Modelling biodiversity – from grasslands (habitats) to butterflies and bumblebees (species)

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SYKE

Significance of landscape quality for farmland biodiversity

- Why land cover data is important in farmland biodiversity research?
- What kind of land use and remote sensing data is needed?
- How it can be used to explain and predict variation in biodiversity?
- How it can assist in designing conservation action?

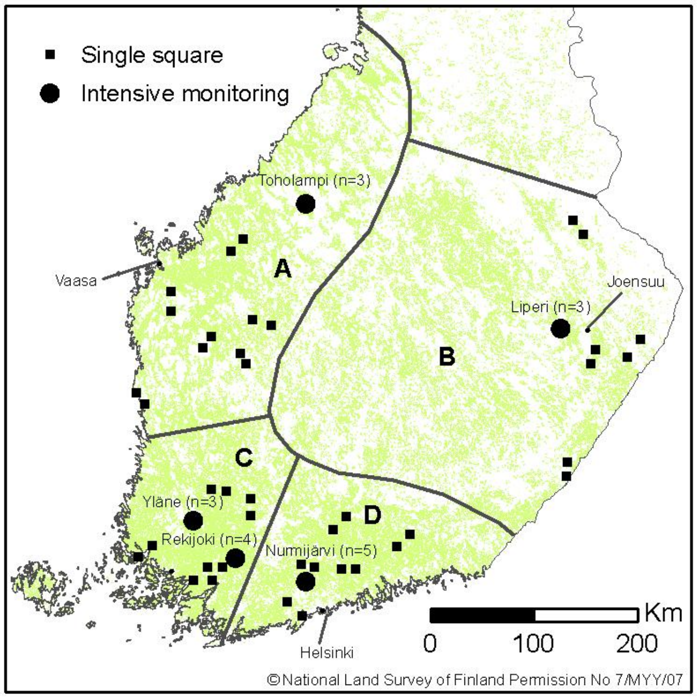
Examples from Finnish case studies

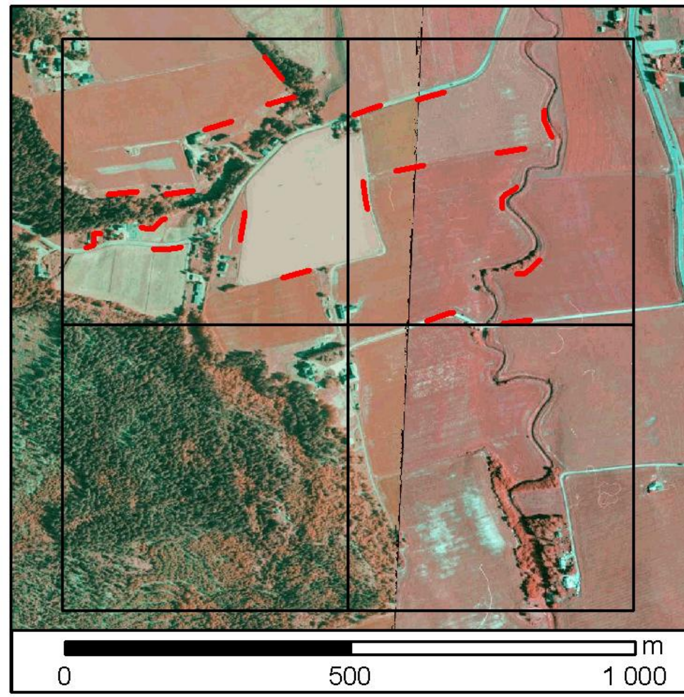
Why land cover data is important in farmland biodiversity research?

- Landscape structure is important for explaining and predicting
  - Existing spatial patterns of farmland biodiversity and ecosystem services
  - Future development of biodiversity
  - How various conservation measures can mitigate biodiversity decline in practice

MYTVAS study: an example from Finnish agricultural landscapes

- Monitoring of biodiversity at local and landscape scales
  - 50 m transects (n = 1355) and 0.25 km^2 landscapes (n = 2 x 68 = 136)





Alpha diversity + Beta diversity = Gamma diversity (species richness)

(Mean within-plot diversity + mean between-plot diversity = landscape level diversity)

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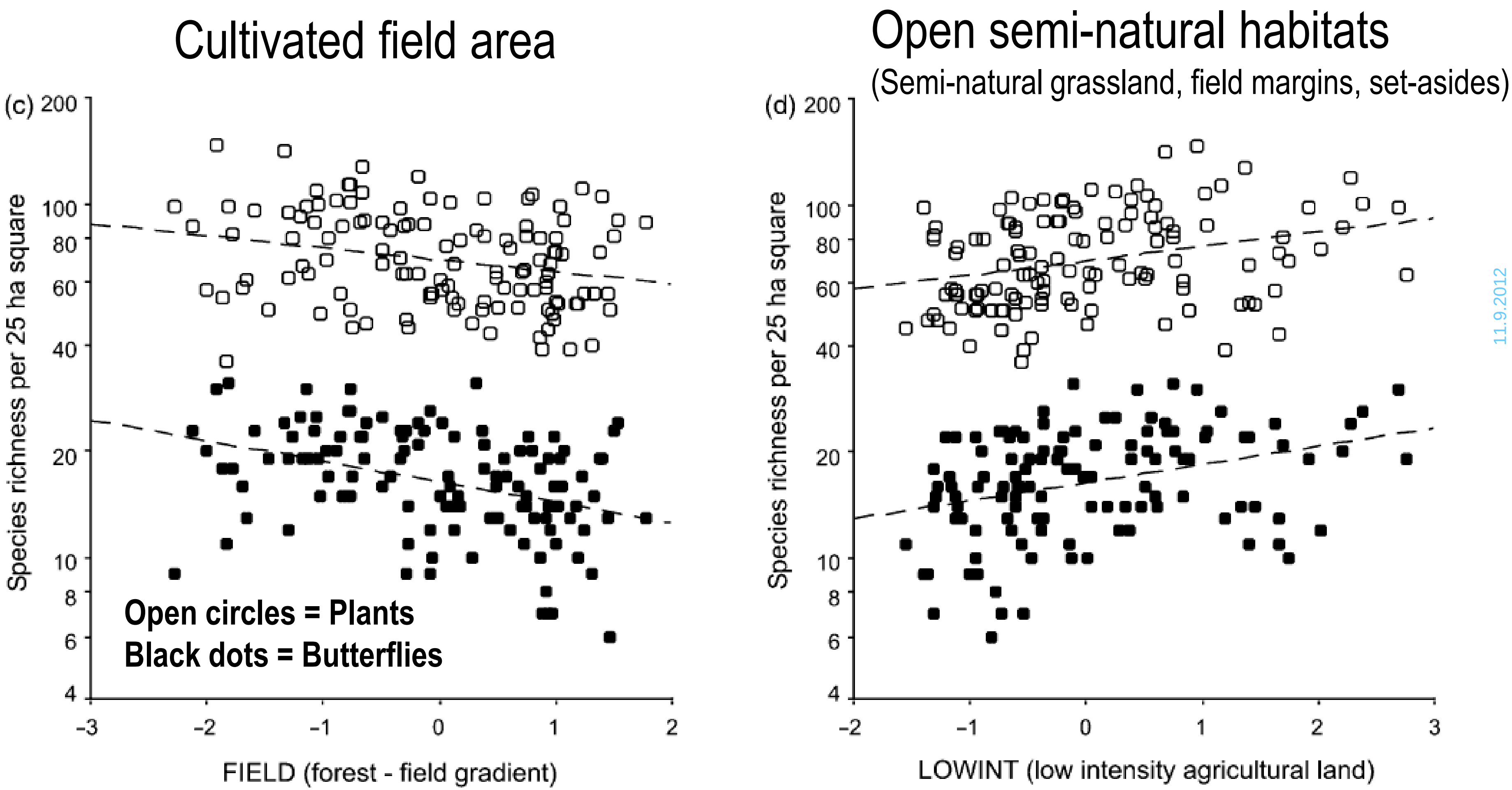
Landscape structure explains landscape level variation in farmland plant and butterfly species richness (gamma diversity)



11.9.2012

Kivinen, Luoto, Kuussaari & Helenius 2006, Journal of Biogeography 33, 862-875

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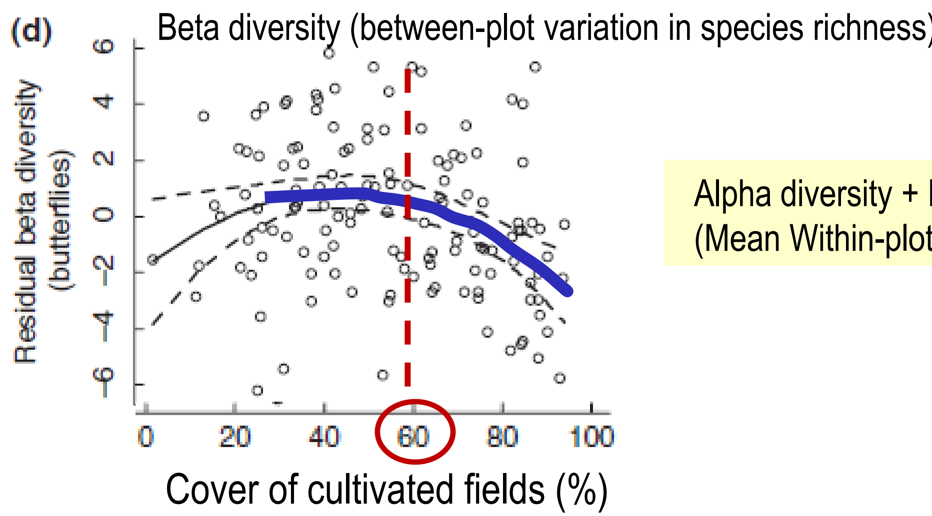
Intensive land use leads to homogenization of butterfly communities

Butterfly beta diversity decreases with agricultural intensity (cover of cultivated fields)



Alpha diversity + Beta diversity = Gamma diversity
(Mean Within-plot + Between-plot = Total species richness)

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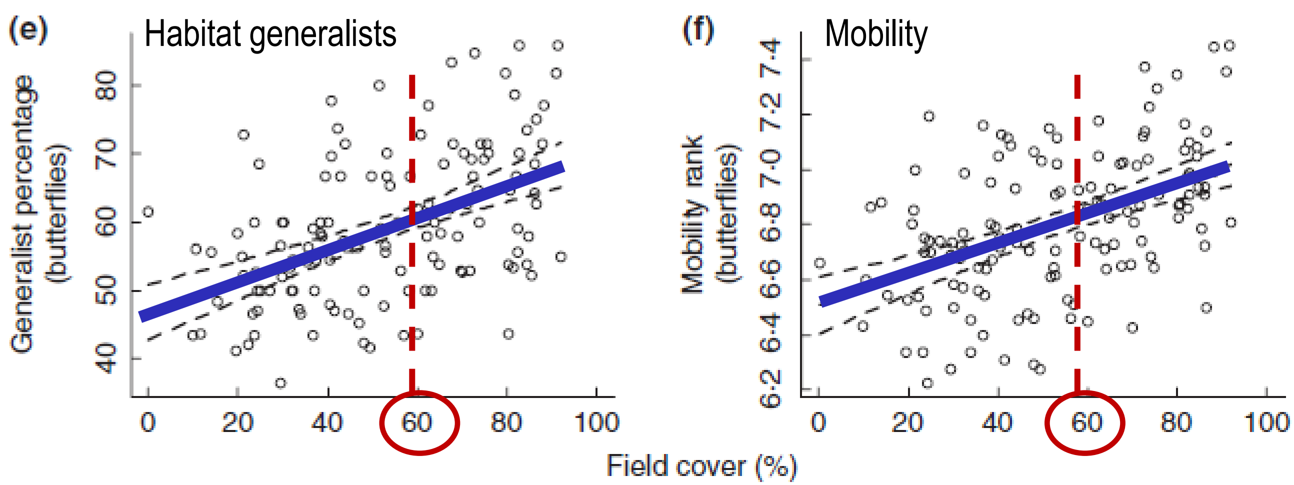
Proportion of habitat generalists and mobile species increases with agricultural intensity



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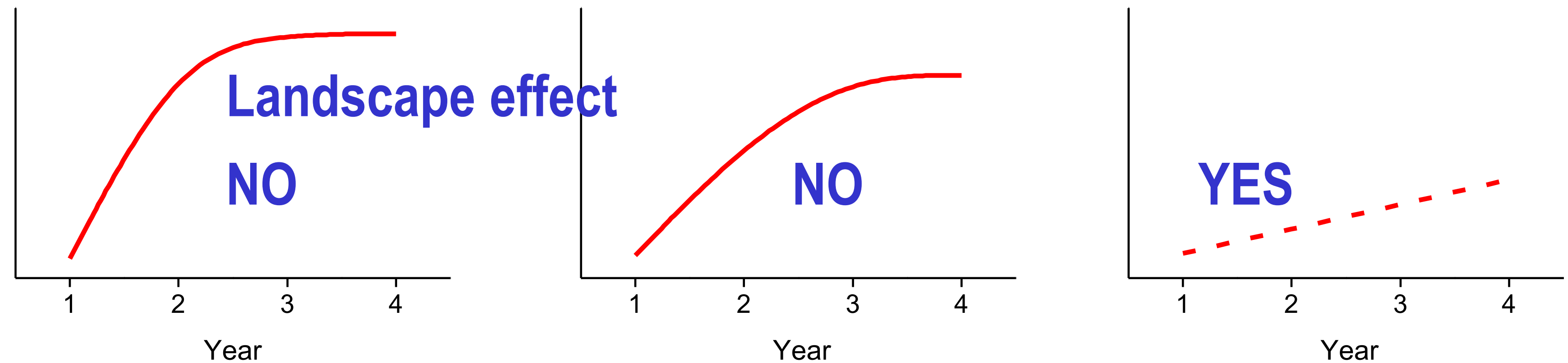
Ekroos, Heliölä & Kuussaari 2010, Journal of Applied Ecology 47, 459–467

Landscape structure especially important in conservation of declining species

- Establishment of wildflower strips at the edges of cultivated fields to promote pollination services, biodiversity and species of conservation concern

Pollination services (Bumblebee abundance) | **Biodiversity** (Total insect species richness) | **Conservation** (Habitat specialist abundance)



- Pollination services and biodiversity increased rapidly and strongly, whereas species of conservation concern showed only slow and weak increase
- Species of conservation concern responded positively to the proportion of forests in the surroundings of the study field parcels

Alanen, Hyvönen, Lindgren & Kuussaari 2012, Submitted manuscript

What kind of land use and remote sensing data is needed?

- Open uncultivated (semi-natural) habitats most important for farmland biodiversity
  - Semi-natural grasslands, field margins, field-forest edges, long-term set-asides
- Other land cover classes often helpful
  - E.g. area of cultivated fields, forests and built areas
- Information on habitat quality facilitates deeper analyses
  - Detailed information on cultivated crops
  - Management of semi-natural habitats e.g. grazing or mowing
  - Occurrence of species of conservation concern

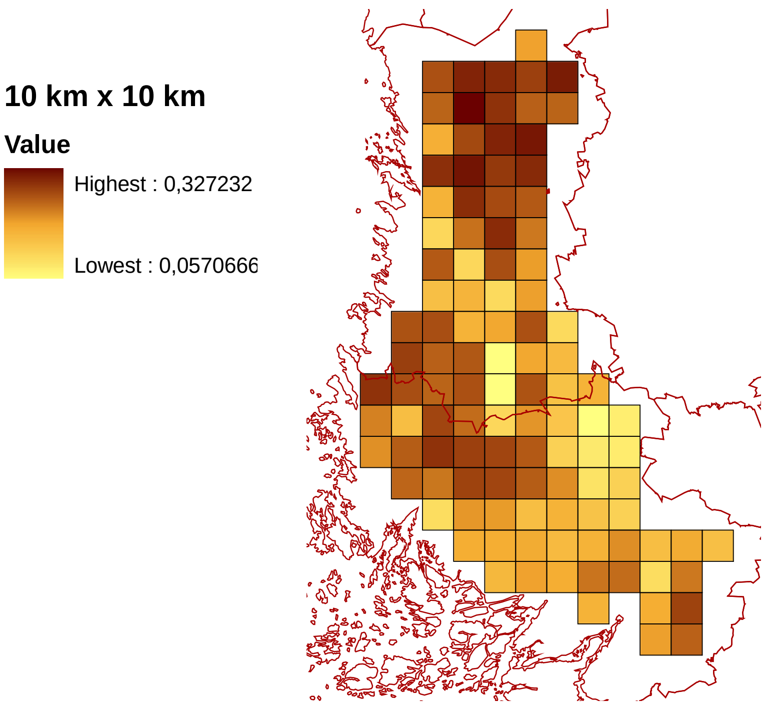
Sources of useful land cover data

- CORINE Land Cover Data (25 m x 25 m resolution)
- Aerial photographs
- SLICES grasslands (combined information from various sources)
- National register of agricultural land use (annual crop information)
- Agri-environment scheme contract areas (conservation management of semi-natural habitats)
- National inventory of traditional rural biotopes (3 value classes)
- Soil type (85 m x 85 m resolution)
- Topography (Digital elevation model)

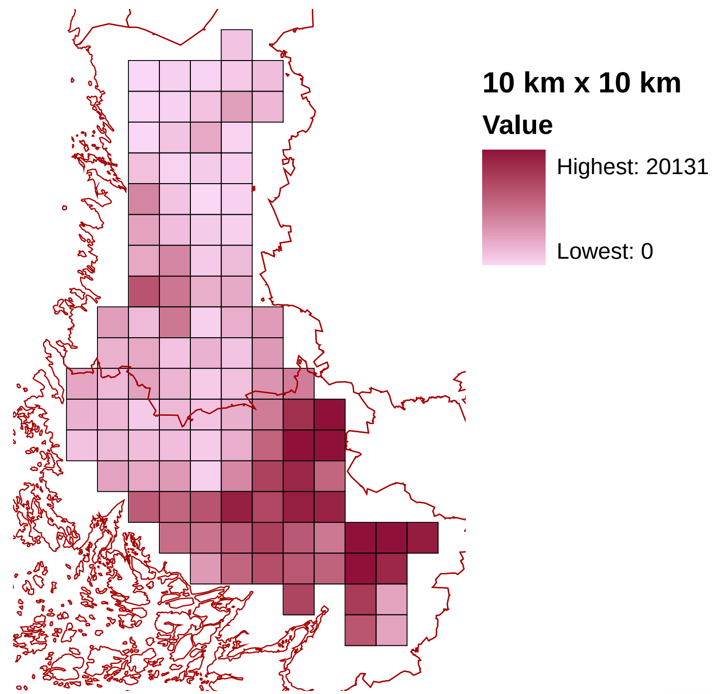
Mapping pollination services for agriculture in SW Finland

- Pollinator habitats as a proxy of availability pollination services
- Maps based on estimated suitability of different habitats for bumblebee foraging and nesting (applying the InVEST model of Lonsdorf et al. 2009)

Availability

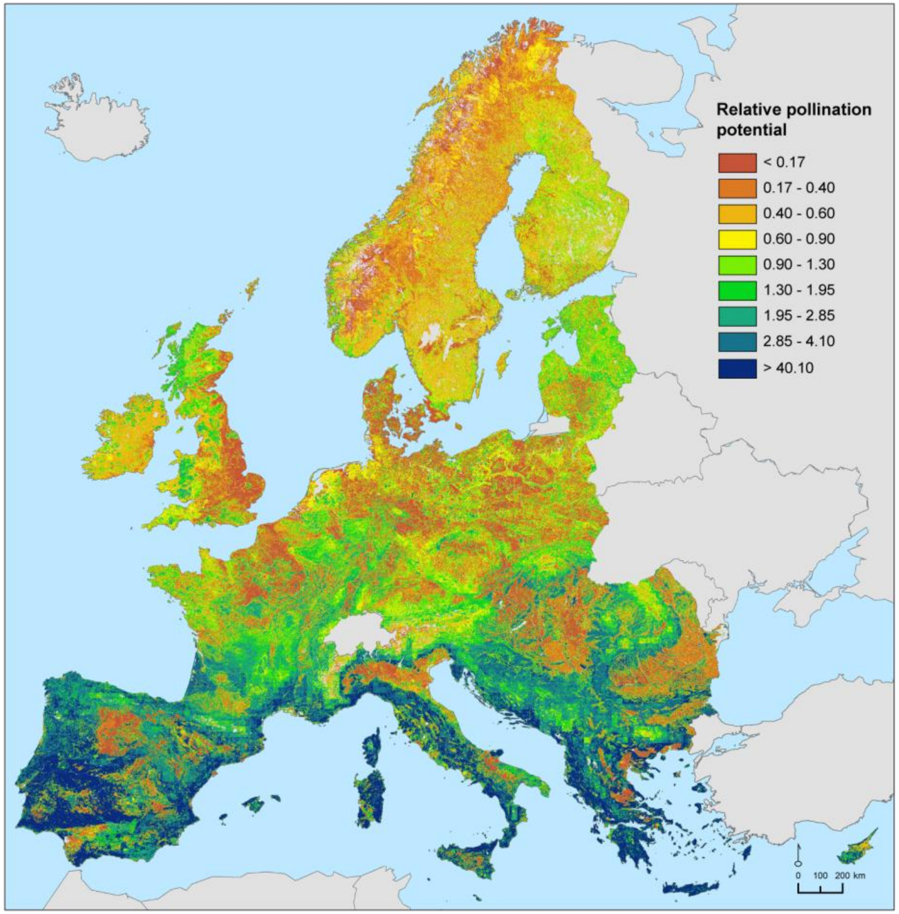


Demand

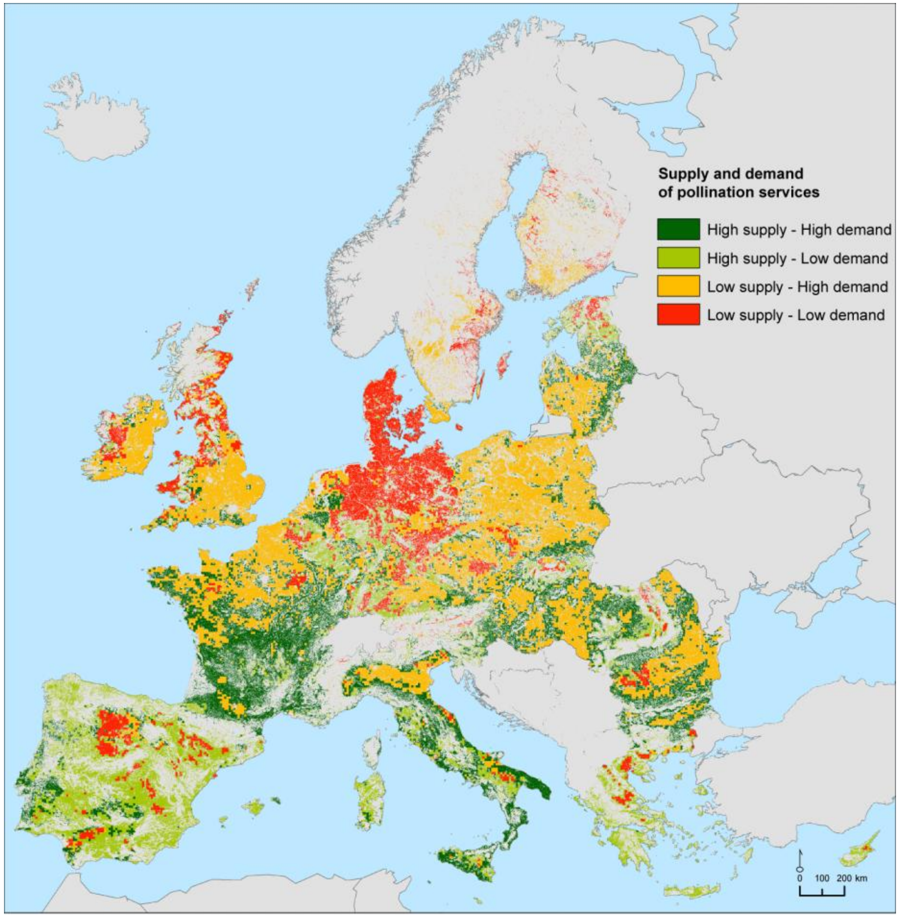


Alanen, Leikola & Kuussaari (2012) *in Maes et al. A spatial assessment of ecosystem services in Europe. Report of the PRESS 2 project*

Availability of pollination services (relative pollinator abundance)

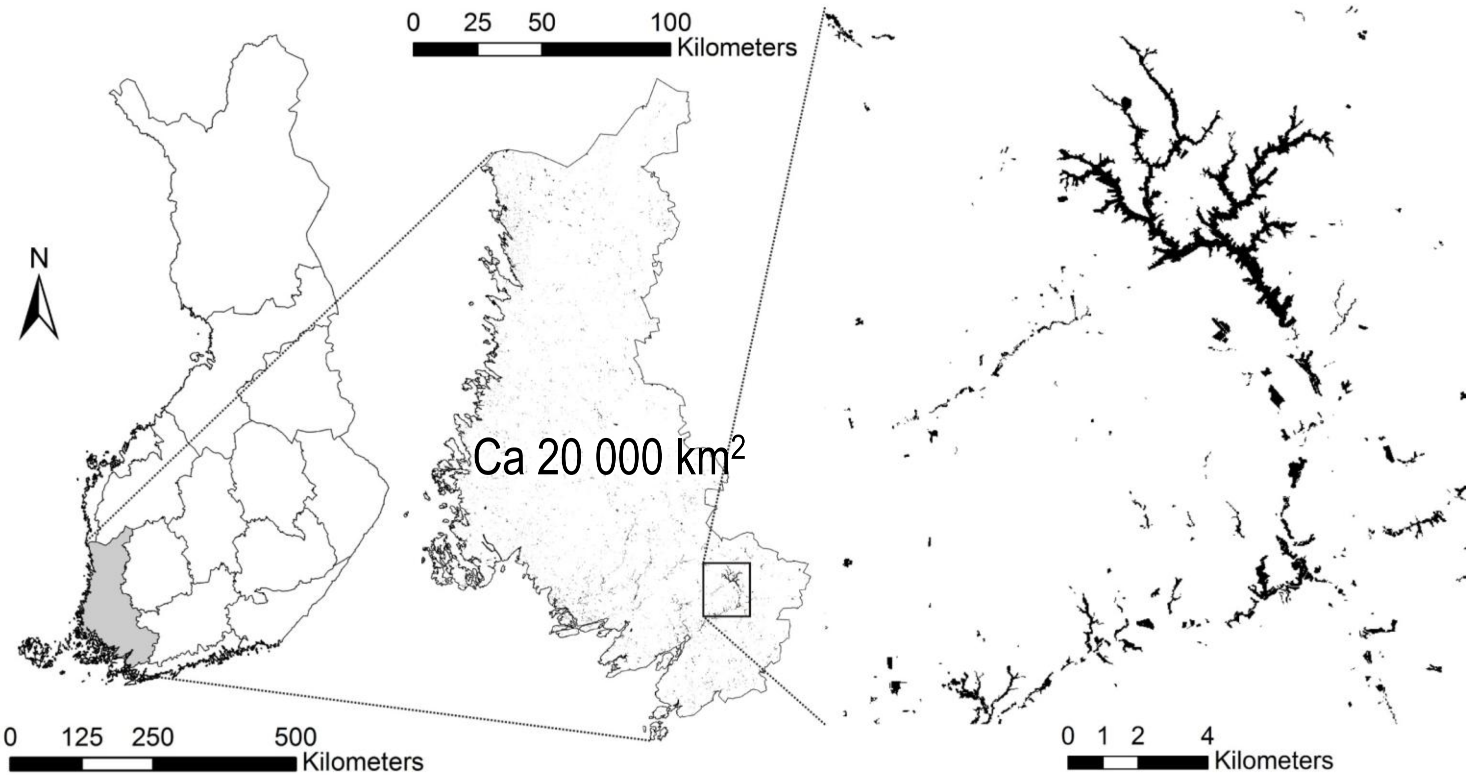


Supply and demand of pollination services



Maes et al. (2012) A spatial assessment of ecosystem services in Europe. Report of the PRESS 2 project

Where should conservation management of grasslands focus?



- How different the current network of management contract areas is from what Zonation would prioritize (when taking into account grassland connectivity) ?
- If spatial allocation of contracts was possible, how and how much could the current network be improved?

Arponen, Heikkinen, Paloniemi, Pöyry, Similä & Kuussaari 2012, Submitted manuscript

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Semi-natural grassland data

Layer	Contains		Area (ha)		Weights	Source
Habitat layer	Nationally important open traditional biotope sites		443		4	National survey
	Regionally important open tbt sites		229		3	
	Locally important open tbt sites		247		2	
	Pastures and meadows		3238	union 10558	1	Statistics Finland
Potential restoration sites in grey colour	Grasslands		8917		1	Remote sensing
	Wooded traditional biotope sites		2016		1	National survey
Management contract layer	Management of TBT	Open	1831		2	The register of the Ministry of Agriculture and Forestry
- Ca 20% of all grasslands		Wooded	265		1	
	Enhancement of biodiversity management	Open	1186		1	
		Wooded	114		0.5	

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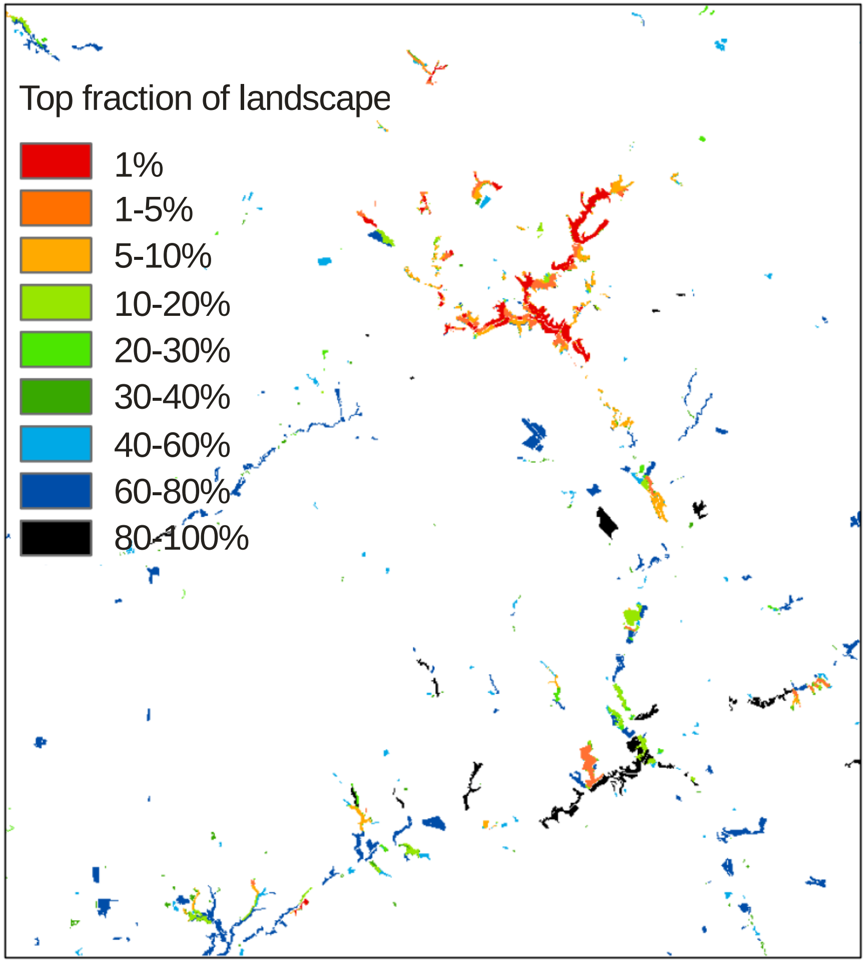
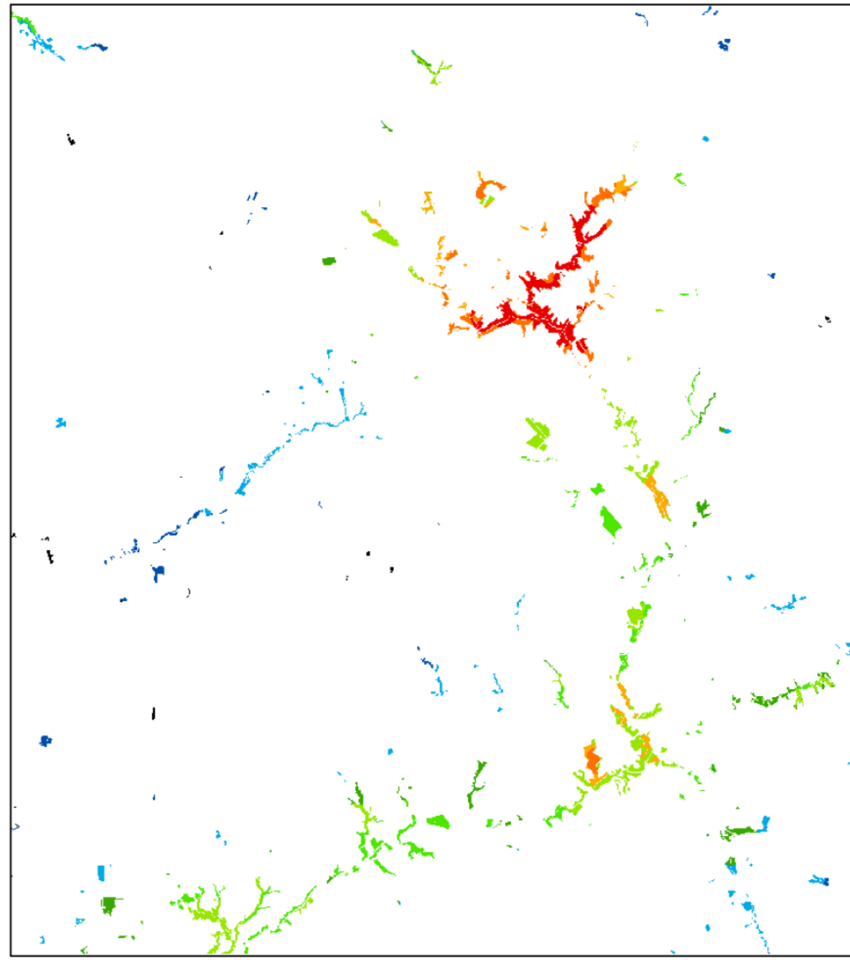
Zonation analysis with open sites only

No connectivity



2 km connectivity



-> More emphasis on the well-connected river valleys (red and green)

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Arponen, Heikkinen, Paloniemi, Pöyry, Similä & Kuussaari 2012, Submitted manuscript

Conclusions

- Information on landscape structure is important
  - in explaining and predicting patterns of farmland biodiversity
  - in planning of practical conservation measures
- Even relatively coarse land cover data is valuable, when it is available
  - For use in GIS programs
  - From the whole country (allowing use of various spatial scales)
  - Comparably from different time periods (allowing examination of the effects of land use change on biodiversity)
- Improved spatial resolution and more detailed habitat classifications tend to improve results in explaining and predicting biodiversity patterns