A biodiverzitás védelem tájökológiai perspektívái

Batáry Péter

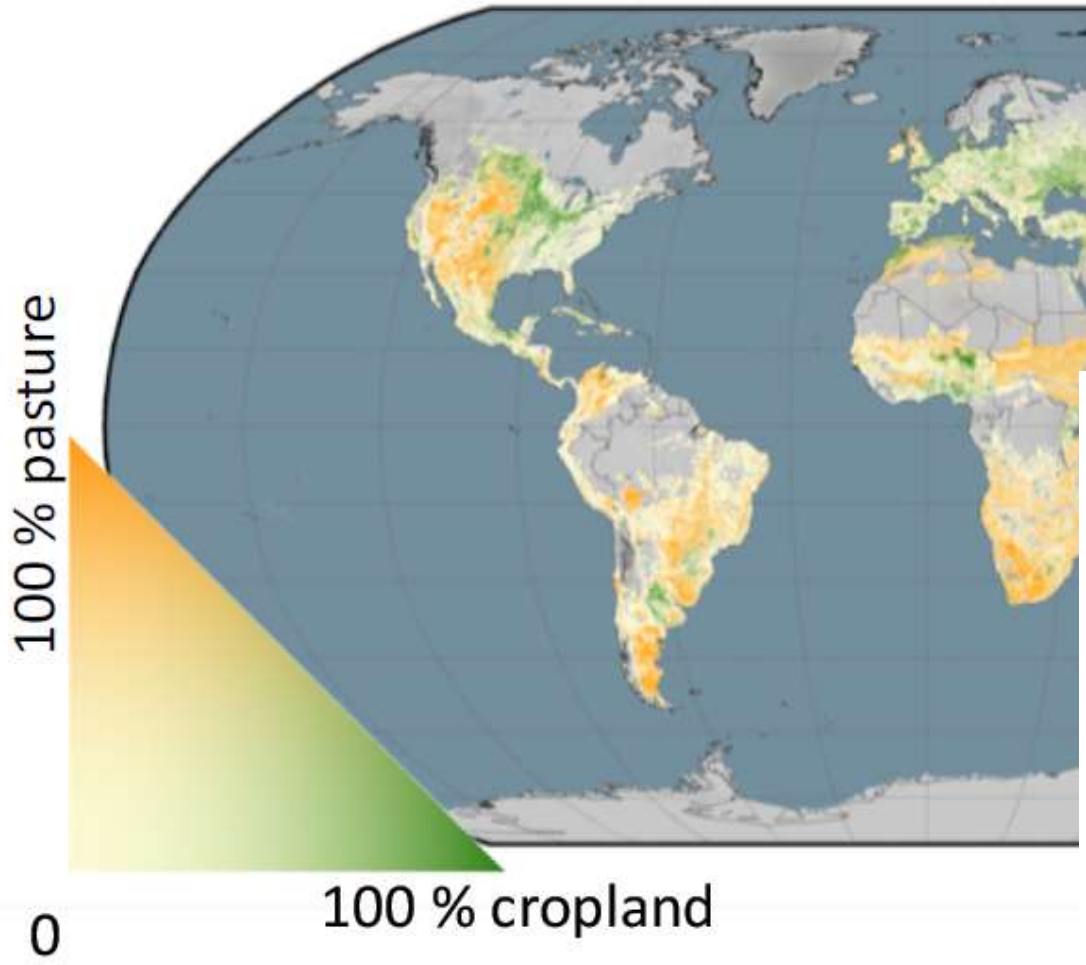
ÖK ÖBI Lendület Táj és Természetvédelmi Ökológia Kutatócsoport

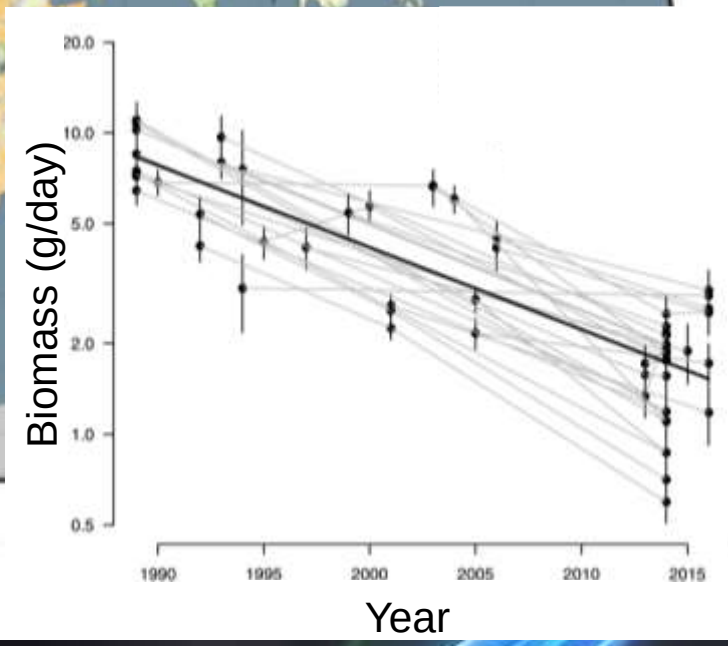
Outline

1. Introduction (Landscape structure, Study types)
2. Meta-analysis on Agri-Environment Schemes
3. Bird study on Agri-Environment Schemes
4. Habitat fragmentation study
5. FarmLand project
6. East-West project
7. Urbanization meta-analysis
8. Conclusions

1. Introduction: Planet under pressure

40 % of Earth's terrestrial surface covered by agriculture.

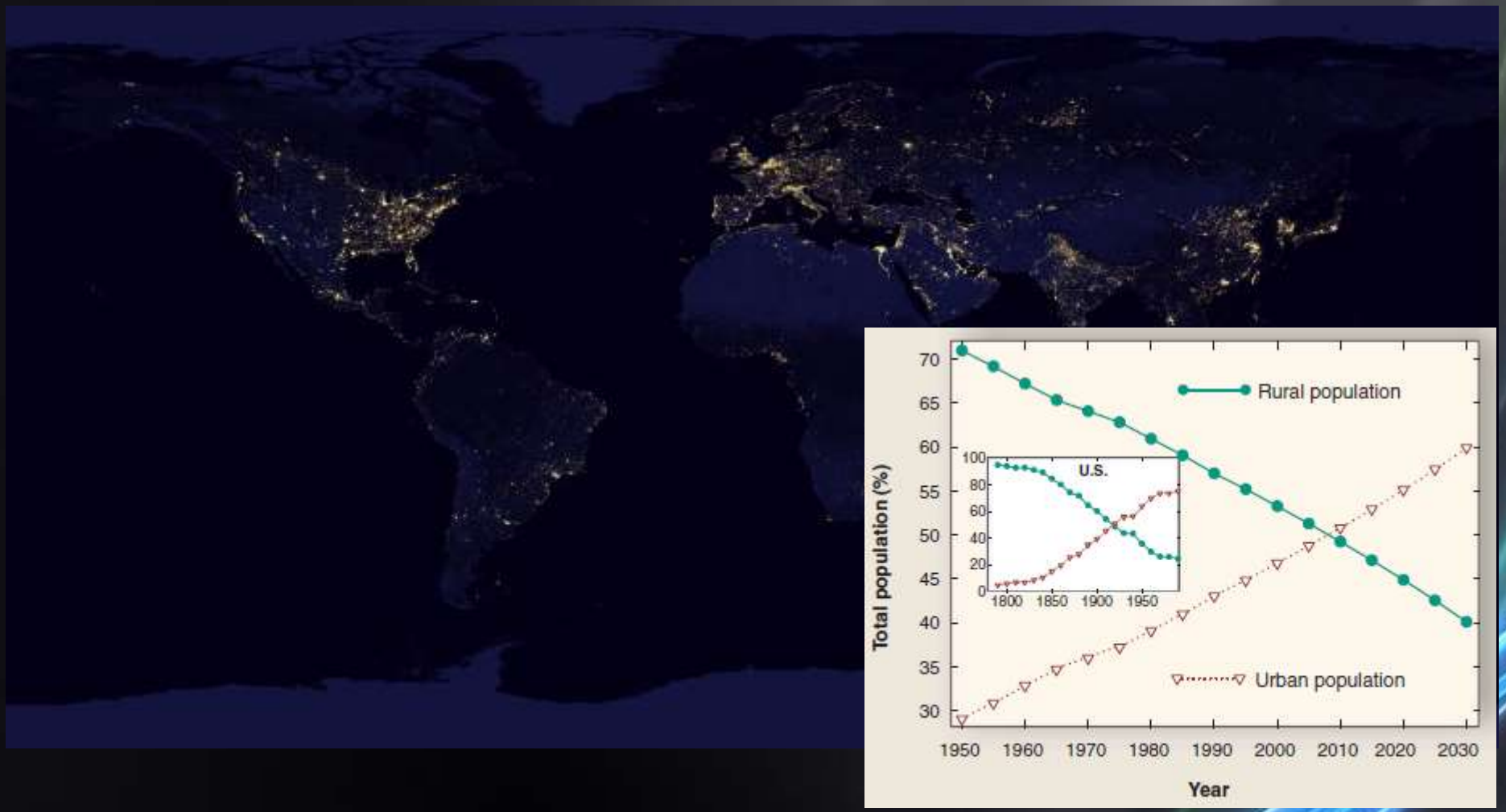




Foley et al. 2011. Nature; Hallmann et al. 2017 PLOS ONE

1. Introduction: Planet under pressure

3 % of Earth's terrestrial surface covered by urban areas.



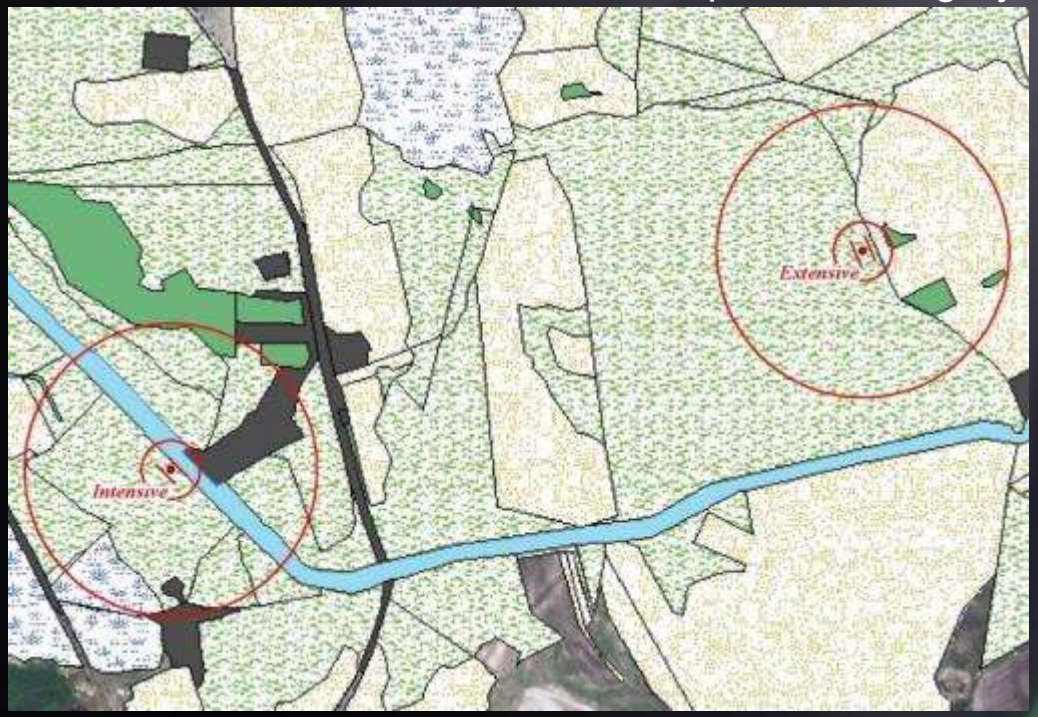
Grimm et al. 2008 Science; Alberti et al. 2015 TREE; Johnson & Munshi-South 2017 Science

1. Introduction: Landscape structure

Landscape composition refers to the variety and abundance of patch types without regard to their spatial character or arrangement.

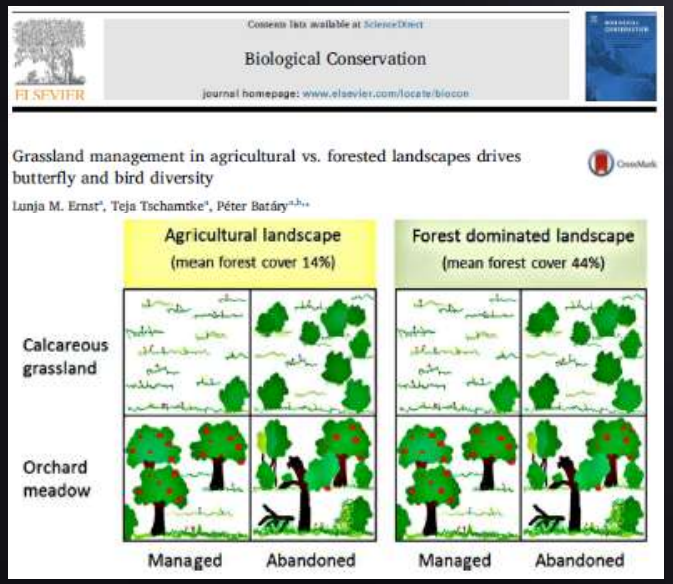
Landscape configuration, in contrast, refers to the spatial character and arrangement, position, or orientation of landscape elements.

Bösztör puszta, Hungary



Turner et al. 2001. Springer; Leitão et al. 2006. Island Press

1. Introduction: Intensification vs. Fragmentation studies



Converted environment

- Intensive farmland or urban areas
- Local: management intensity
- Landscape: composition (crop%, sealed area %, Shannon-diversity)

1. Introduction: Intensification vs. Fragmentation studies

<u>Converted environment</u>

- Intensive farmland or urban areas
- Local: management intensity
- Landscape: composition (crop%, sealed area%, Shannon-diversity)

<u>Habitat fragments</u>

- Remaining (semi)-natural fragments
- Local: habitat quality, fragment size
- Landscape: configuration (isolation/connectivity)

Interaction of effects between and within scales

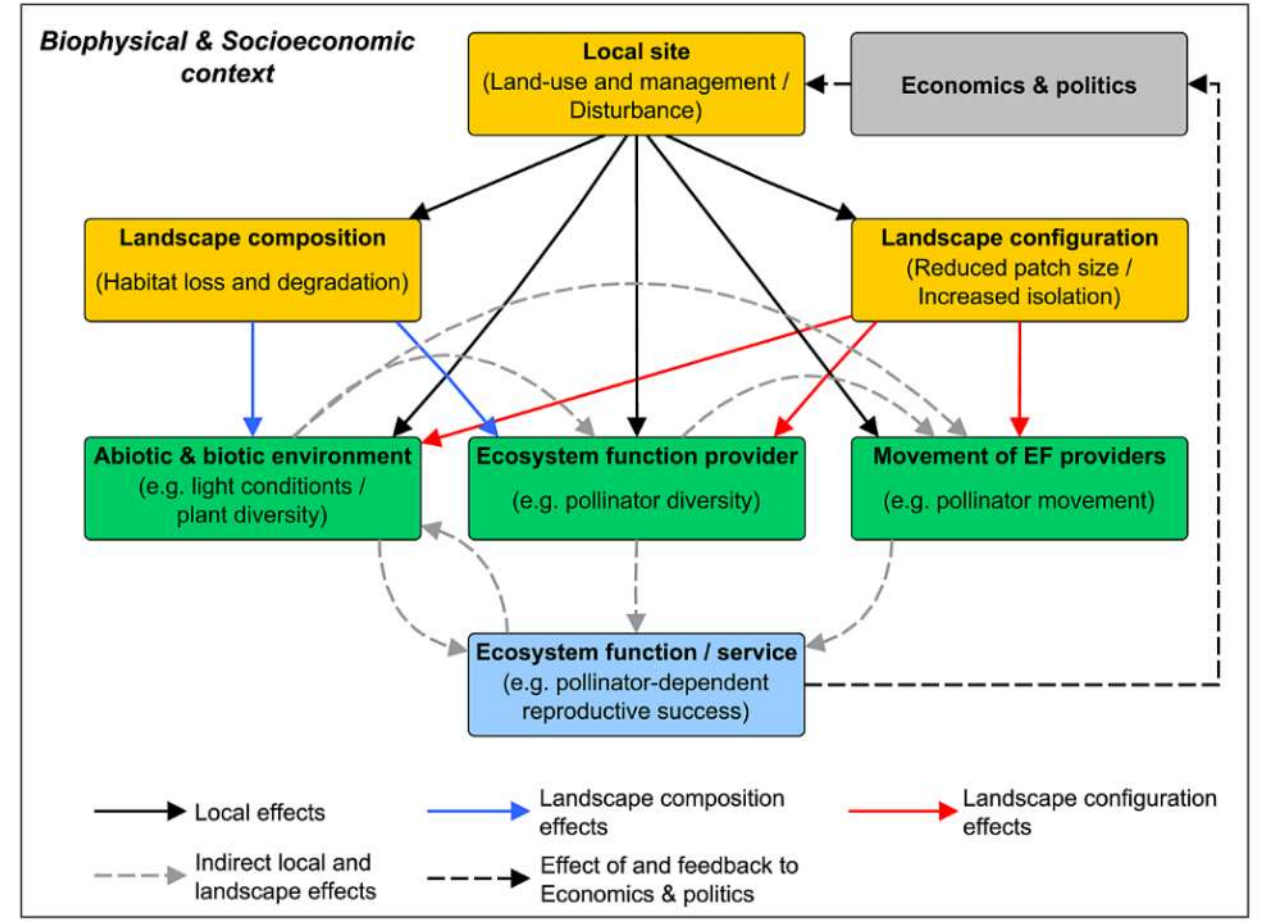
Sirami et al. 2019. PNAS; Martin et al. 2019. Ecol. Lett.

1. Introduction: The framework

REVIEW

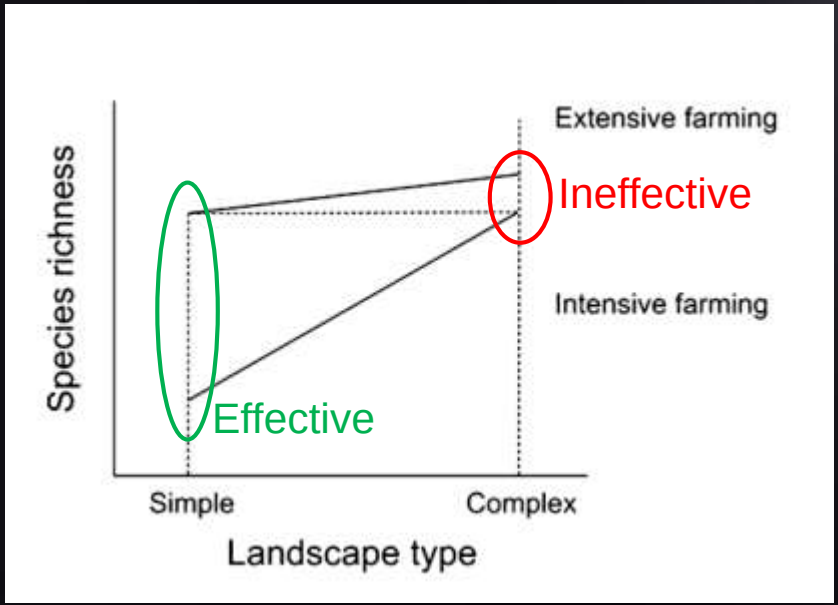
Biologia Futura: landscape perspectives on farmland biodiversity conservation

Péter Batáry[1] · András Báldi[2,3] · Johan Ekroos[4] · Róbert Gallé[1] · Ingo Grass[5] · Teja Tscharntke[6]



2. Meta-analysis on Agri-Environment Schemes

How does landscape complexity moderate the effects of agri-environmental management?



Simple landscape: <20% semi-natural area

Complex landscape: >20% semi-natural area

Tscharntke et al. 2005 Ecol.Lett., see also Tscharnke et al. 2012 Biol.Rev.

2. Meta-analysis on Agri-Environment Schemes

- Extensive literature search in ISI WoS (until July 2008):

1. agri-environment* AND biodiversity
2. agri-environment* AND species
3. organic AND farming AND biodiversity
4. organic AND farming AND species
5. organic AND agriculture AND biodiversity
6. organic AND agriculture AND species
7. agri* AND management AND intensity AND biodiversity
8. agri* AND management AND intensity AND species
9. integrated AND agriculture AND biodiversity
10. integrated AND agriculture AND species

- 1287 articles ---> 357 potential pdf ---> experiments selection based on strict criteria

- Data needed: mean, SD/SE/var/CI and sample size of species richness / abundance of taxa both in low and high intensity management (AEM and control) categories.

- Species richness dataset: 109 observations of 46 papers
  Abundance dataset: 114 observations of 45 papers

2. Meta-analysis on Agri-Environment Schemes

- Effect size: standardized mean difference (Hedges' d)

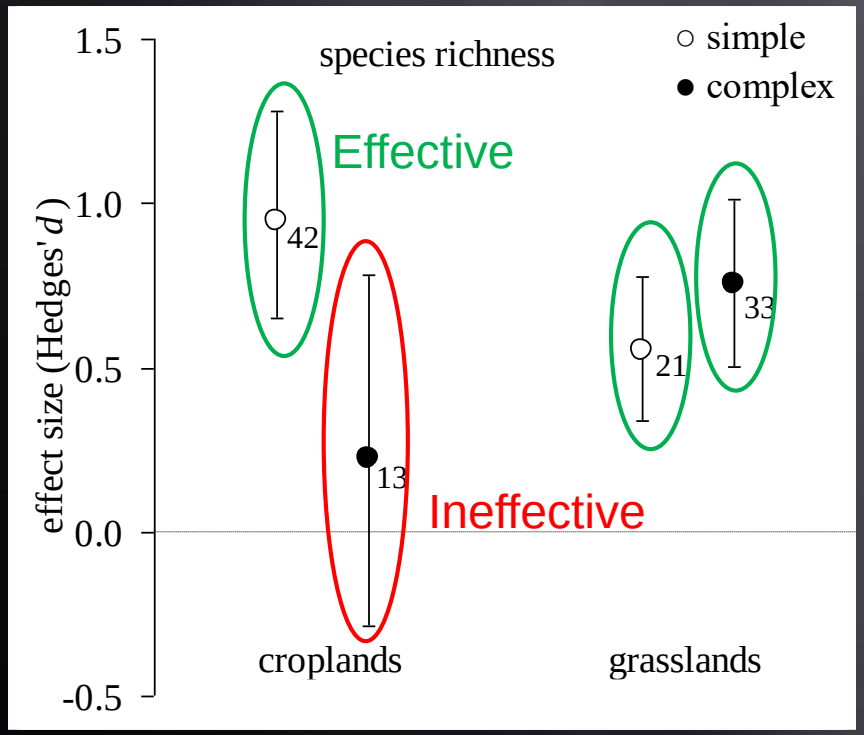
$$d = \frac{\left(\overline{X}^{E} - \overline{X}^{C}\right)}{S}\left(1 - \frac{3}{4\left(N^{C} + N^{E} - 2\right) - 1}\right)$$

- Effect size was positive, if species richness or abundance was higher in low (AEM) than in high intensity (control) fields.

- Put experiments in either 'simple' or 'complex' landscape categories (if it was not possible then excluded). Landscapes with high % of semi-natural areas were referred to as 'complex', landscapes with few of these areas as 'simple'.

- Both datasets (species richness and abundance) were divided into two main parts according to the investigated habitat: croplands vs. grasslands.

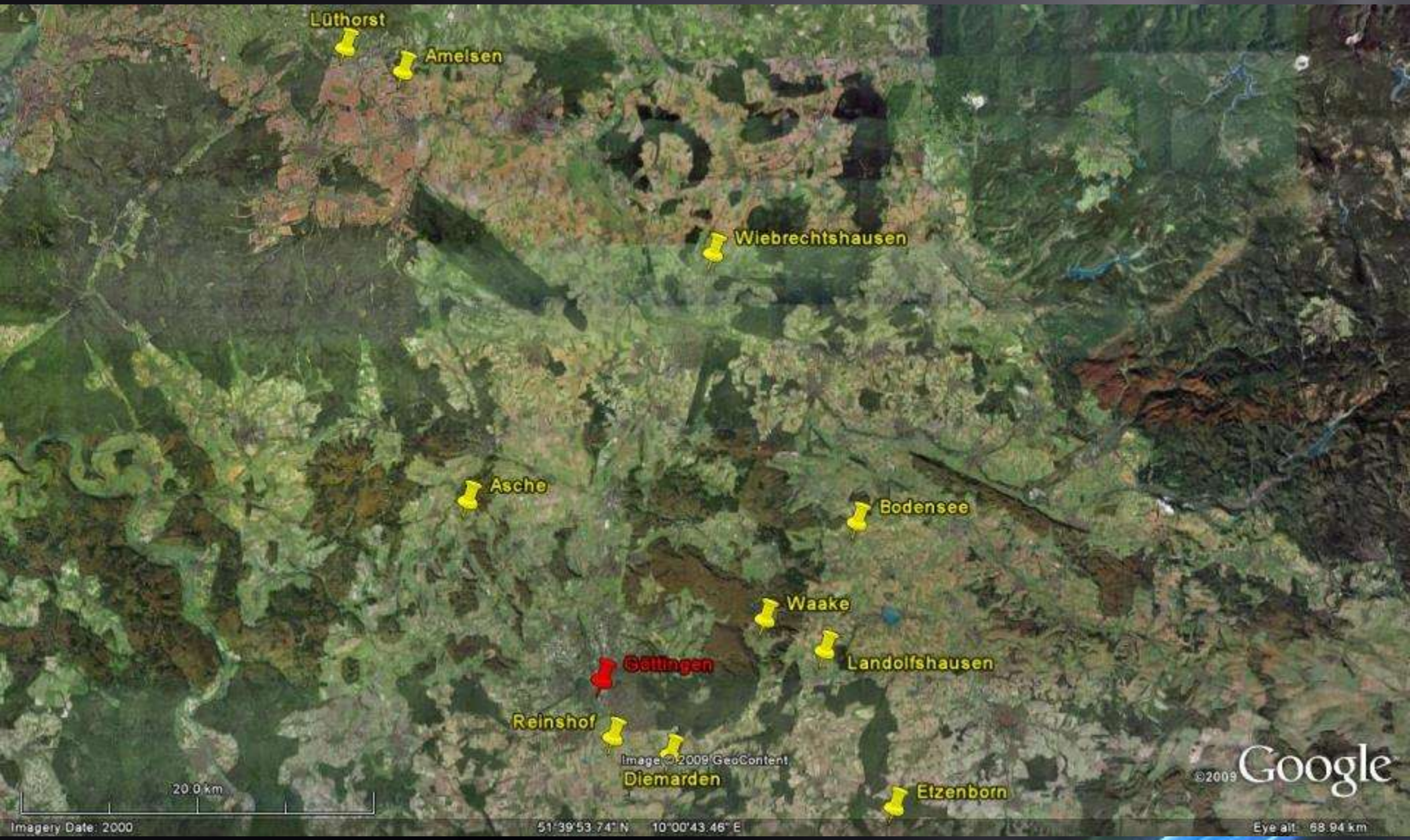
2. Meta-analysis on Agri-Environment Schemes



- Landscape composition moderates the effectiveness of AEM in croplands.

Batáry et al. 2011. Proc.Roy.Soc.B; see also Marja et al. 2019. Ecol. Lett.

3. Bird study on Agri-Environment Schemes



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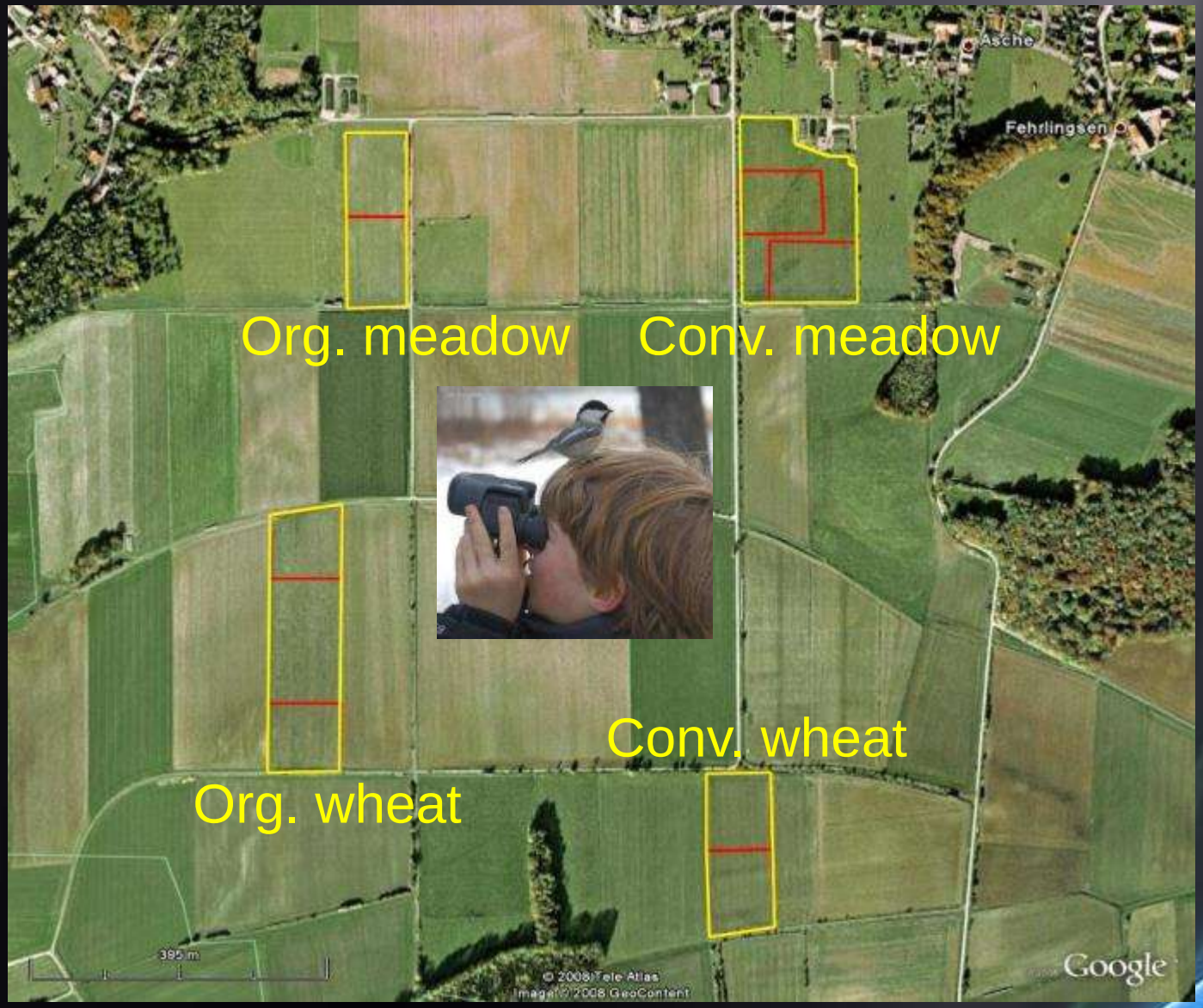
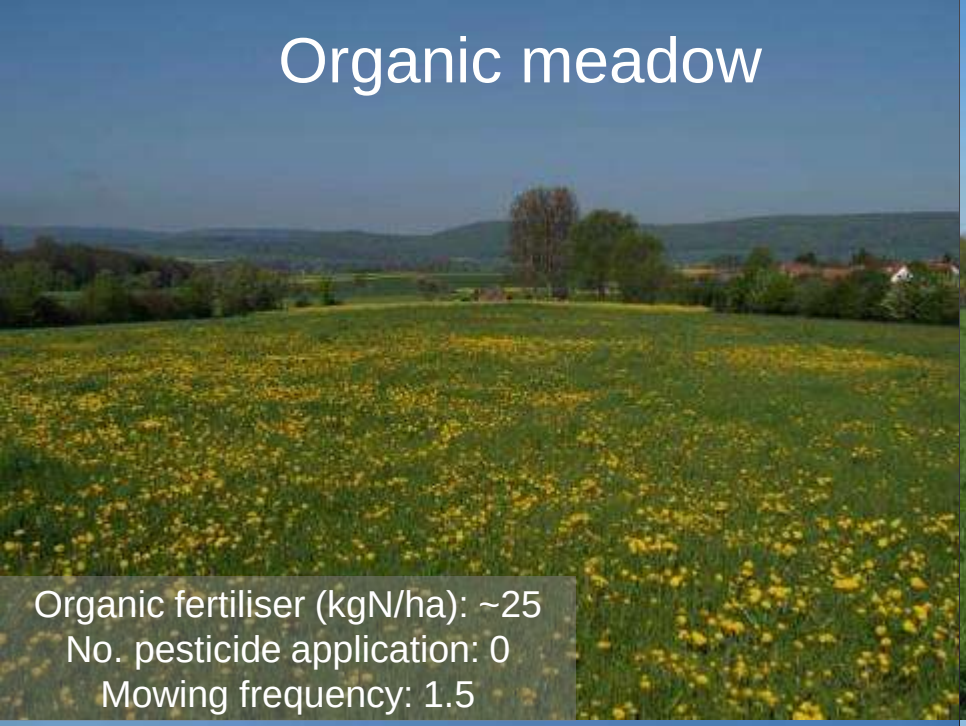
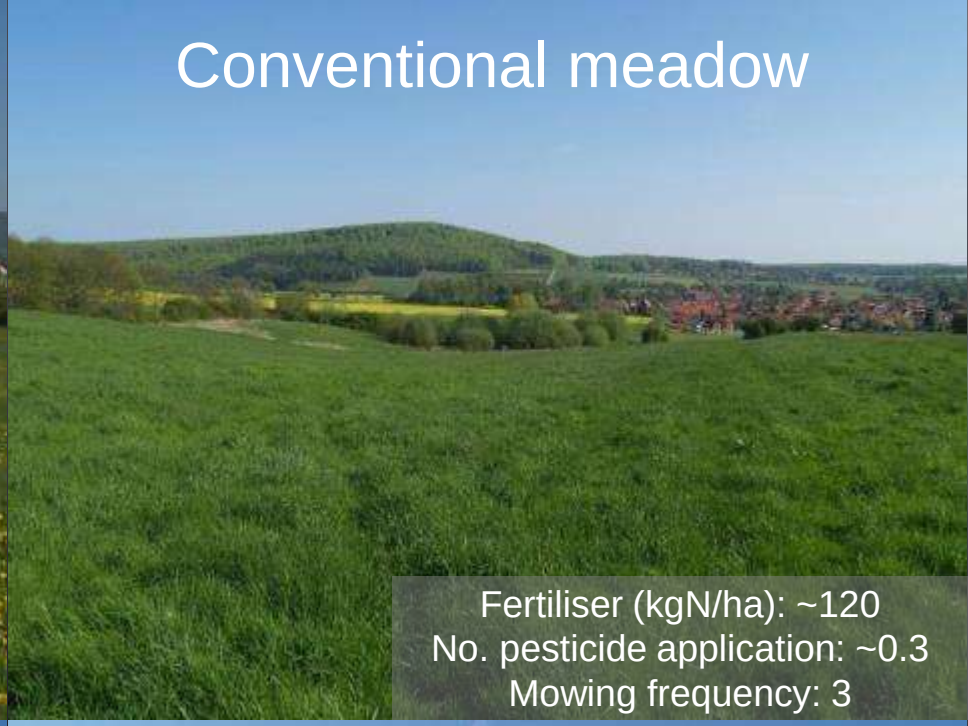
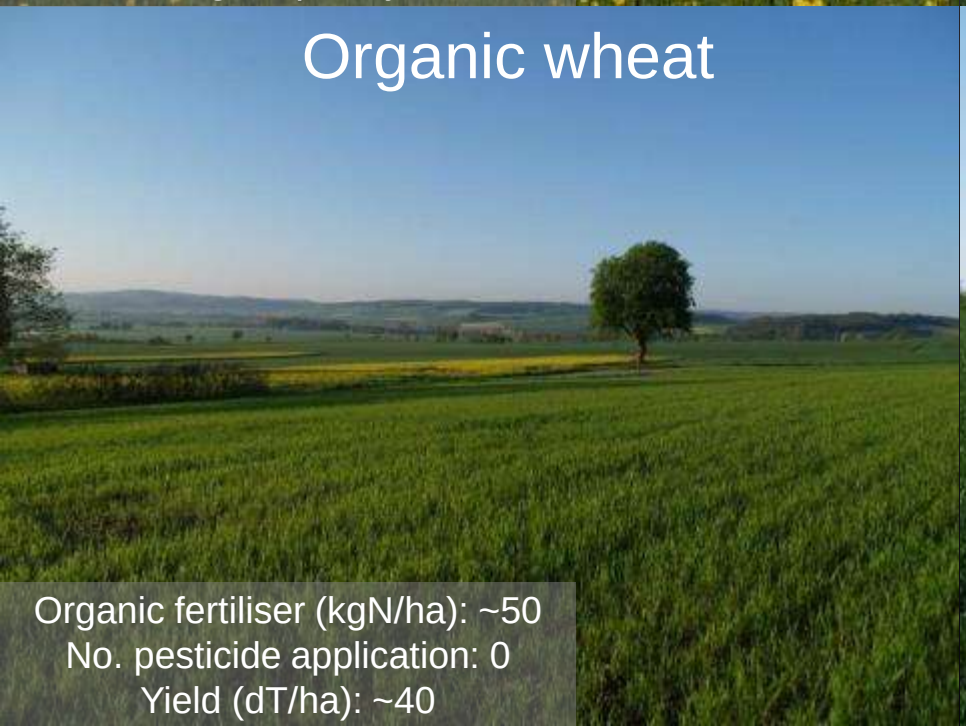


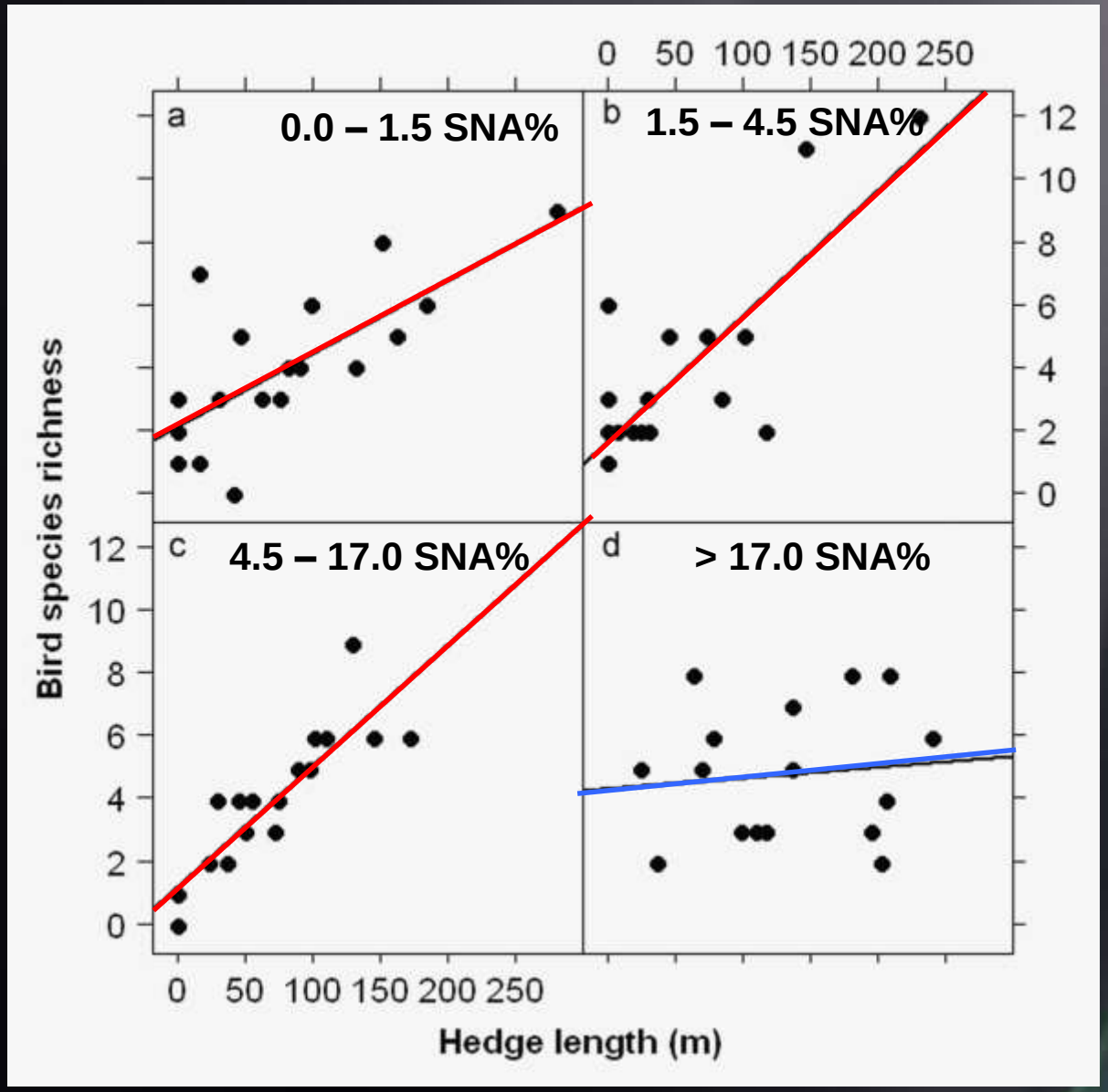

Organic meadow
Organic fertiliser (kgN/ha): ~25
No. pesticide application: 0
Mowing frequency: 1.5


Conventional meadow
Fertiliser (kgN/ha): ~120
No. pesticide application: ~0.3
Mowing frequency: 3


Organic wheat
Organic fertiliser (kgN/ha): ~50
No. pesticide application: 0
Yield (dT/ha): ~40


Conventional wheat
Fertiliser (kgN/ha): ~200
No. pesticide application: ~5
Yield (dT/ha): ~80

3. Bird study on Agri-Environment Schemes



Batáry et al. 2010 Biol.Conserv.; see also e.g. Batáry et al. 2012 Agric.Ecosyst.Environ.

4. Habitat fragmentation study

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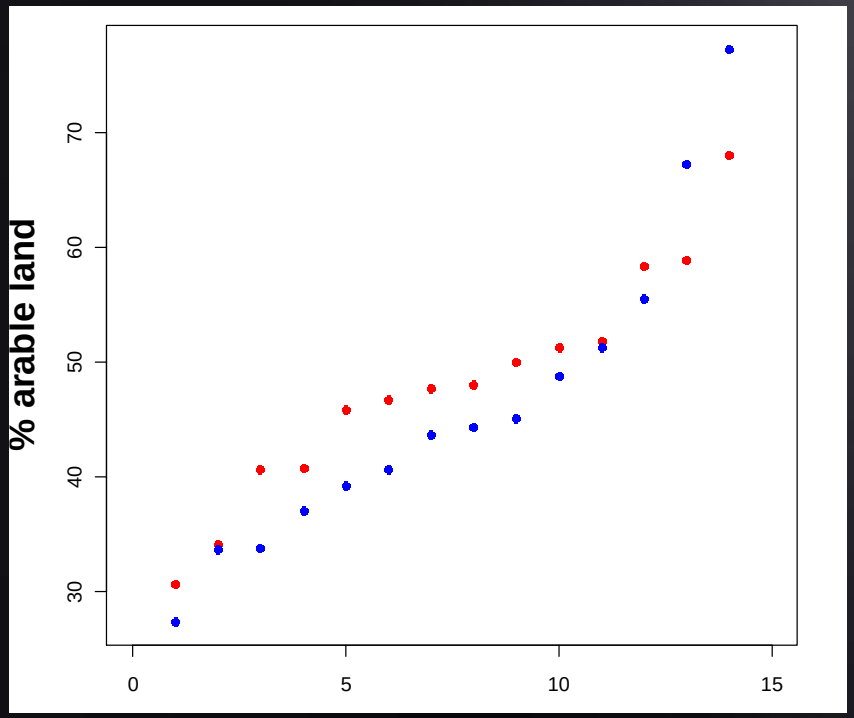
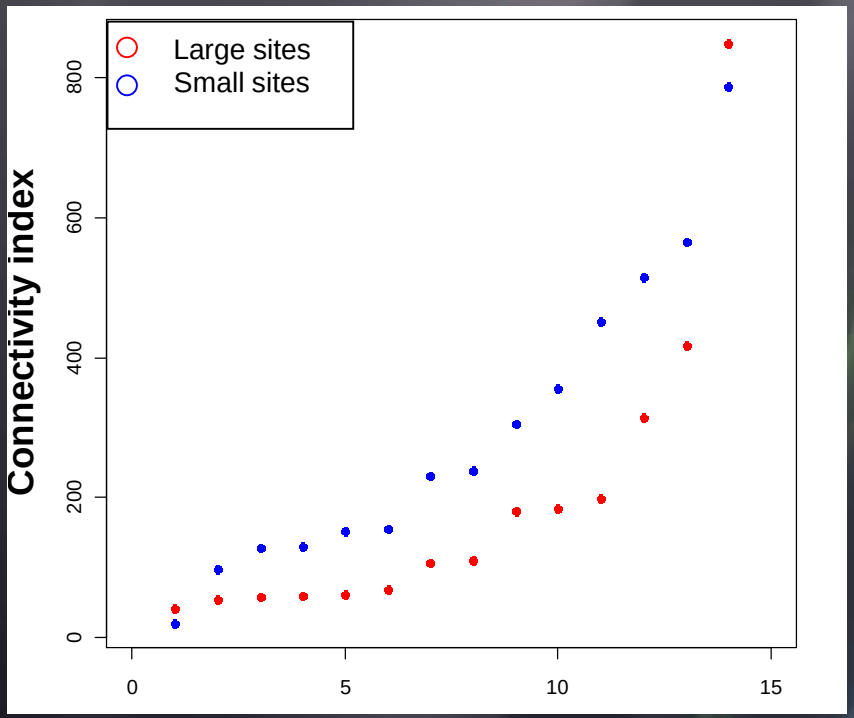
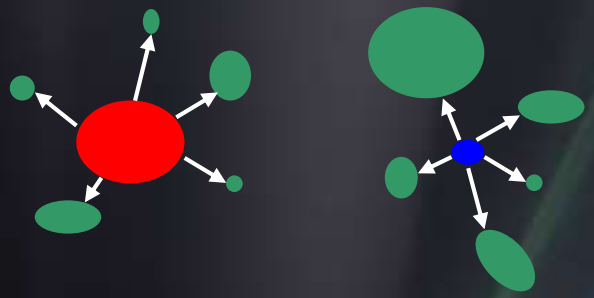


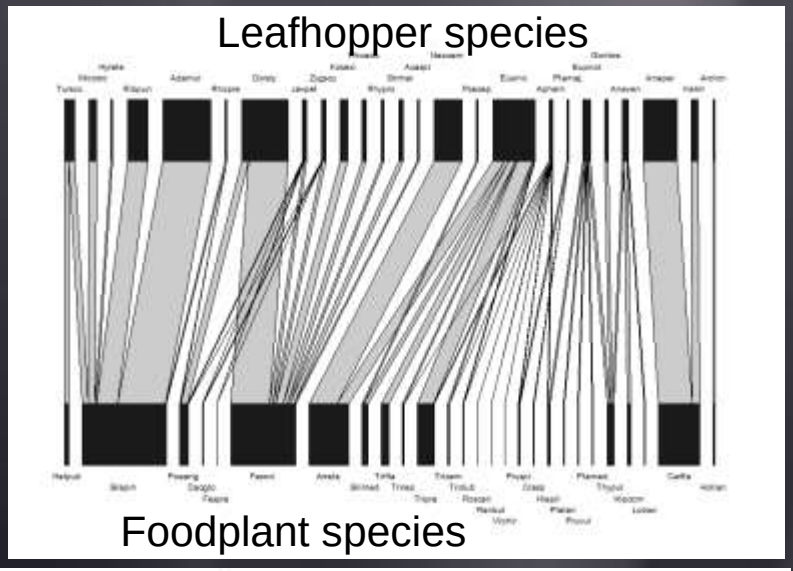


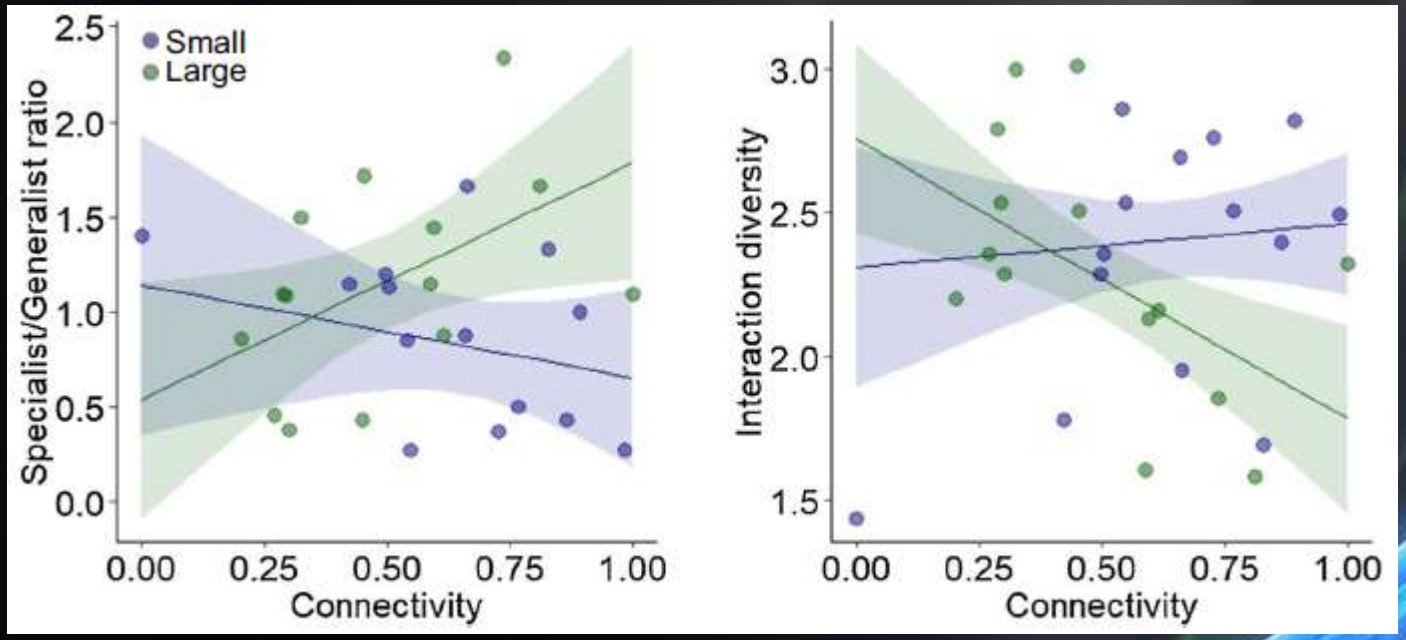


$$CI_i = \sum exp(-\alpha d_{ij}) A_j^{\beta}$$

Hanski et al. 2000. Ecology

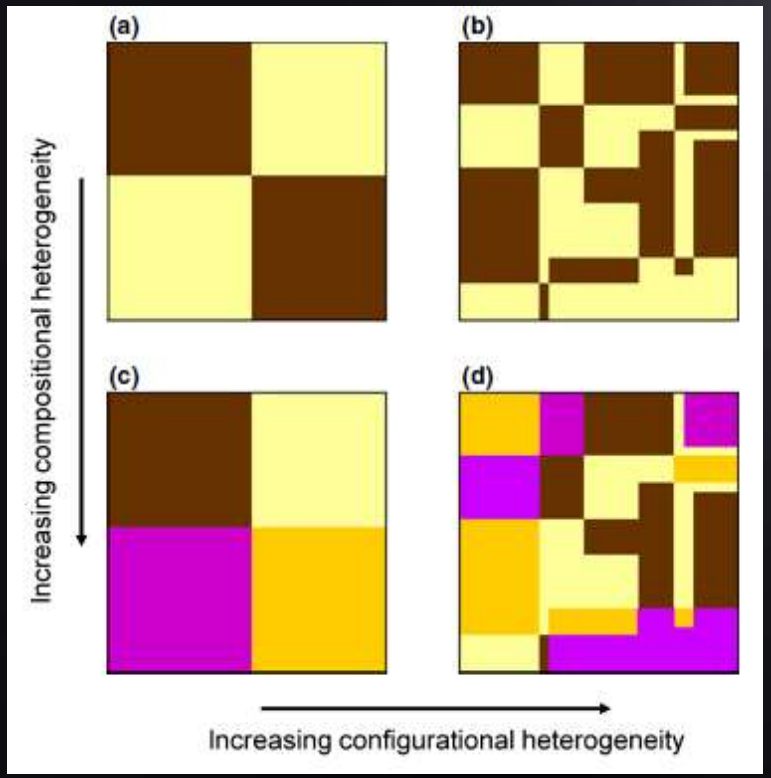
4. Habitat fragmentation study

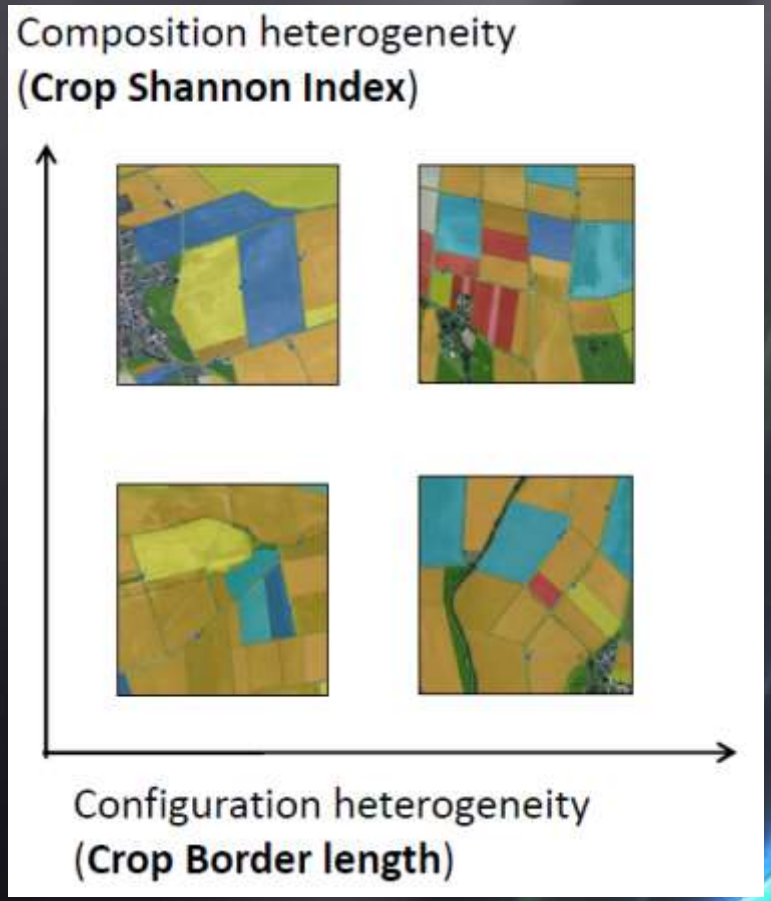




Batáry et al. 2021 Oecologia; see also e.g. Rösch et al. 2013. J.Appl.Ecol.

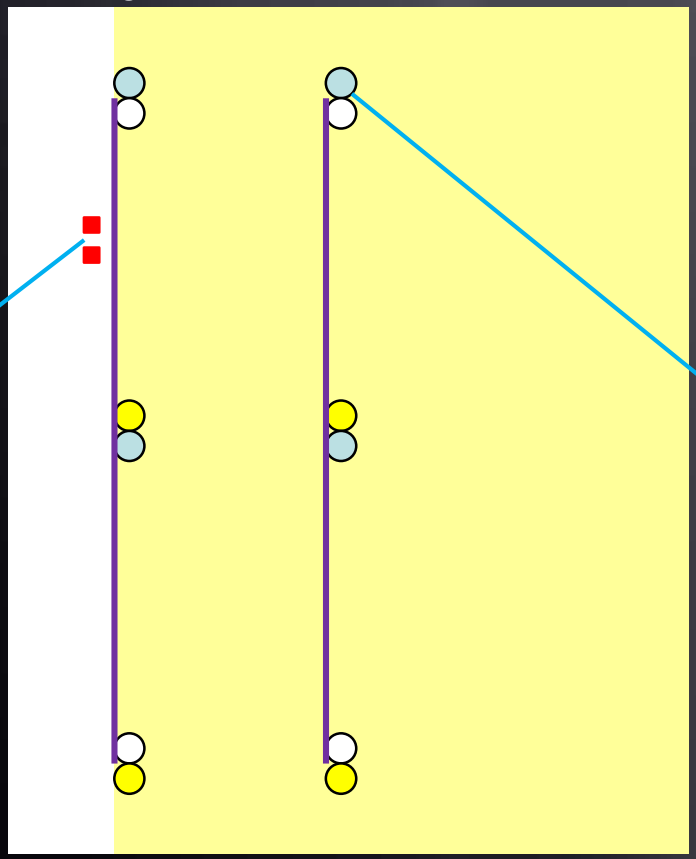
5. FarmLand project





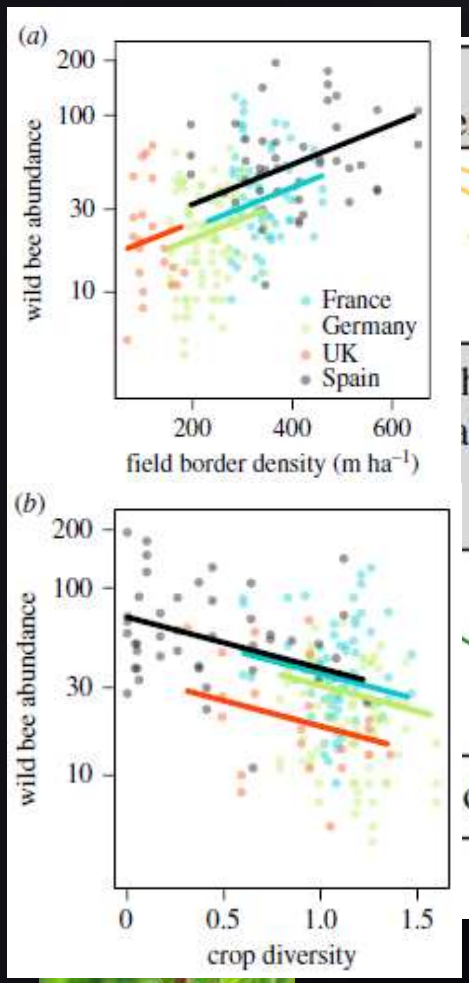
5. FarmLand project

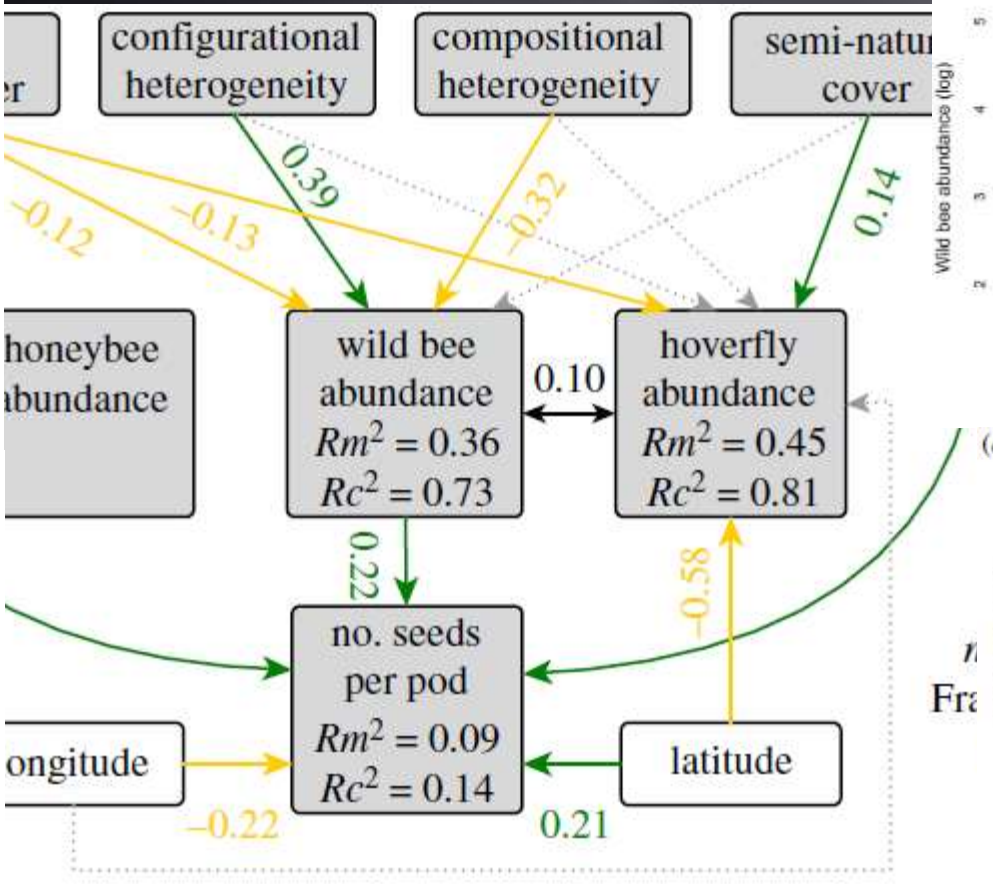
Raphanus sativus
- Seeds per pod

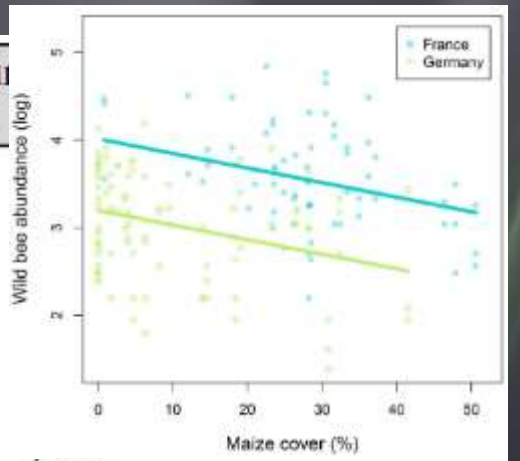


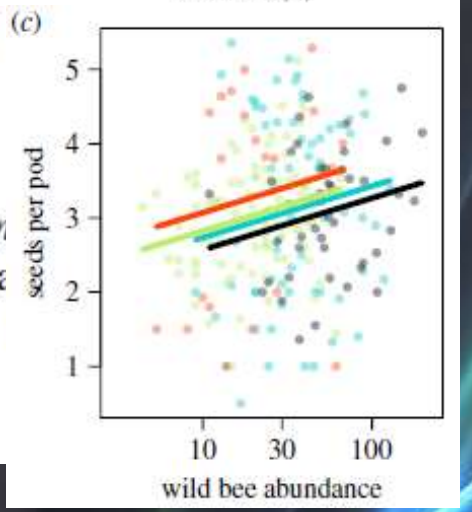
Pan traps for bees and syrphids
- 3 colours
- 12 traps
- 4 days
- 2 visits

5. FarmLand project

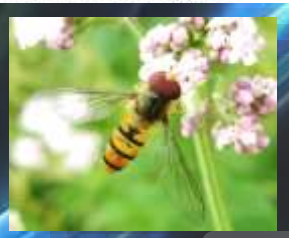








Landscape configurational heterogeneity by small-scale agriculture, not crop diversity, maintains pollinators and plant reproduction in western Europe



Hass et al. 2018 Proc. Roy. Soc. B; see also e.g. Bosem Baillod et al. 2017 J. Appl. Ecol.

6. East-West project (EWP)

Division of Germany to East and West (1945-90)

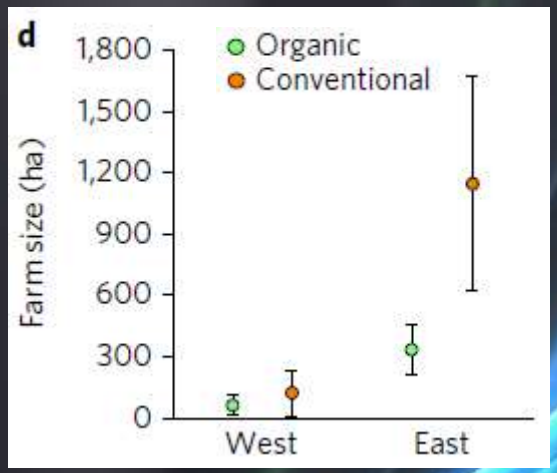
After >30 years of German reunification (1990-2021), still lot of differences (economy, social aspect, culture...)

6. EWP: Collectivization in the East Block in the ’50ies

6. EWP: Strong contrast in field and farm size

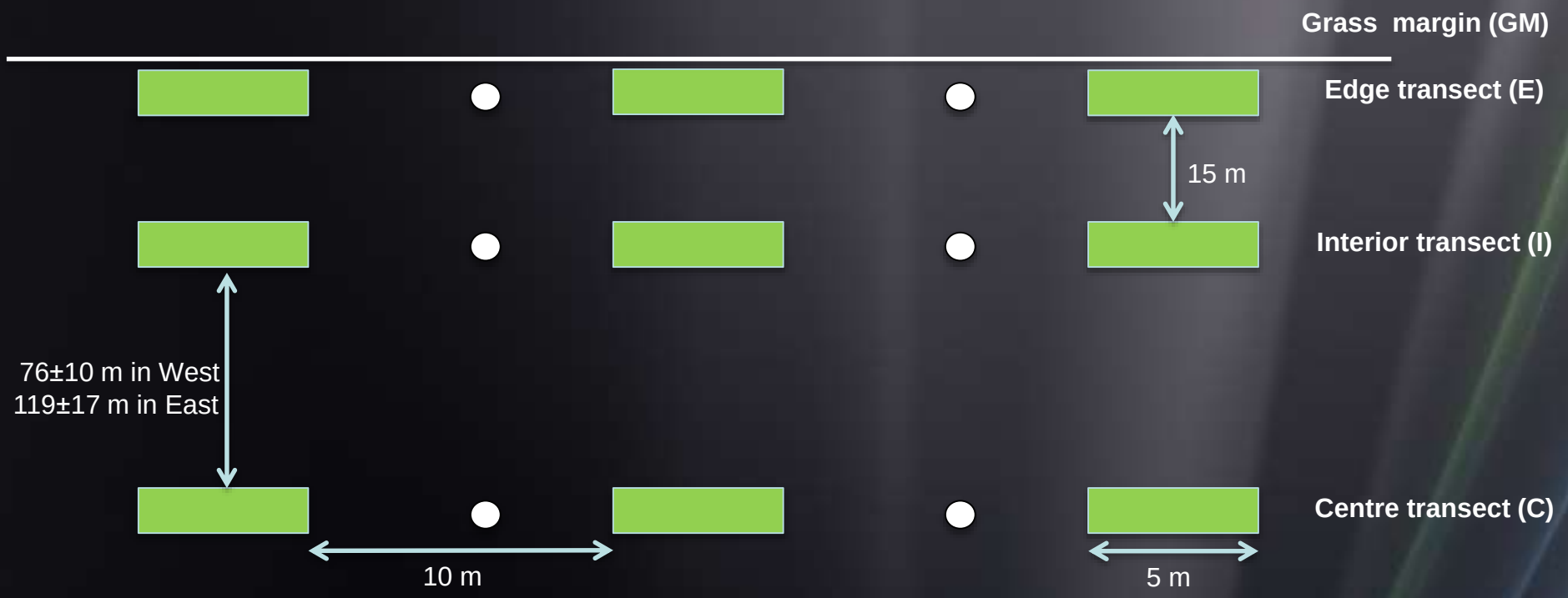
9 pairs of organic and conventional wheat fields in both regions = 36 wheat fields.

Field size
East: ~ 20 ha
West: ~ 3 ha



>70% longer field edges in the West than in the East.

6. EWP: Within-field study design for measuring biodiversity



Erigone dentipalpis

Anchomenus dorsalis

Aloconota gregaria

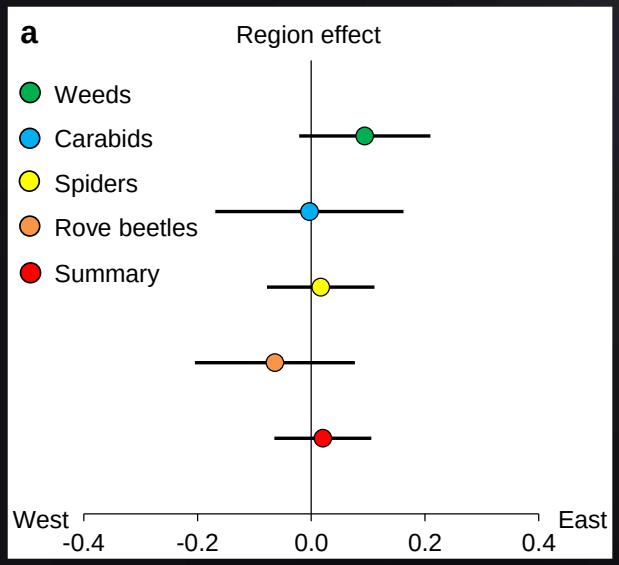
Field edge

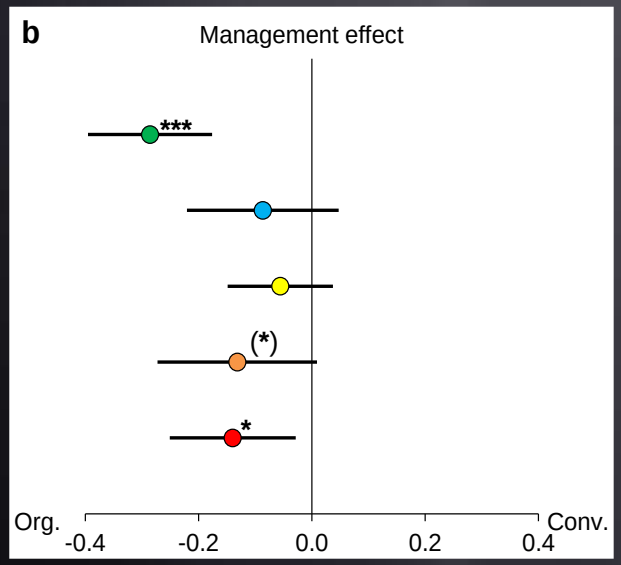
Botanical plots (1×5m)

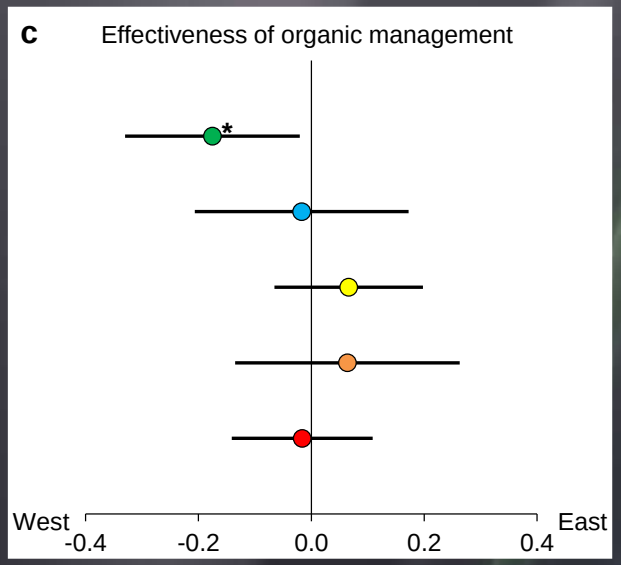
Distances

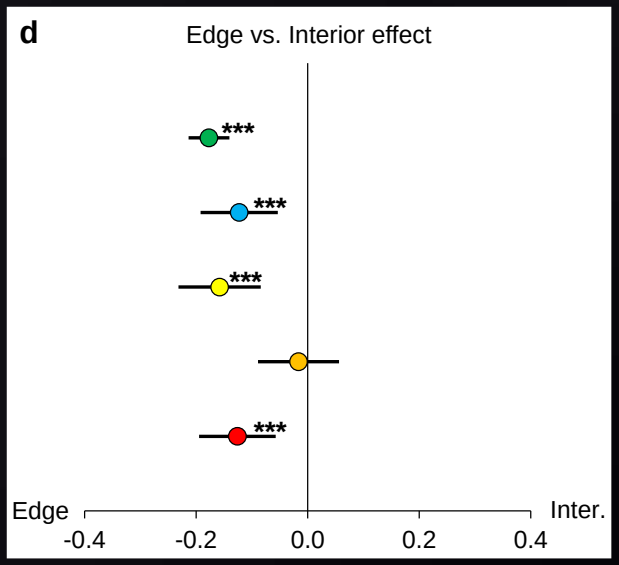
Funnel traps

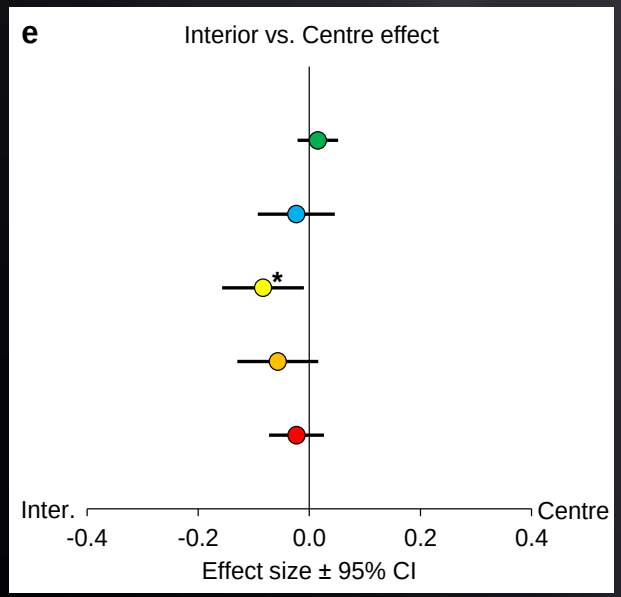
6. EWP: Weed and arthropod species richness

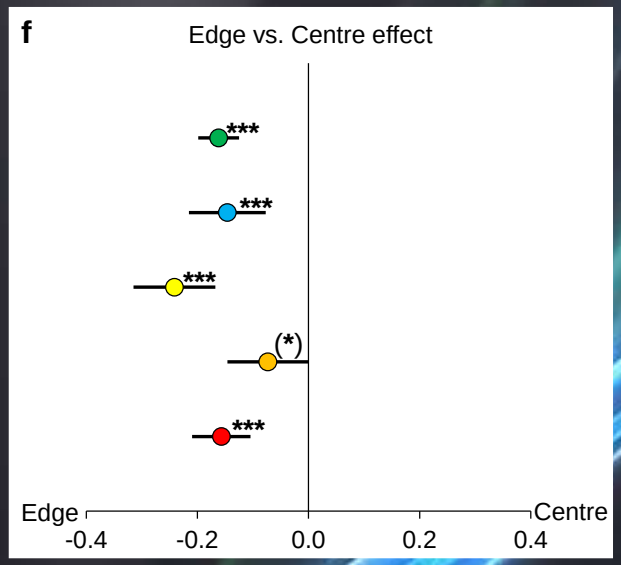




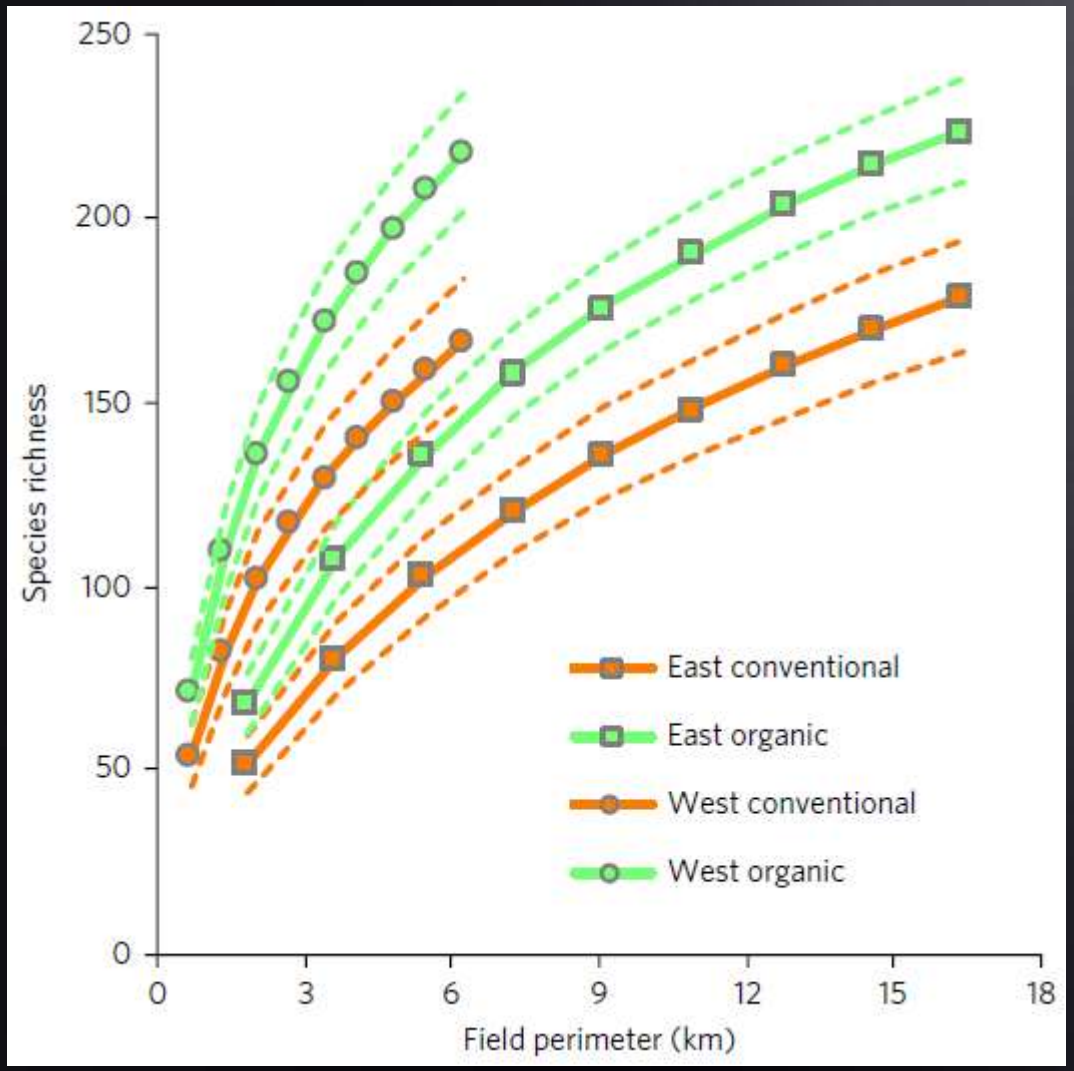


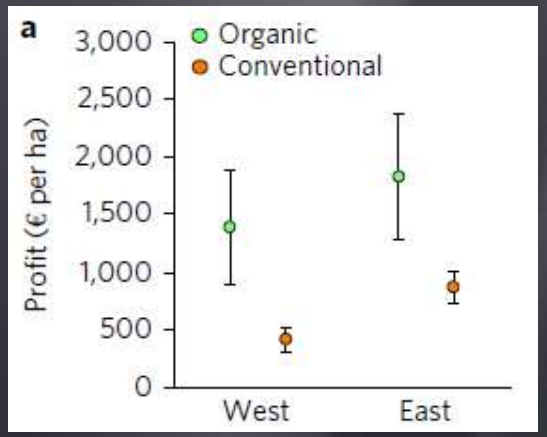


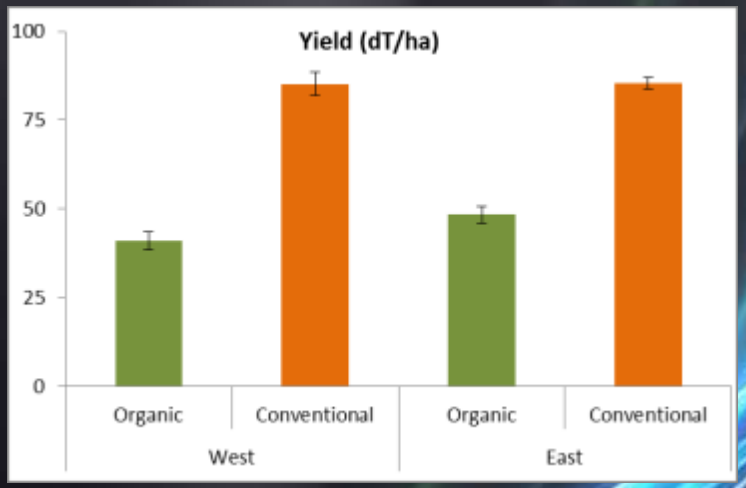




6. EWP: Beta diversity, profit and yield



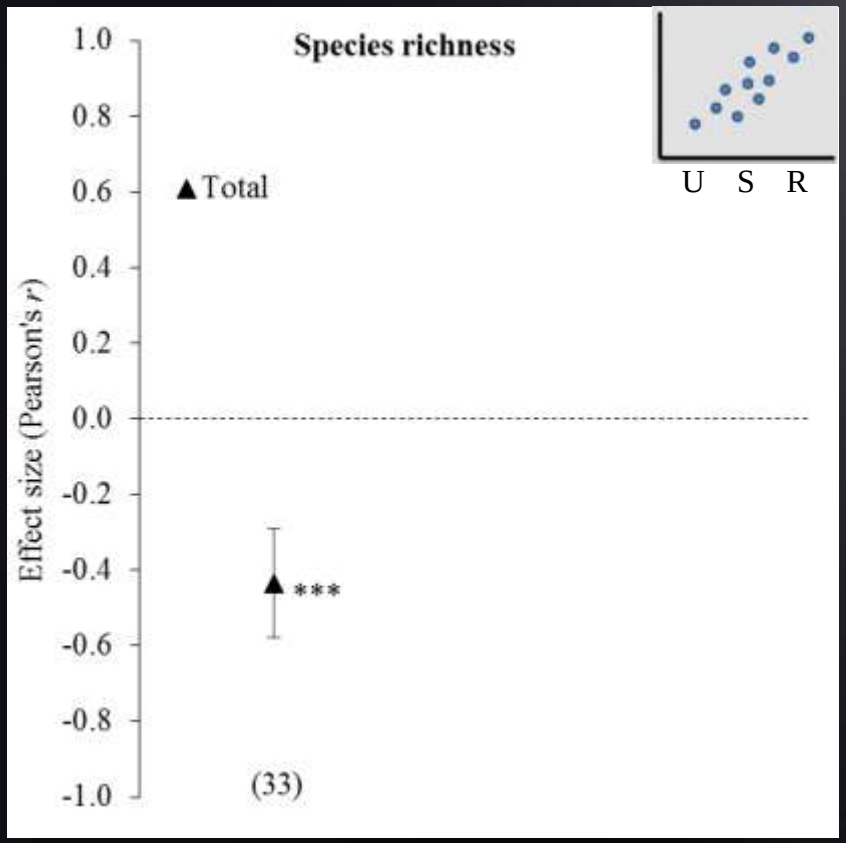


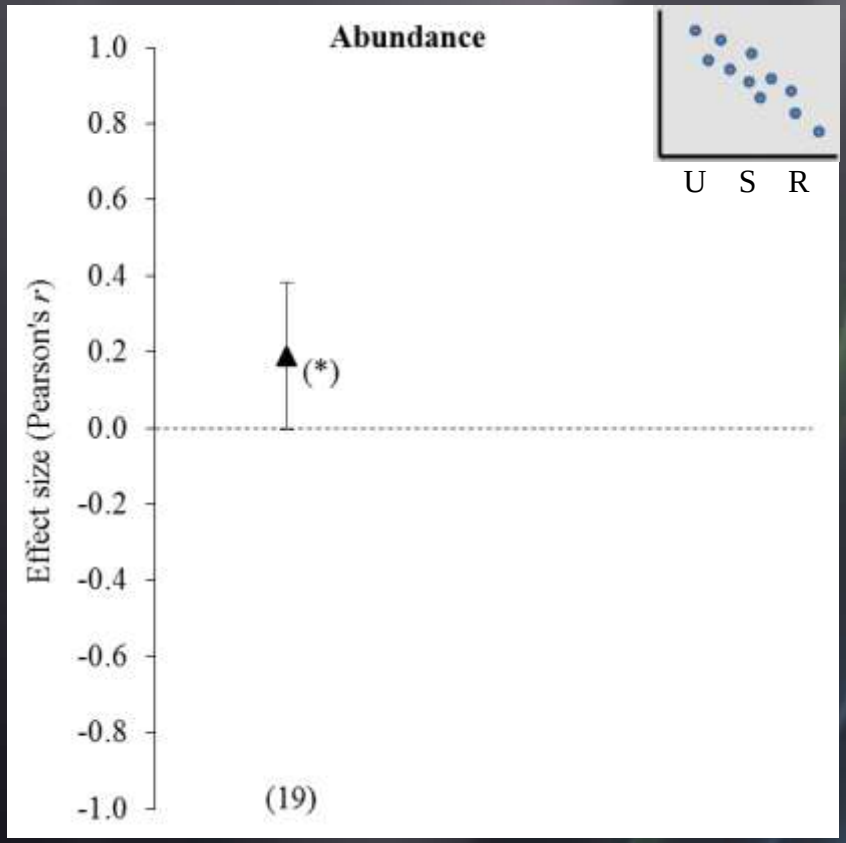


Contribution of small-scale agriculture to biodiversity was more important than organic management.

Batáry et al. 2017. Nature Ecol. Evol.; see also e.g. Gallé et al. 2019 J. Appl. Ecol.

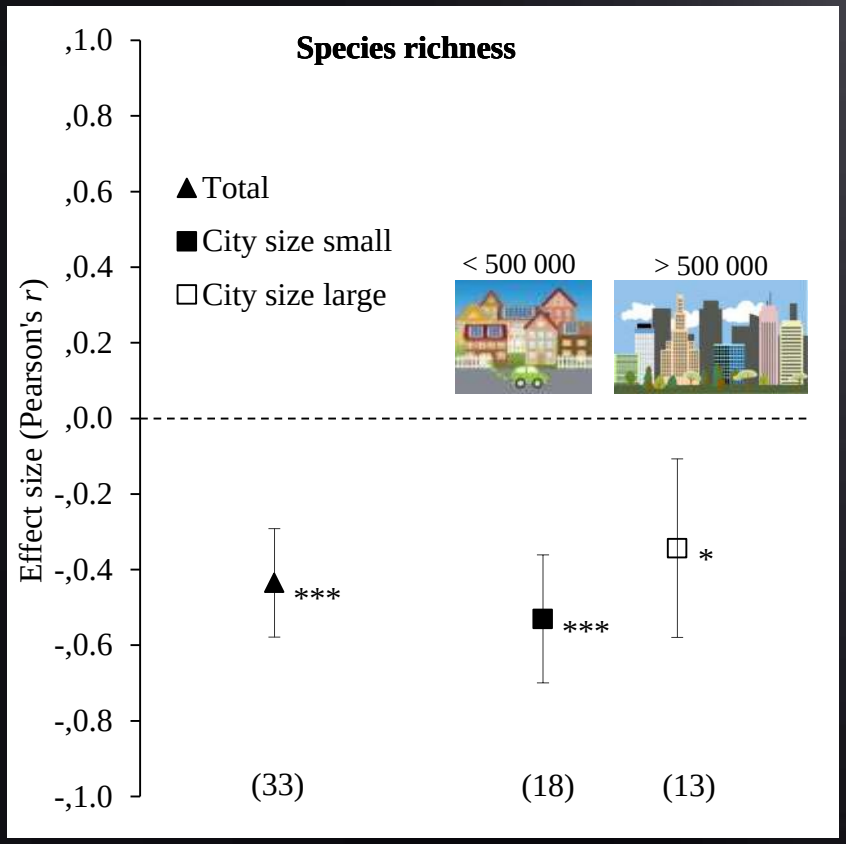
7. Urbanization meta-analysis on birds

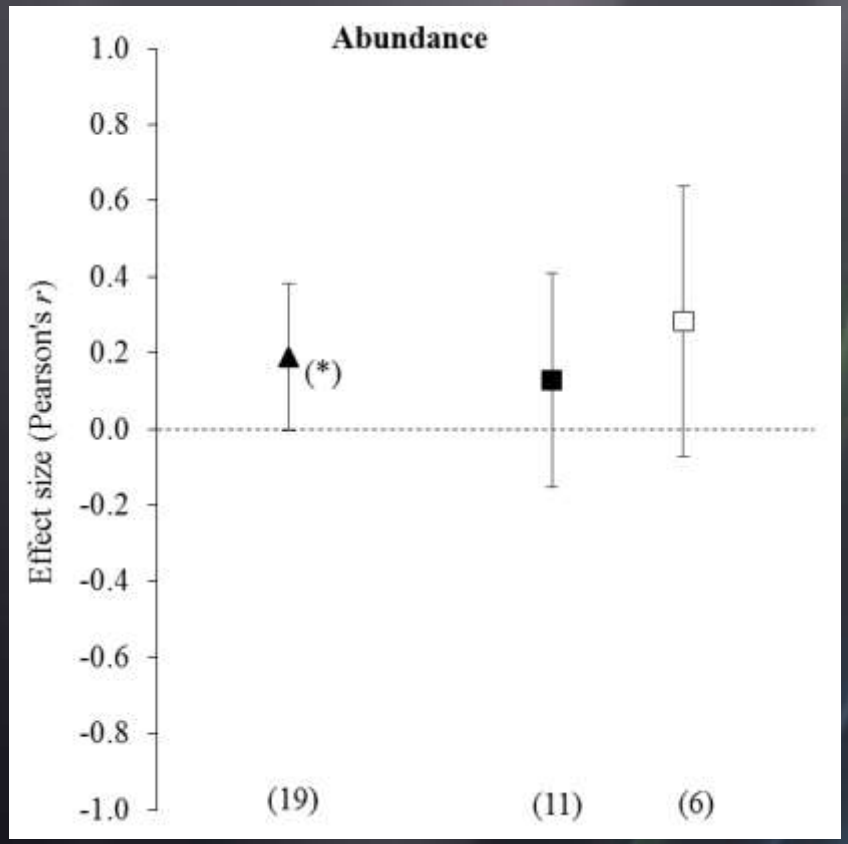




This results indirectly suggests a homogenization of bird communities probably with increasing number of individuals of generalist species toward city centers.

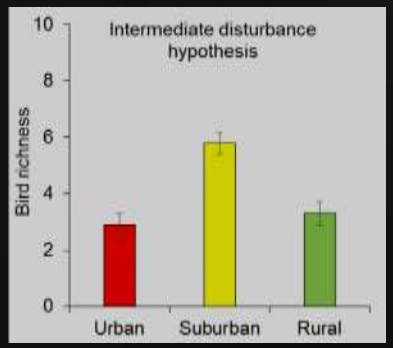
7. Urbanization meta-analysis on birds

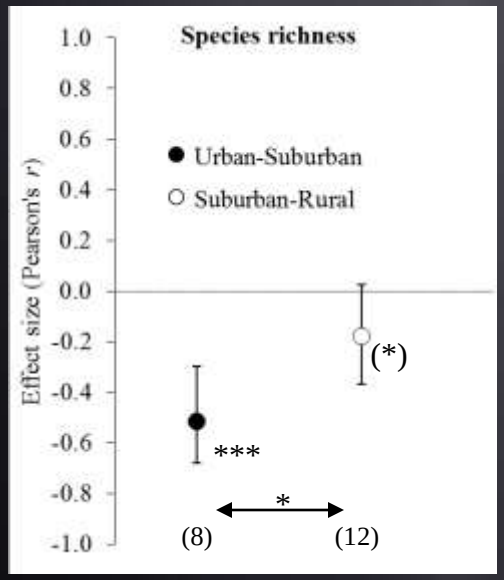


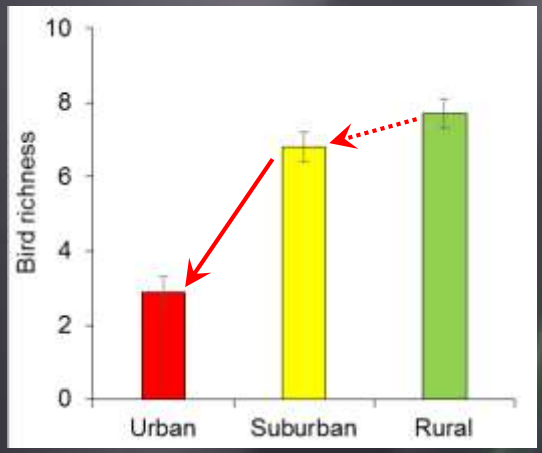


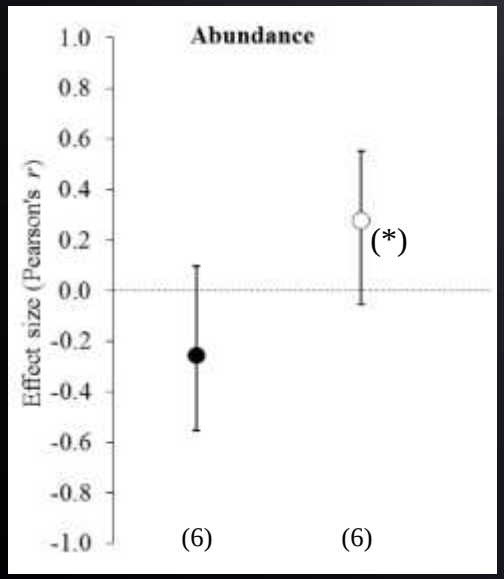
Negative effects on bird richness tended to be more expressed in small cities (population < 500 000) with no significant difference between small and large cities.

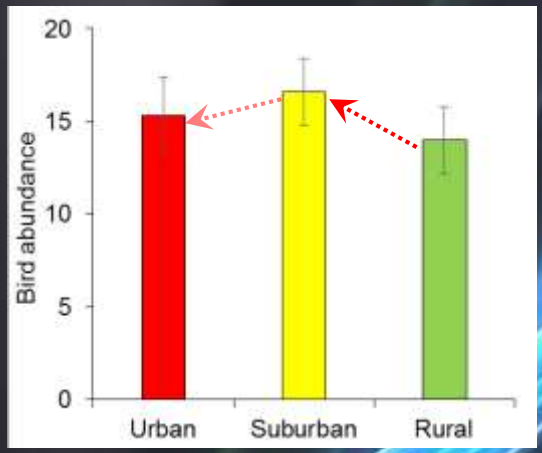
7. Urbanization meta-analysis on birds











Batáry et al. 2018. Global Change Biol.; see also Chamberlain et al. 2020 Global Ecol. Biogeogr.

8. Overall conclusion and recommendation

- Landscape structure often determines the efficiency of management interventions and the biodiversity patterns found.

- Important to consider:
  - Relevant landscape parameter(s)
  - Composition or configuration
  - Correlations among landscape and local variables
  - Spatial scale
  - Temporal changes


Combining land-sparing and land-sharing in European landscapes

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Advances in Ecological Research, Volume 64
ISSN 0065-2504
https://doi.org/10.1016/bs.aecr.2020.09.002

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TREE 2577 No. of Pages 12
ARTICLE IN PRESS
Trends in Ecology & Evolution
CellPress
Opinion

Beyond organic farming – harnessing biodiversity-friendly landscapes

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Köszönöm szépen a figyelmet!