Öckinger, E., Segre, H., Kleijn, D., Batáry, P. (2024). Quantifying potential trade-offs and win-wins between arthropod diversity and yield on cropland under agri-environment schemes – a meta-analysis. Journal of Environmental management 353: 120277.

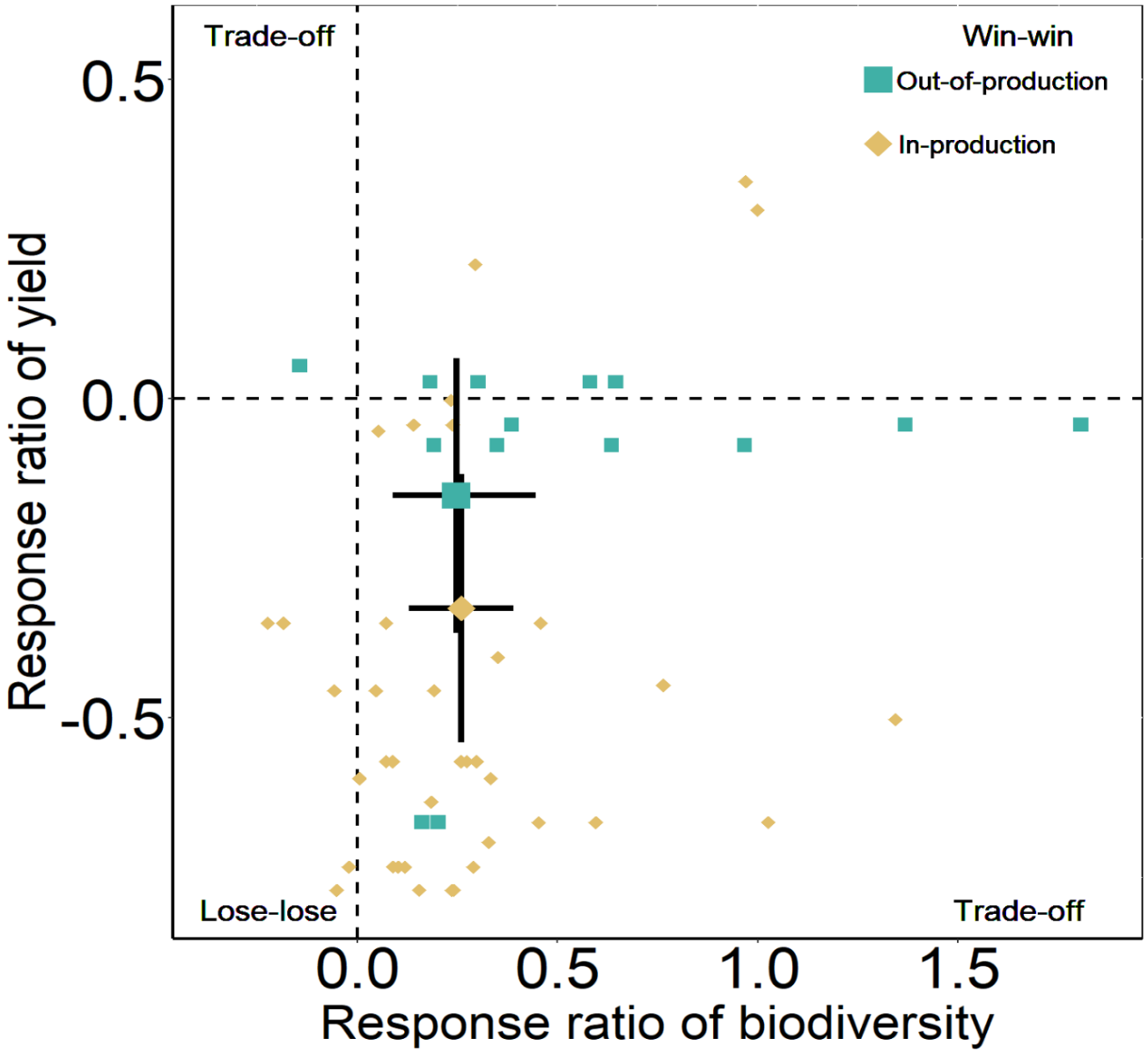
Results



31% increase of diversity

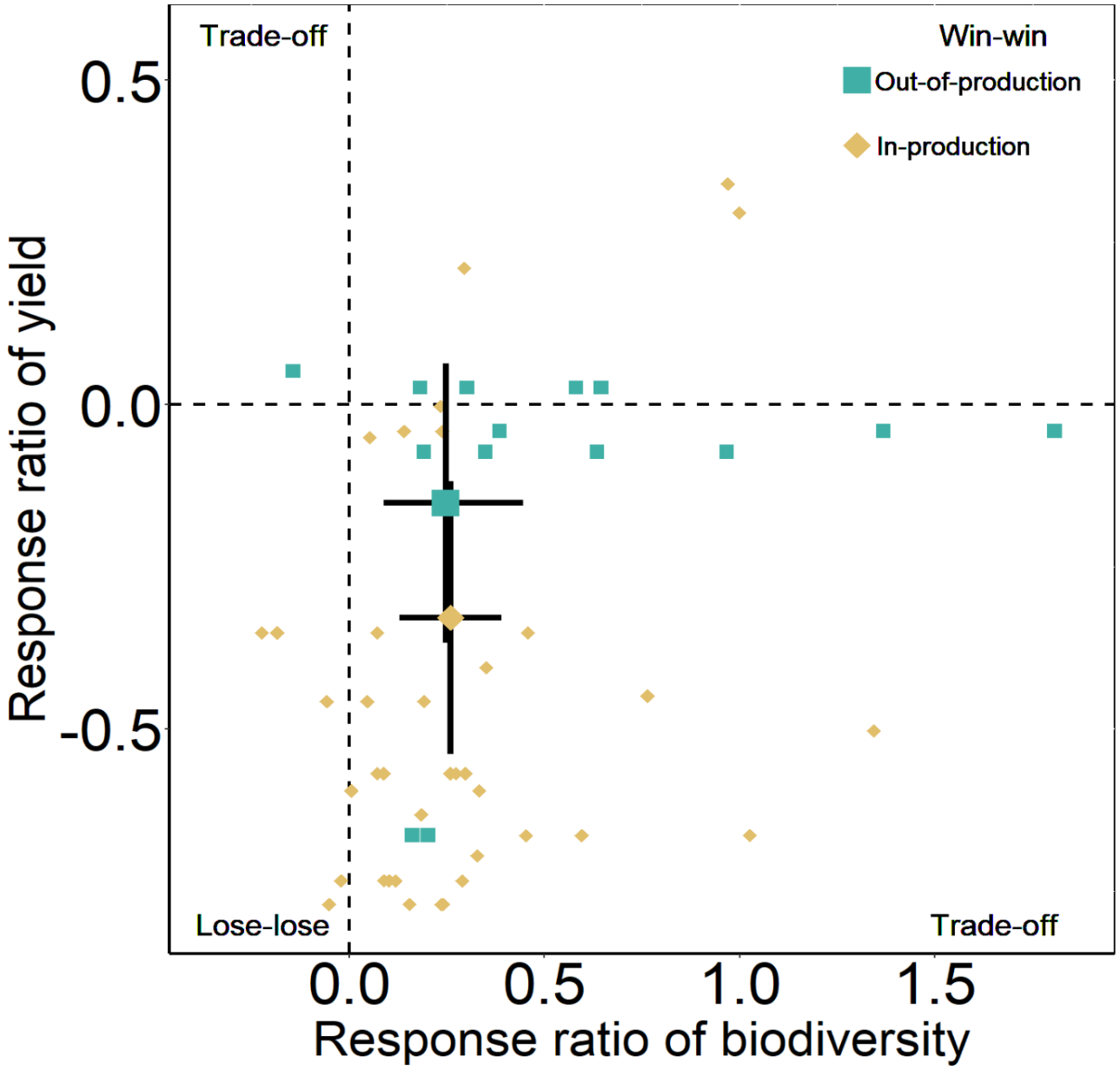
21% decrease of the yield

Results



The yield effects in our study are underestimated in out-of-production AES.

Results



ECOLOGY LETTERS

Letters | Open Access

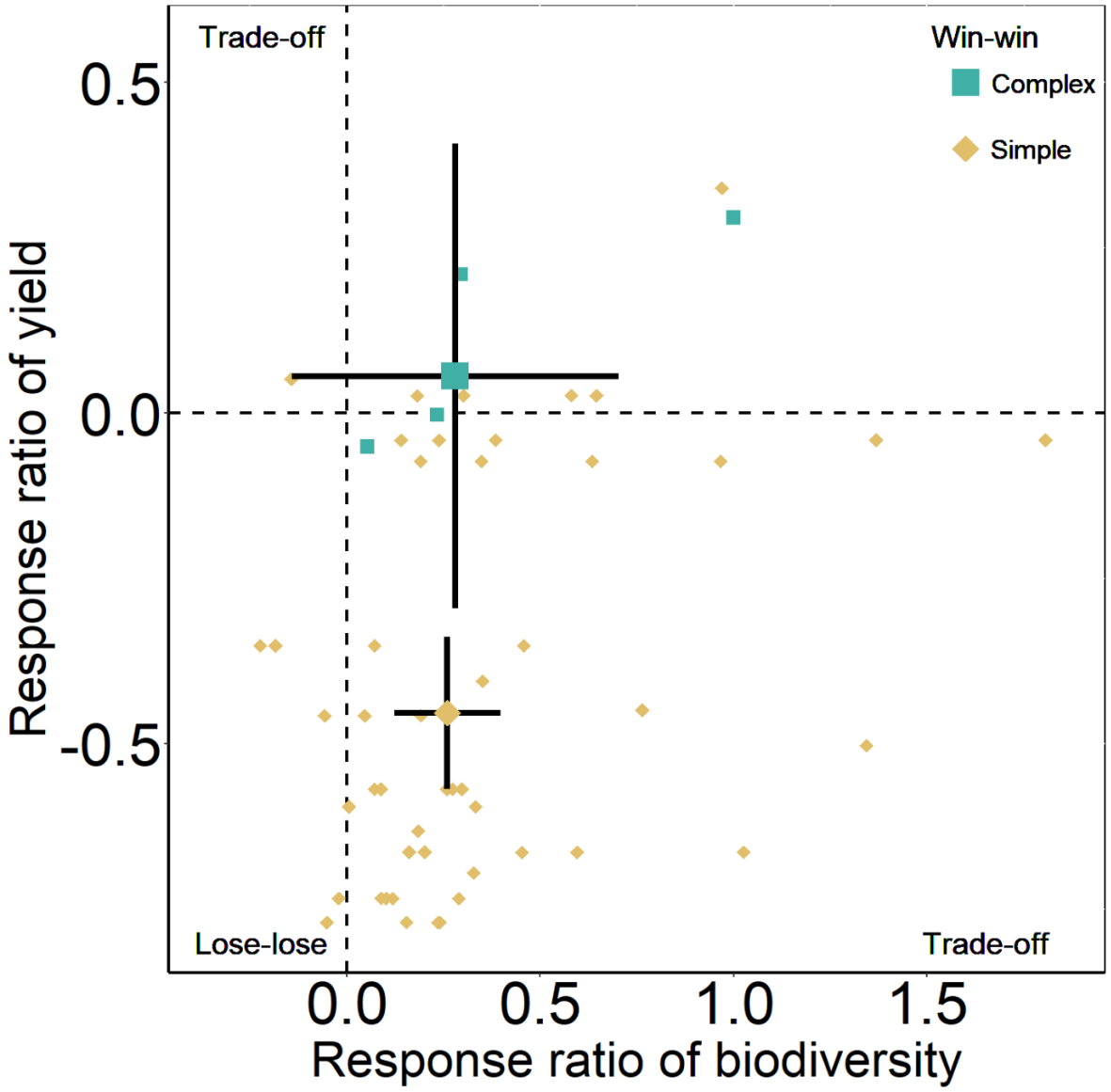
The effectiveness of flower strips and hedgerows on pest control, pollination services and crop yield: a quantitative synthesis

Correction(s) for this article

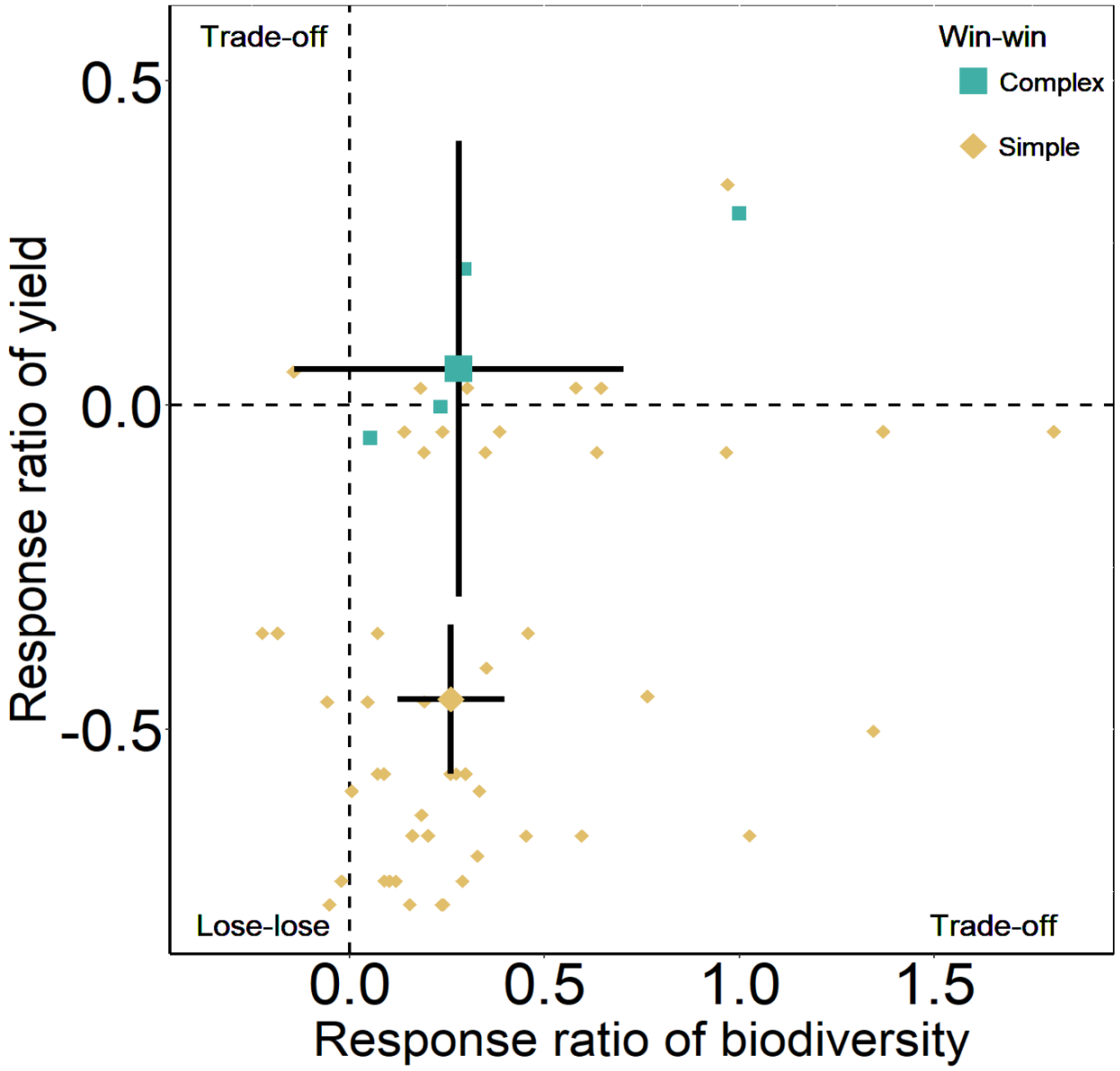
Matthias Albrecht, David Kleijn, Neal M. Williams, Matthias Tschumi, Brett R. Blaauw, Riccardo Bommarco, Alistair J. Campbell, Matteo Dainese, Francis A. Drummond, Martin H. Entling, Dominik Ganser, G. Arjen de Groot, Dave Goulson, Heather Grab, Hannah Hamilton, Felix Herzog, Rufus Isaacs, Katja Jacot, Philippe Jeanneret, Mattias Jonsson, Eva Knop, Claire Kremen, Douglas A. Landis, Gregory M. Loeb, Lorenzo Marini, Megan McKerchar, Lora Morandin, Sonja C. Pfister, Simon G. Potts, Maj Rundlöf, Hillary Sardiñas, Amber Sciligo, Carsten Thies, Teja Tscharntke, Eric Venturini, Eve Veromann, Ines M.G. Vollhardt, Felix Wäckers, Kimiora Ward, Duncan B. Westbury, Andrew Wilby, Megan Woltz, Steve Wratten, Louis Sutter ... See fewer authors

First published: 18 August 2020 | https://doi.org/10.1111/ele.13576 | Citations: 74

Results


Trade-off
Win-win
Complex
Simple
Lose-lose
Trade-off
0.5
0.0
-0.5
0.0
0.5
1.0
1.5
Response ratio of yield
Response ratio of biodiversity

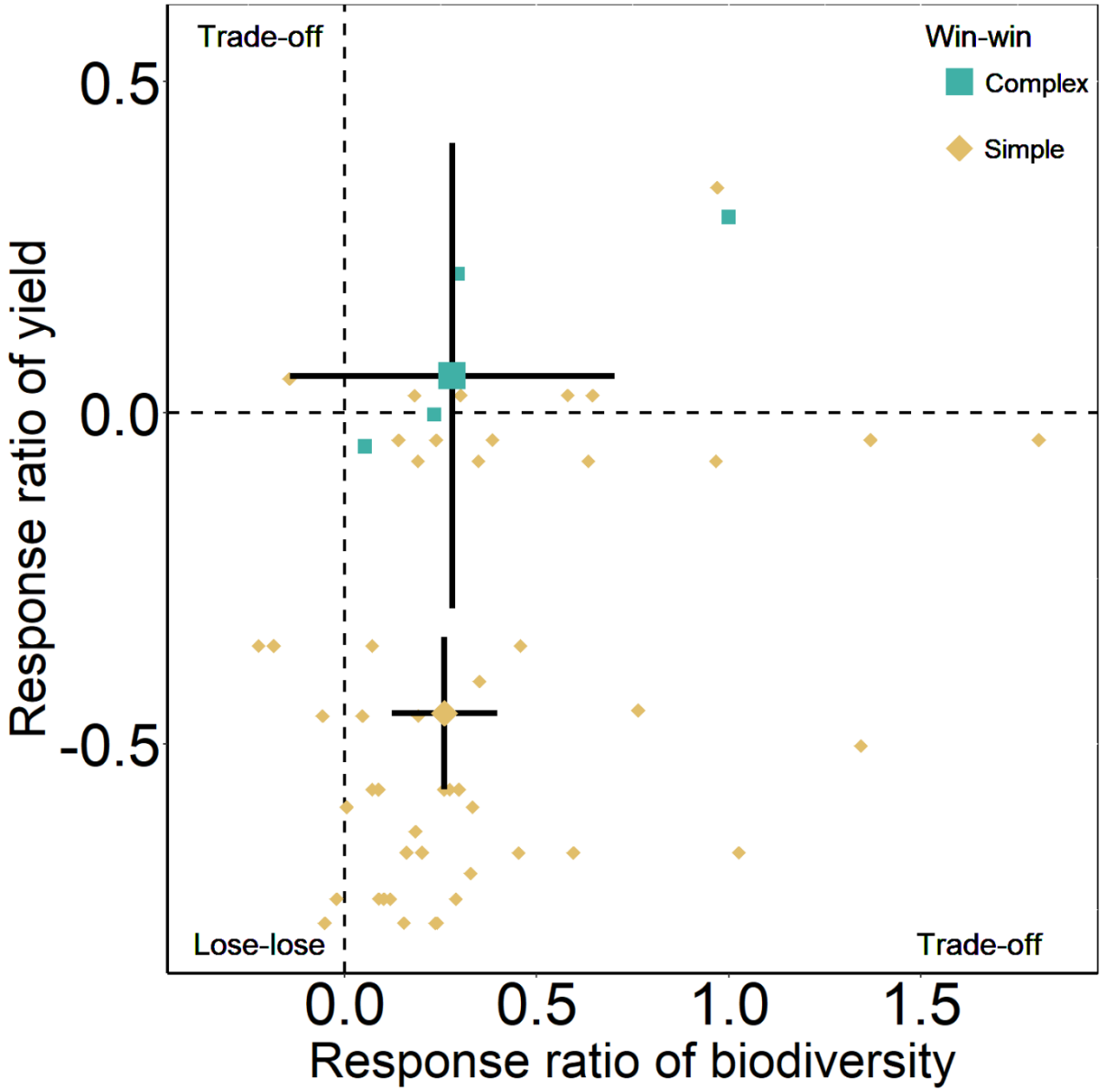
Results



More ecosystem services in the complex landscapes can compensate yield loss Batáry et al. 2017, Tscharntke et al., 2021)

Bötzl et al. (2020) showed that edge effects can significantly reduce yields...

Results



50 YEARS WITH IMPACT
Journal of Applied Ecology
British Ecological Society
Journal of Applied Ecology 2013, **50**, 355–364
doi: 10.1111/1365-2664.12035

Food production vs. biodiversity: comparing organic and conventional agriculture

Doreen Gabriel[1,2,3]*, Steven M. Sait[1], William E. Kunin[1] and Tim G. Benton[1]

[1]School of Biology, University of Leeds, Leeds, LS2 9JT, UK; [2]Institute for Crop and Soil Science, Julius Kühn-Institute – Federal Research Centre for Cultivated Plants, Bundesallee 50, D-38116, Braunschweig, Germany; and [3]Institute of Biodiversity, Thünen Institute – Federal Research Institute for Rural Areas, Fisheries and Forestry, Bundesallee 50, D-38116, Braunschweig, Germany

Crop yield- local conditions, biodiversity wider spatial scale...

Results

Agronomy for Sustainable Development (2024) 44:15
https://doi.org/10.1007/s13593-024-00947-7

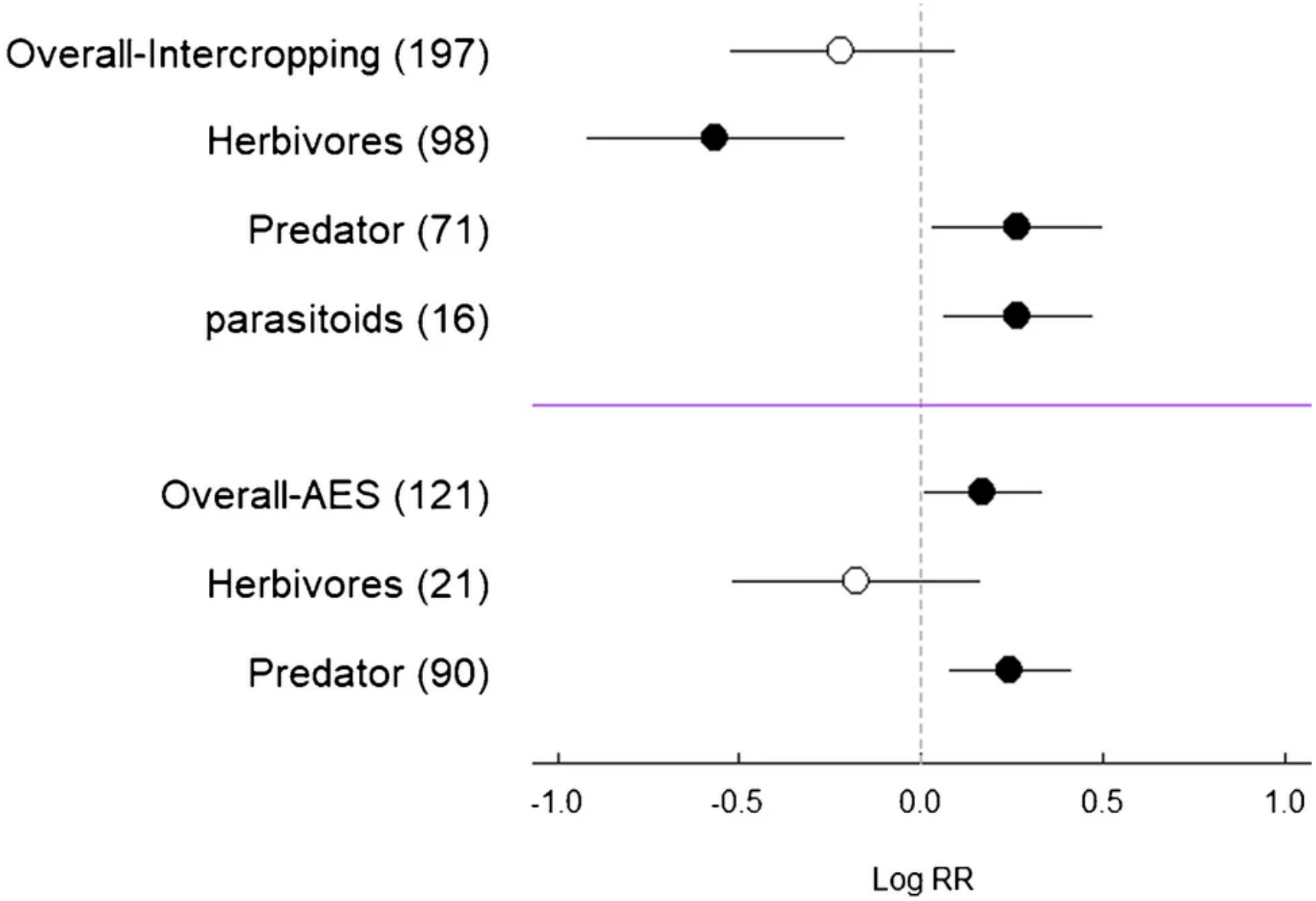
META-ANALYSIS

The effectiveness of intercropping and agri-environmental schemes on ecosystem service of biological pest control: a meta-analysis

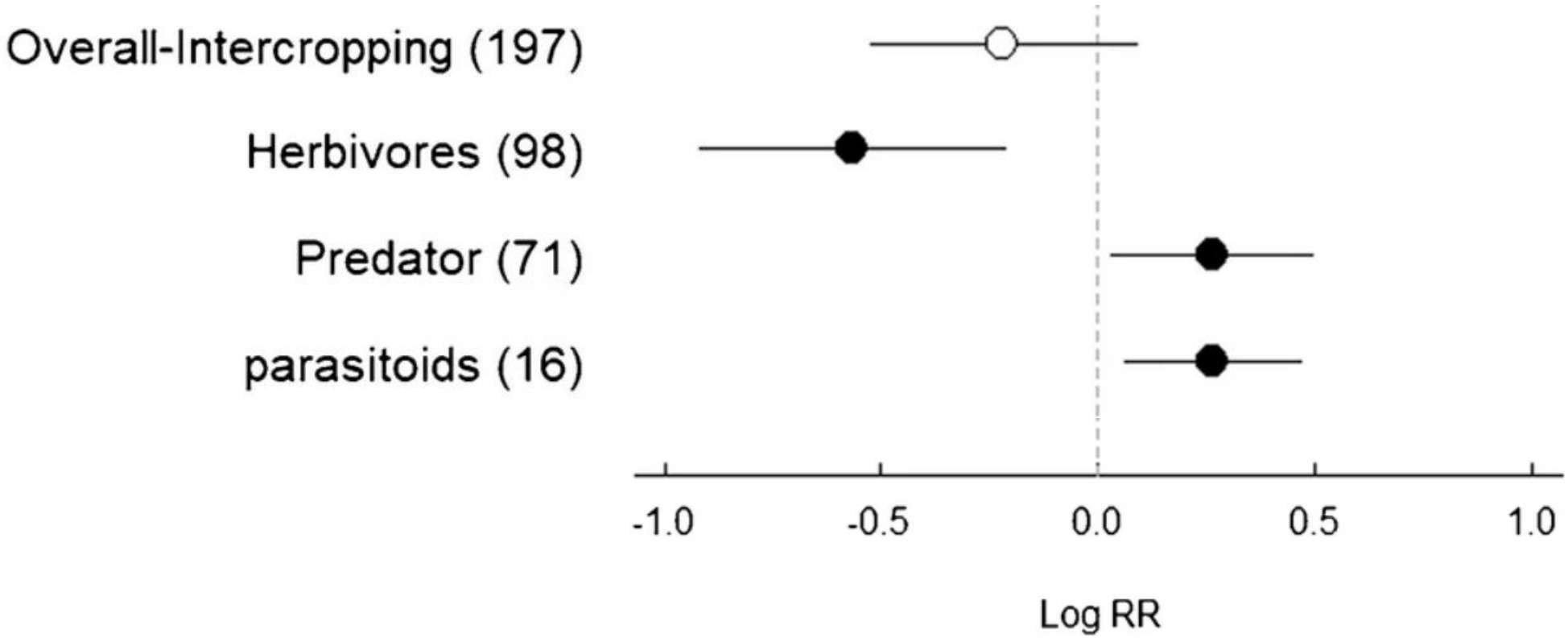
Maryam Yousefi[1,2] · Riho Marja[3] · Elias Barmettler[4,5] · Johan Six[1] · Anne Dray[1] · Jaboury Ghazoul[1]

Yousefi, M., **Marja, R.**, Barmettler, E., Six, J., Dray, A., Ghazoul, J., 2024. The effectiveness of intercropping and agri-environmental schemes on ecosystem service of biological pest control: a meta-analysis. Agron. Sustain. Dev. 44, 15.

Results


Overall-Intercropping (197)
Herbivores (98)
Predator (71)
parasitoids (16)
Overall-AES (121)
Herbivores (21)
Predator (90)
-1.0
-0.5
0.0
0.5
1.0
Log RR

Results


Overall-Intercropping (197)
Herbivores (98)
Predator (71)
parasitoids (16)
-1.0
-0.5
0.0
0.5
1.0
Log RR

Results

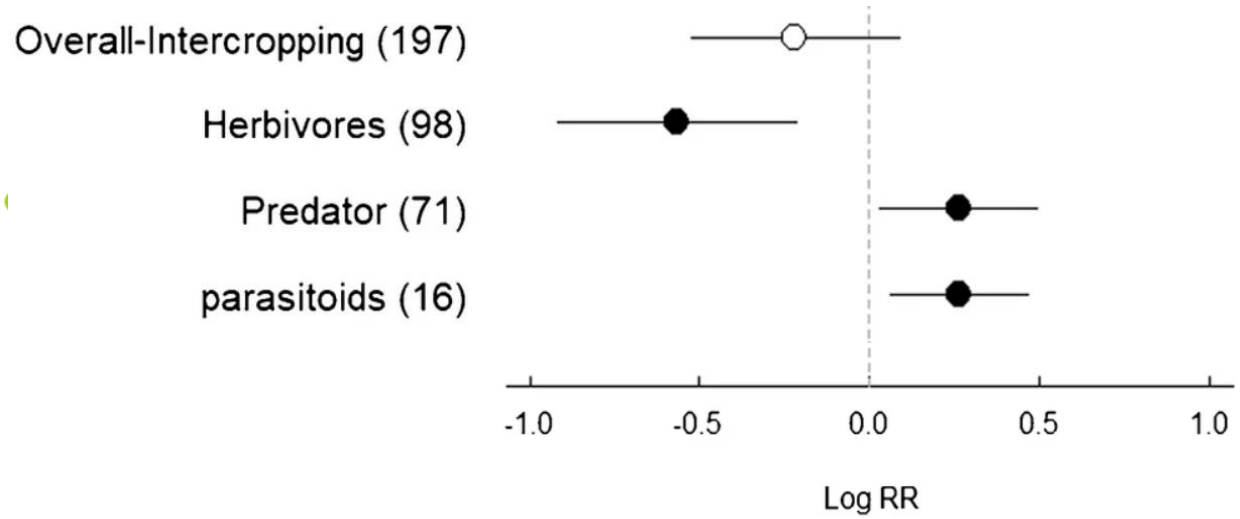
DOI: 10.1111/gcb.15747

PRIMARY RESEARCH ARTICLE

Global Change Biology WILEY

Positive but variable effects of crop diversification on biodiversity and ecosystem services

Damien Beillouin[1,2] | Tamara Ben-Ari[3,4] | Eric Malézieux[1,2] | Verena Seufert[5] | David Makowski[6]



Crop diversification positively affected biodiversity while having a neutral effect on crop yield

Results

Chapter 2

What did we learn from meta-analyses about farmland arthropod conservation?

Péter Batáry, Riho Marja, René Gaigher, Ingo Grass & András Báldi

Batáry, P., **Marja, R.**, Gaigher, R., Grass, I., Báldi, A. 2023. What did we learn from meta-analyses about farmland arthropod conservation? In: Defining Agroecology. A Festschrift for Teja Tscharntke. (27–45). Tredition, Hamburg.

Future directions

A huge knowledge gaps between Europe, North-America, Australia vs the rest of the world (especially tropics).

Many current hypothesis tested only in European studies.

Interaction models needed – most previous meta-analyses used only univariate models.

Recommendations for insect conservation on farmland

Diversification practices (including intercropping);

Mixed-cropping and diversity of crops;

Complex crop-rotations;

Agroforestry;

AES: flower strips, set-asides, edge habits protection and creation;

Measures of reducing management intensity;

Integrated pest-management;

Low-intensity grazing and grazing itself;

Maintaining natural and semi-natural habitats.


Scan me!