Schweizerische Eidgenossenschaft
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Federal Department of Economic Affairs, Education and Research EAER

Agroscope

ETH zürich

Where to bee?

Different semi-natural habitats are required to sustain diverse wild bee communities

Corina Maurer

Louis Sutter, Carlos Martínez-Núñez, Loïc Pellissier, Matthias Albrecht

Farming for pollinators: unlocking economic and ecological gains

02. April 2025

corina.bachofner@agroscope.admin.ch

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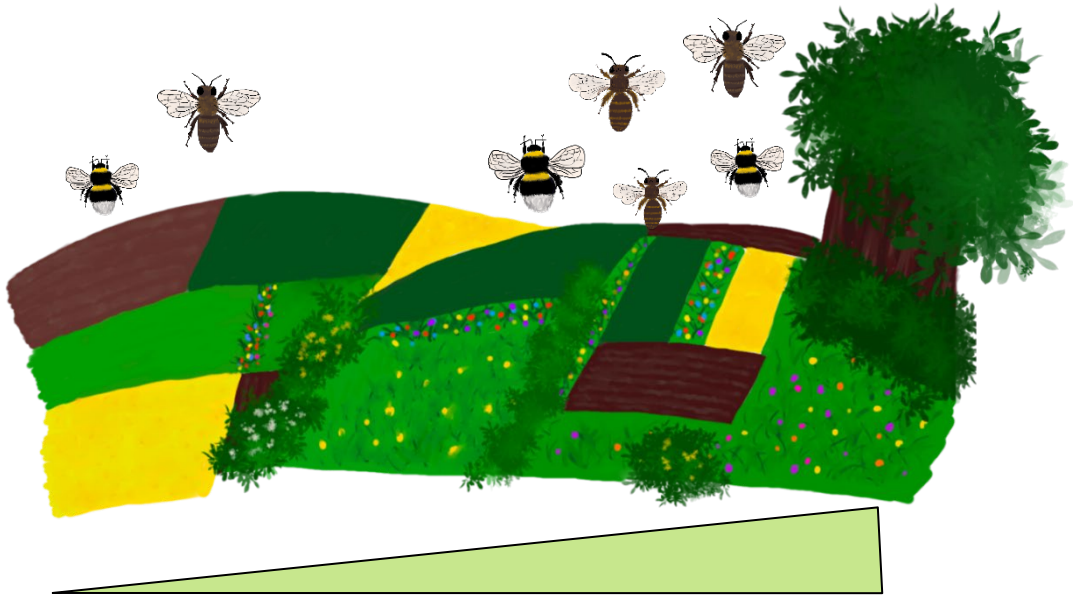
Wild bees and semi-natural habitats

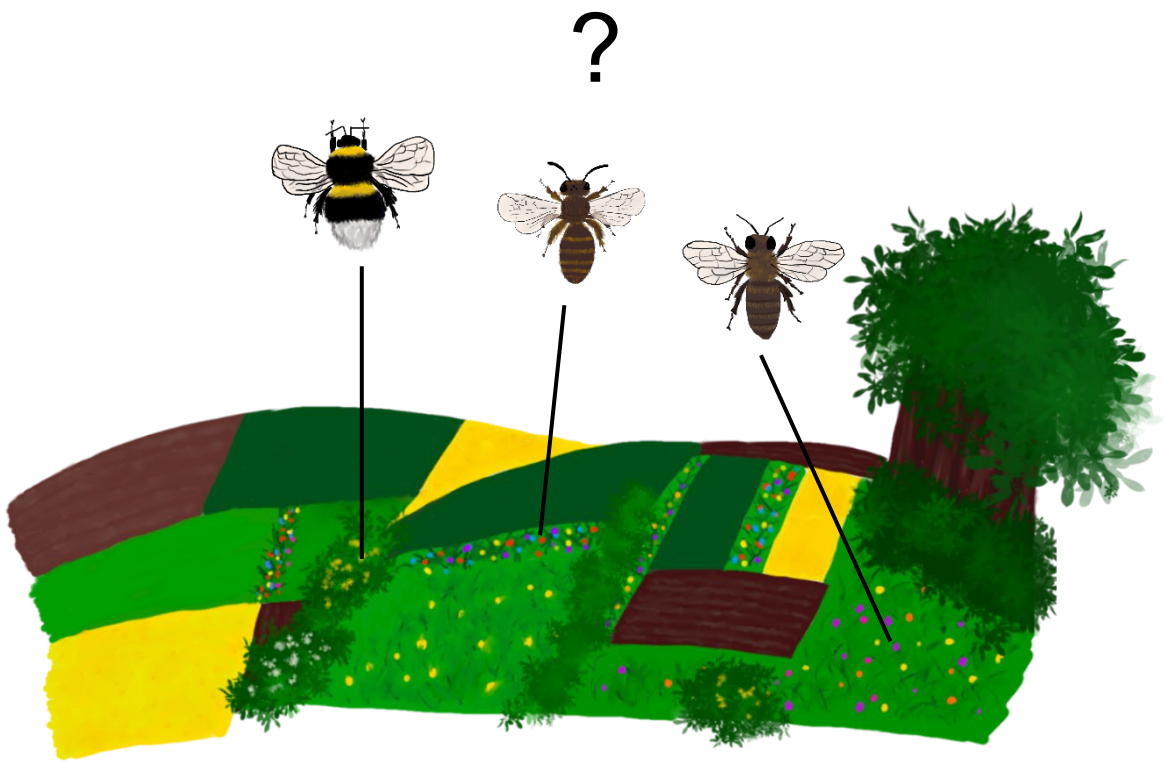
- Food & nesting resources
- High amounts of semi-natural habitats in landscape = many bees and species



amount of semi-natural habitat

e.g. Holzschuh et al. 2010, Kennedy et al. 2013, Nicholson et al. 2017

Where to bee?



- Different habitats
- Depends on season
- Different groups of bees

Cole et al. 2017, Rivers-Moore et al. 2020

Research questions

I. What is the relative importance of different semi-natural habitat types in supporting diverse wild bee communities?

II. Does their importance vary throughout the season and for rare (red-listed) species or crop pollinating species?

III. How do flower richness in the habitat and the surrounding landscape influence wild bee abundance and richness in semi-natural habitats?

Habitat types

Hedgerow

- Native shrubs
- Incl. herbaceous border
- “biodiversity promoting area” (BPA) or not

Flower Strip

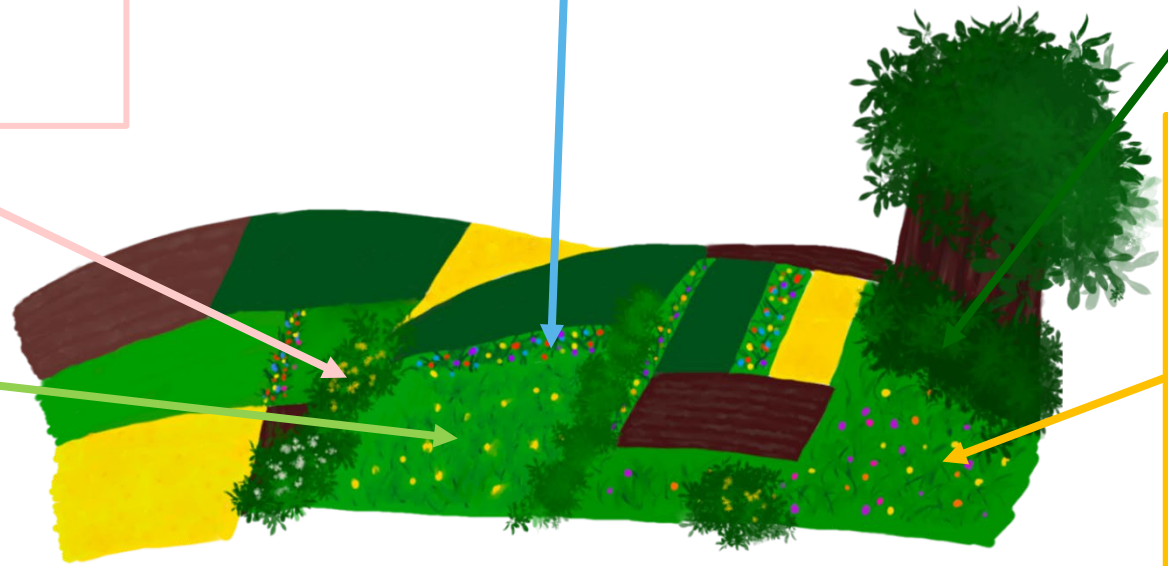
- Sown
- “Buntbrache” (flower fallow/flower strip)
- perennial

Forest Edge

- Edge of deciduous or mixed forest

Intensive Meadow

- Permanent
- Conventionally managed



Extensive Meadow

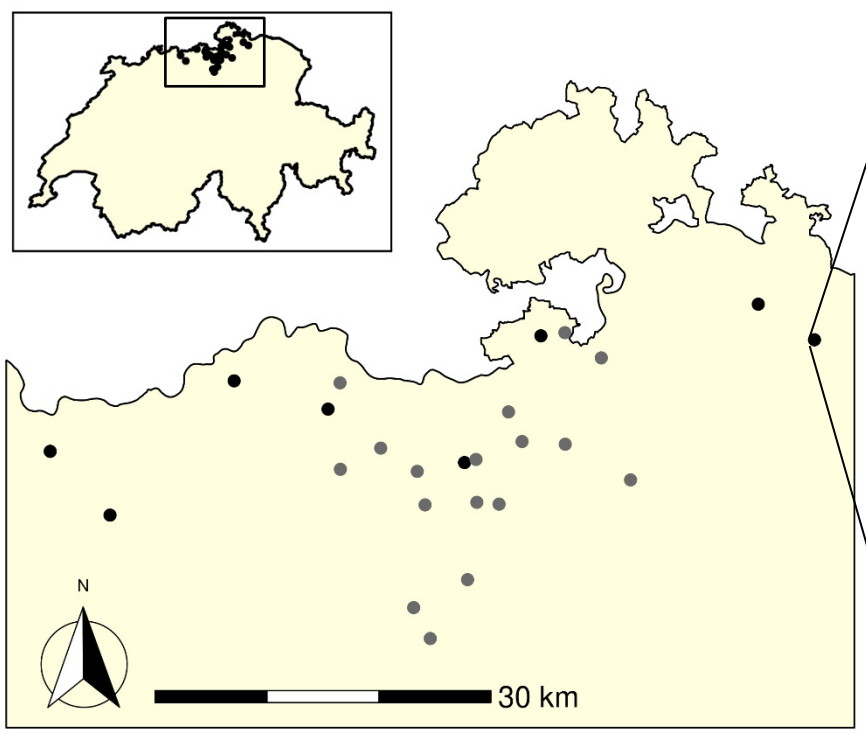
- Permanent
- No fertilizer
- Mown after 15th June
- “biodiversity promoting area” (BPA)

Study design

25 landscapes

Wild bee flower visits along transects

3 sampling rounds (April, May/June, July)



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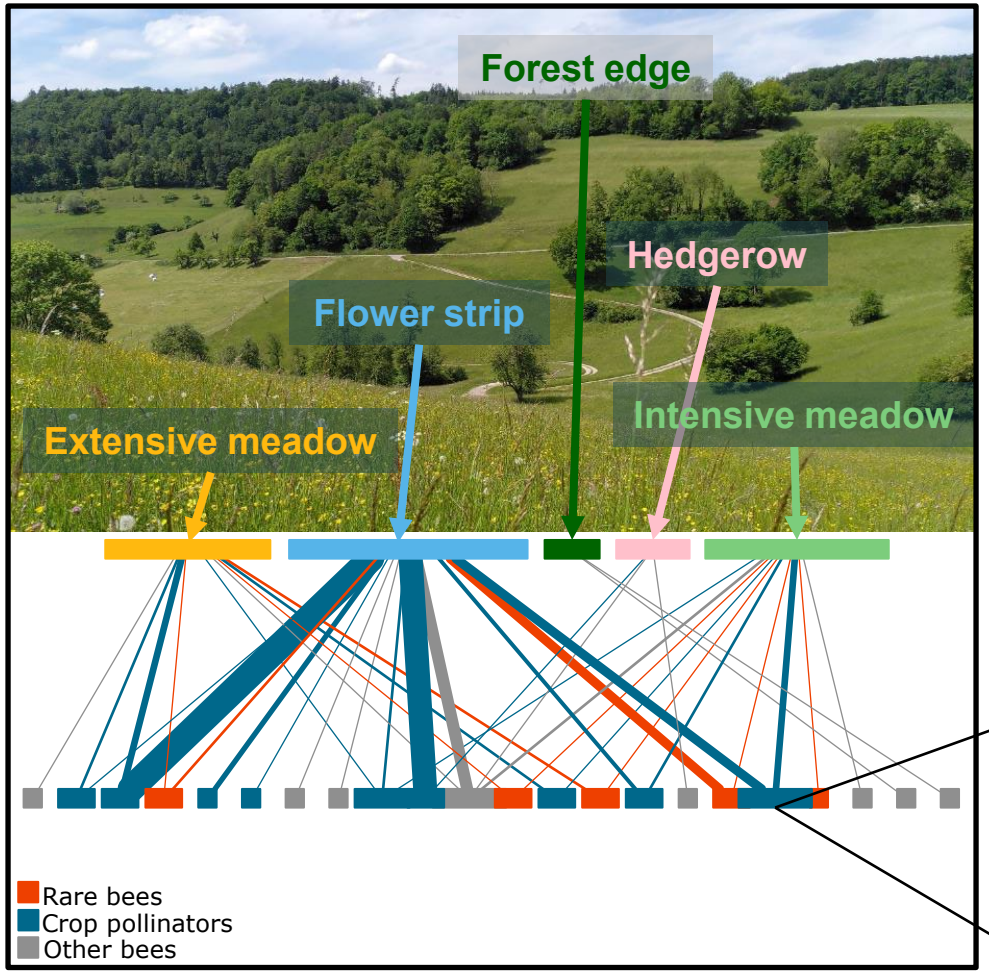
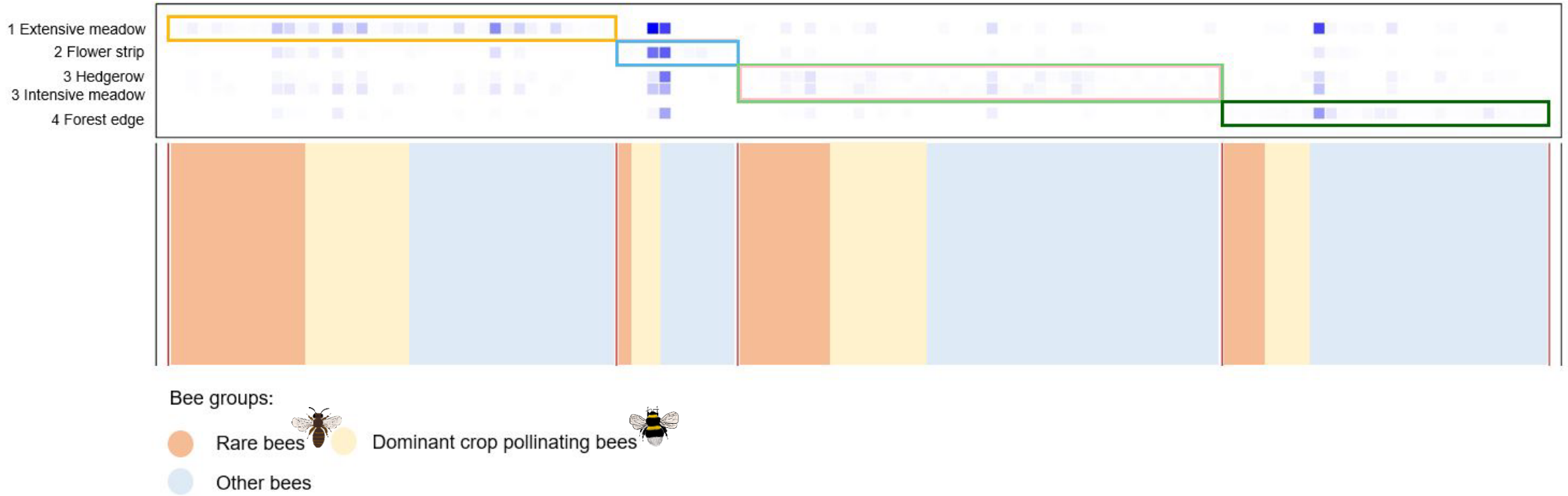
Study design



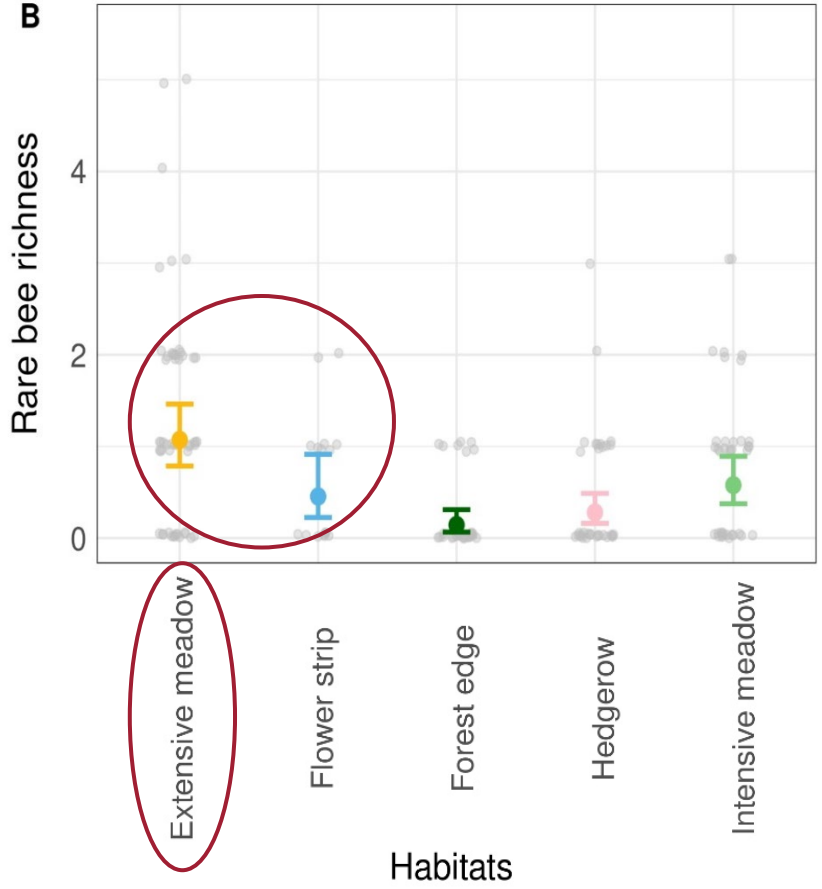
I. Relative importance of different semi-natural habitats

- The different habitats sustain different bee communities

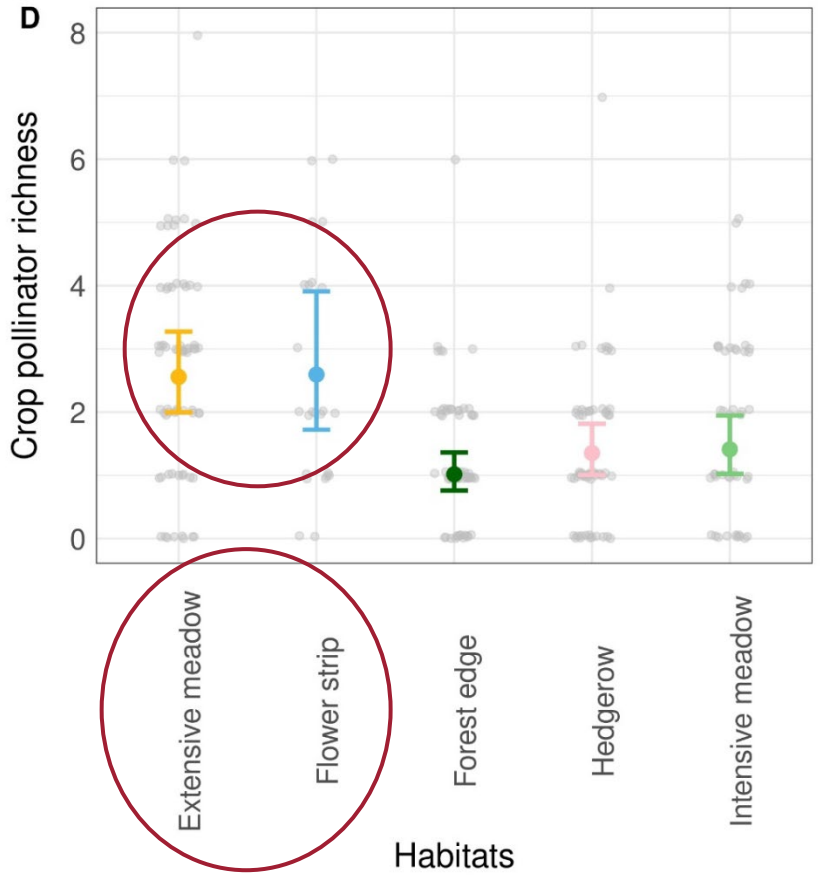


II. Different bee groups

Rare (red-listed) bees

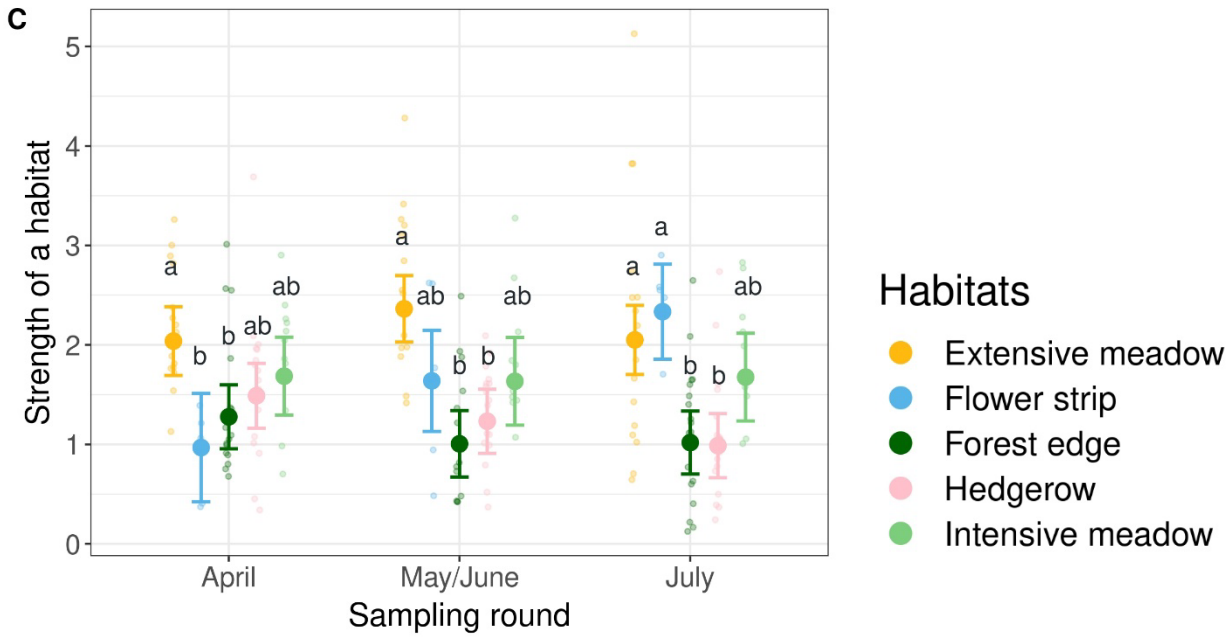


Crop-pollinating bees



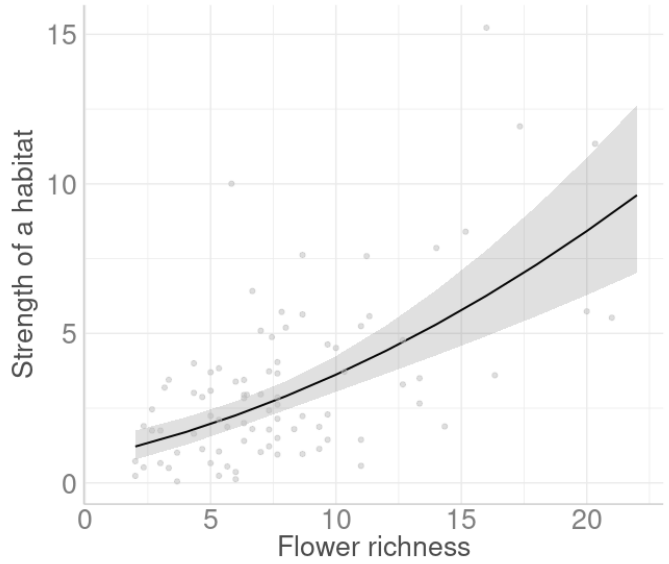
II. Habitat importance is depending on the season

- Extensively managed meadows are important throughout the season
- Flower strips are mainly important in July



III. Flowers and landscape

- A high flower richness within habitats is key!
- Flower richness was more important than the surrounding landscape



Maurer et al. 2022, J Applied Ecology

Conclusions & implications for conservation

- Diverse wild bee communities require different types of semi-natural habitats
- Local flower richness is key!

- Flower strips in July and for crop pollinating bees

- Extensively managed meadows for rare species

Many thanks to…

- Lea Bona
- Stefanie Bossart
- Agricultural Landscapes & Biodiversity group at Agroscope

- VOODOO & QuESSA Projects
- SNF Swiss National Science Foundation

VOODOO
Viral eco-evolutionary dynamics of wild and domestic pollinators under global change

QuESSA

Swiss National Science Foundation

Thank you for your attention!

Appendix

Bee species	Bee group	Total abundance
Andrena alfkenella	rare	2
Andrena chrysosceles	crop pollinator	2
Andrena cineraria	rare	10
Andrena dorsata	crop pollinator	2
Andrena flavipes	crop pollinator	23
Andrena haemorrhoa	crop pollinator	45
Andrena hattorfiana	rare	1
Andrena helvola	crop pollinator	1
Andrena lathyri	rare	3
Andrena nitida	crop pollinator	16
Andrena ovatula	crop pollinator	18
Andrena pandellei	rare	0
Andrena subopaca	crop pollinator	3
Andrena viridescens	rare	4
Bombus hortorum	crop pollinator	64
Bombus humilis	rare	44
Bombus lapidarius	crop pollinator	288
Bombus lucorum	crop pollinator	10
Bombus pascuorum	crop pollinator	242
Bombus pratorum	crop pollinator	24
Bombus ruderatus	rare	25
Bombus subterraneus	crop pollinator	11
Bombus sylvarum	rare	61
Bombus terrestris	crop pollinator	392
Colletes cunicularius	rare	2
Colletes similis	rare	4
Halictus rubicundus	crop pollinator	6
Halictus scabiosae	rare	10
Halictus simplex	crop pollinator	11
Halictus simplex agg.	crop pollinator	17
Halictus subauratus	rare	2
Lasioglossum glabriusculum	rare	26
Lasioglossum interruptum	rare	1
Lasioglossum lativentre	rare	5
Lasioglossum lineare	rare	2
Lasioglossum malachurum	crop pollinator	108
Lasioglossum marginatum	rare	2
Lasioglossum nigripes	rare	7
Lasioglossum pallens	rare	2
Lasioglossum parvulum	rare	1
Lasioglossum pauperatum	rare	1
Lasioglossum pauxillum	crop pollinator	41
Lasioglossum politum	crop pollinator	11
Lasioglossum puncticolle	rare	1
Melitta nigricans	rare	0

Appendix

Identification of key plants per habitat:

1. 1 bee-flower network per habitat (including all 25 landscapes and 3 sampling rounds)
2. Calculate strength and proportional generality for each plant species (package bipartite)
3. Identify plants with both values of strength and proportional generality >= 80% quantile (per habitat)

Strength: sum of dependencies of a species (for plants: sum of number of bee species) (Bascompte et al. 2006)

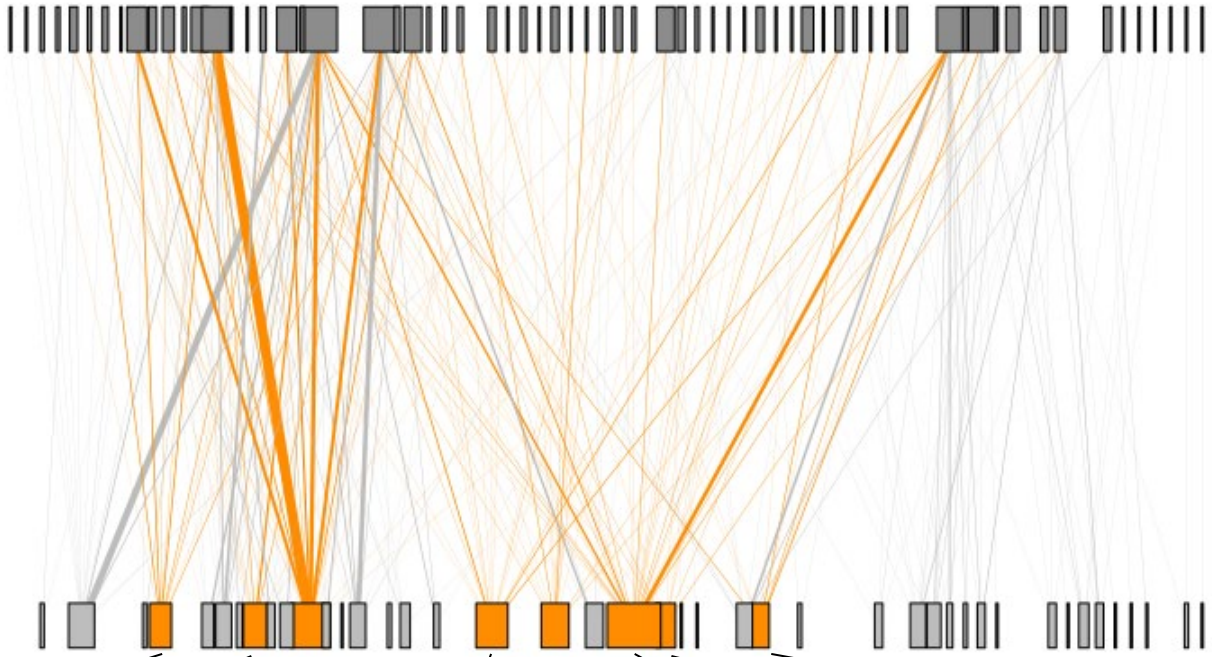
Proportional generality: the number of partner species in relation to the potential number of partner species

Package bipartite: Dormann et al. 2021

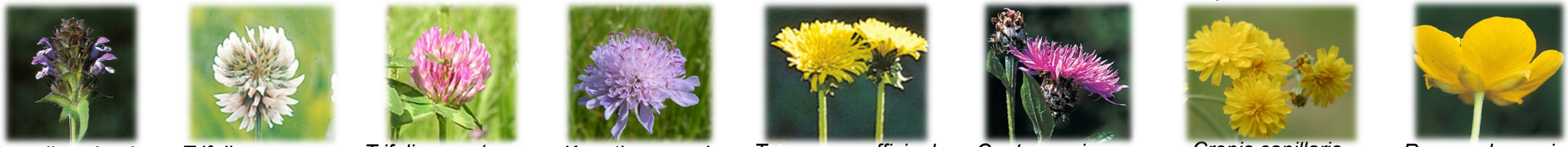
!!! All analyses without honeybees !!!

Appendix: Key plants extensive meadows

Wild bees



Visited flowers

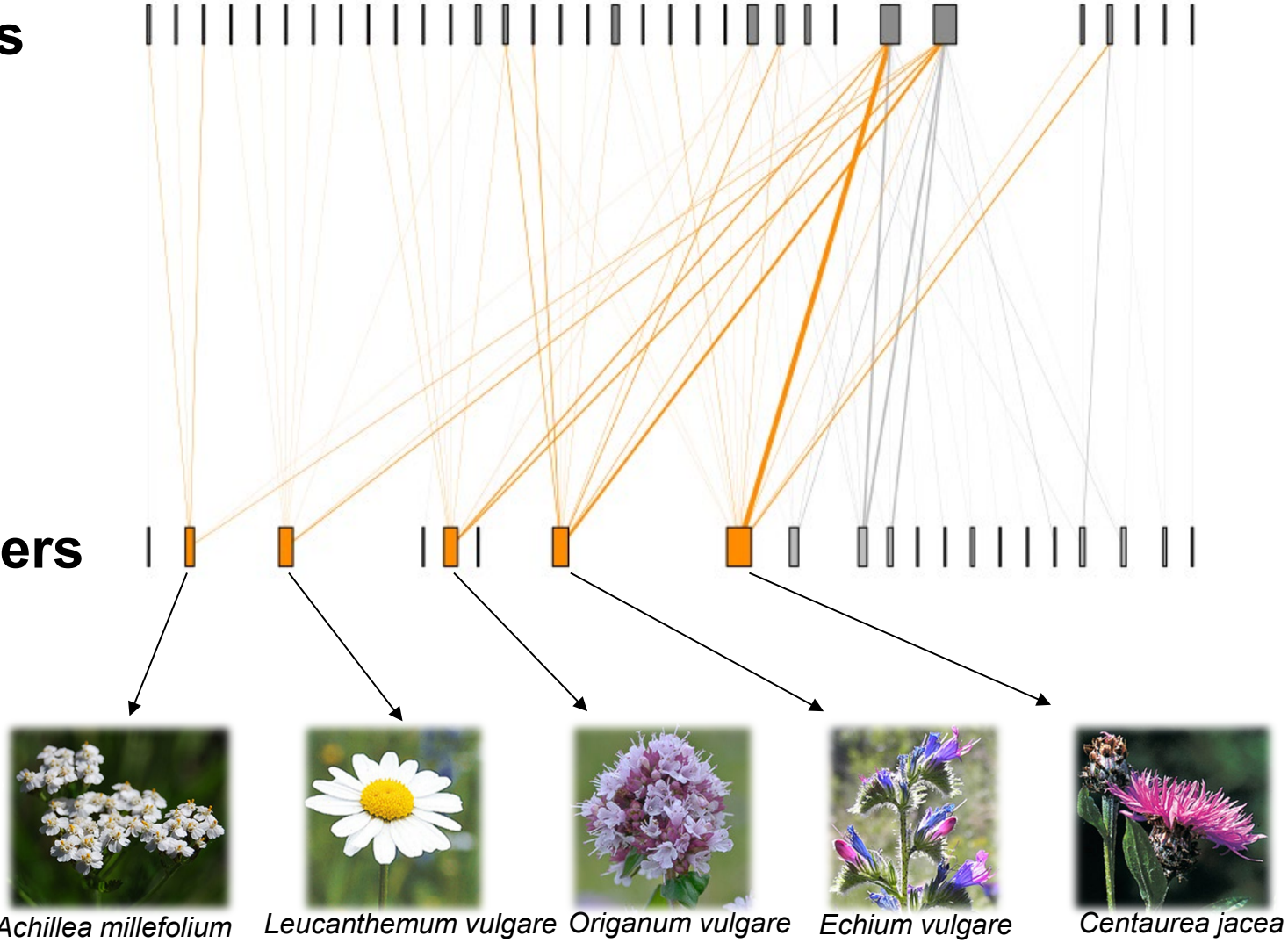


Prunella vulgaris *Trifolium repens* *Trifolium pratense* *Knautia arvensis* *Taraxacum officinale* *Centaurea jacea* *Crepis capillaris* *Ranunculus acris*

Appendix: Key plants flower strip

Wild bees

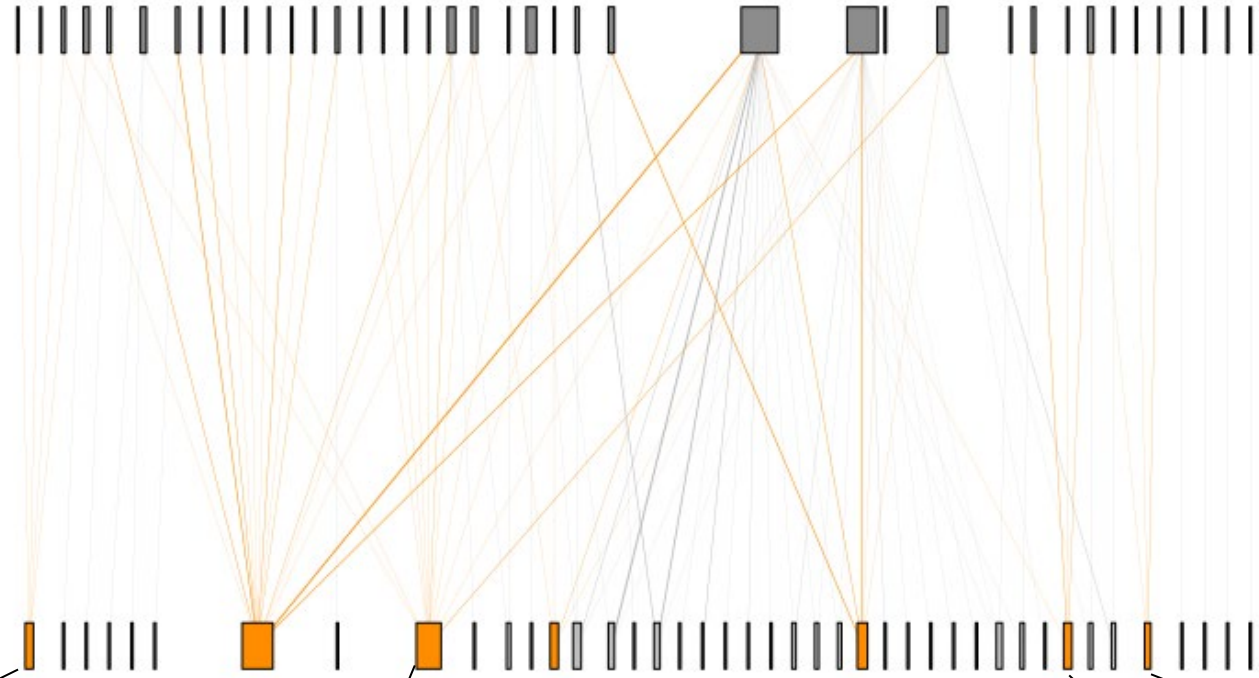
Visited flowers



Achillea millefolium *Leucanthemum vulgare* *Origanum vulgare* *Echium vulgare* *Centaurea jacea*

Appendix: key plants forest edge

Wild bees

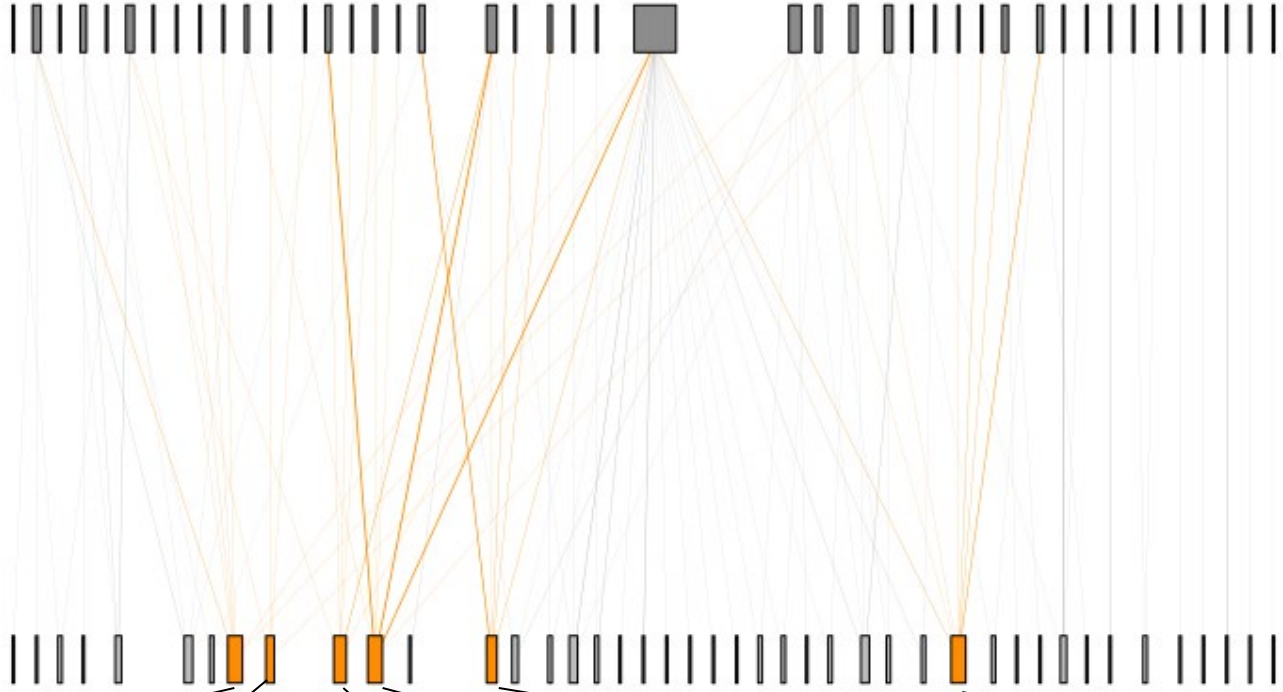


Visited flowers

Torilis japonica | *Taraxacum officinale* | *Rubus caesius* | *Trifolium repens* | *Rubus fruticosus aggr.* | *Ligustrum vulgare* | *Hypericum perforatum*

Appendix: key plants hedgerow

Wild bees



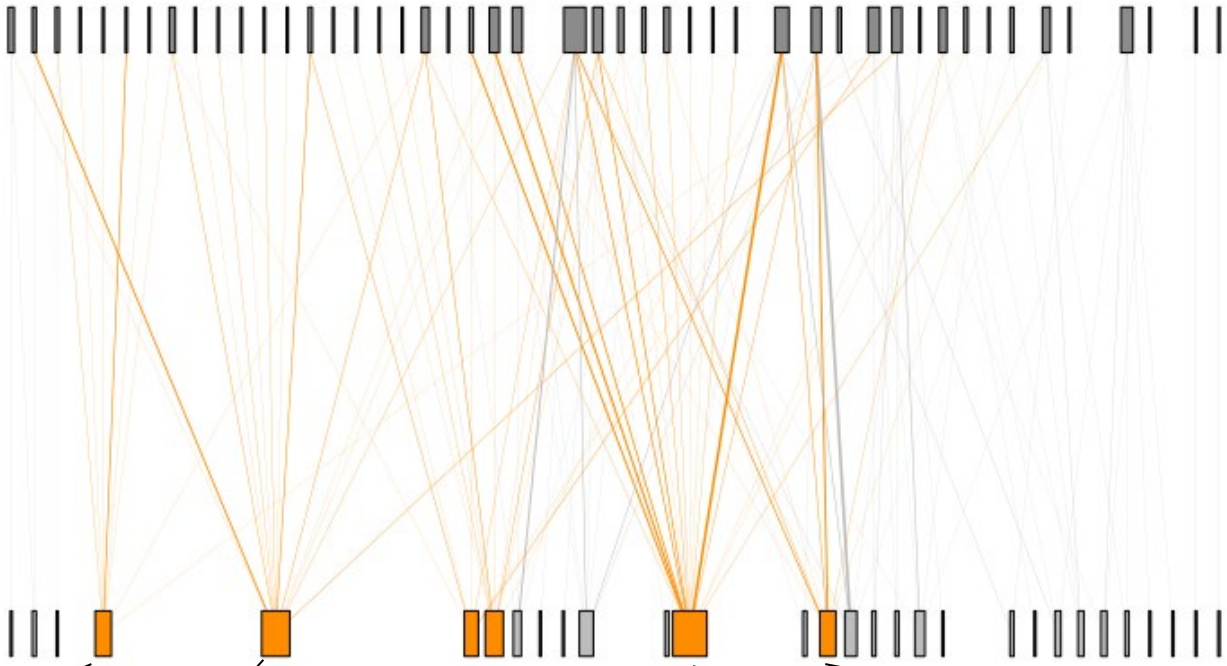
Visited flowers

Taraxacum officinale *Ranunculus bulbosus* *Trifolium pratense* *Vicia sepium* *Lamium galeobdolon* *Plantago lanceolata*

Picture sources:
https://www.infoflora.ch/
https://umweltplattform.ch/de/essbare_pflanzen/plantago-lanceolata-846539_1920/#iLightbox[postimages]/0

Appendix: key plants intensive meadows

Wild bees



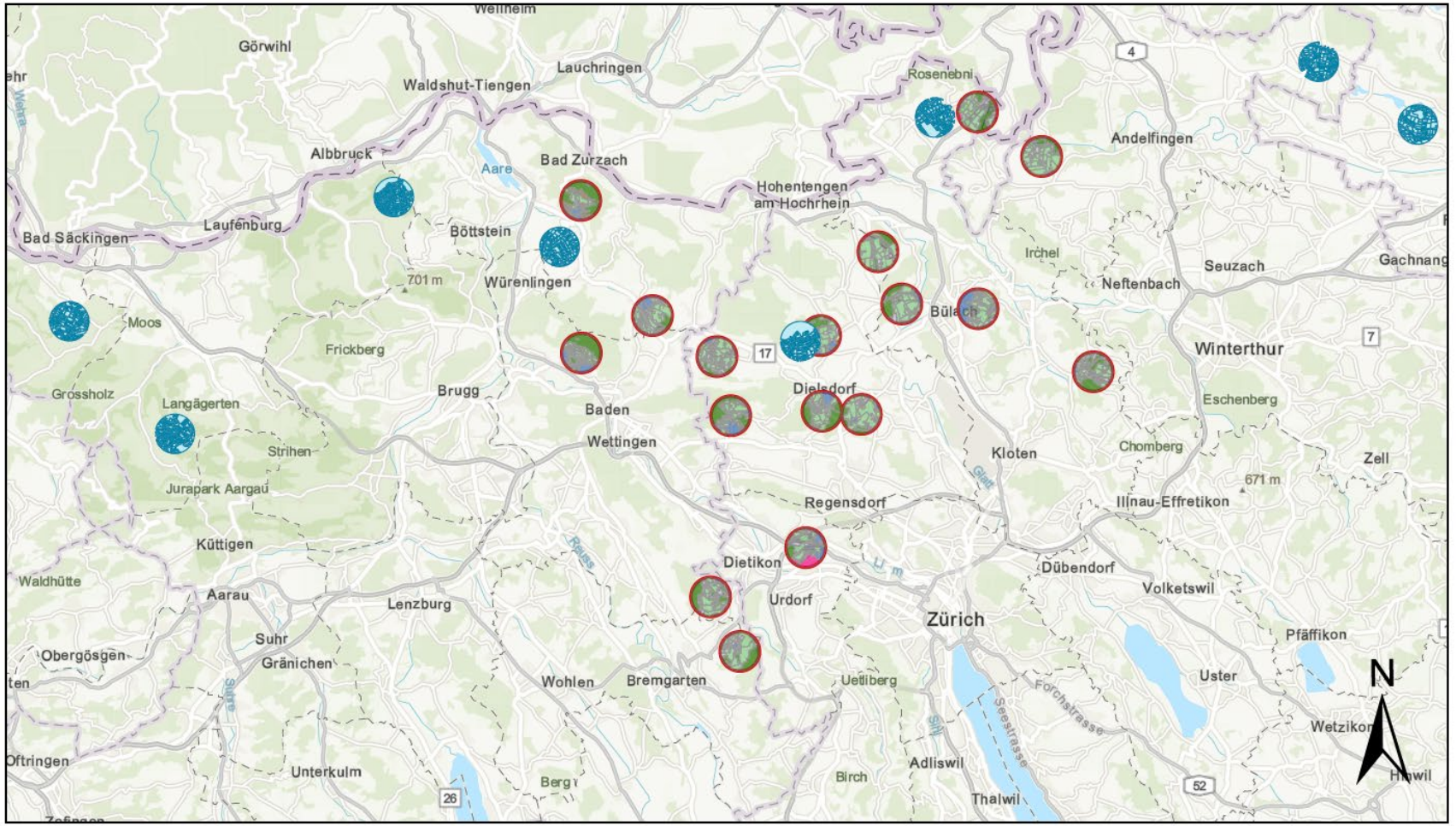
Visited flowers

Ranunculus acris | *Taraxacum officinale* | *Plantago lanceolata* | *Vicia sepium* | *Trifolium pratense* | *Trifolium repens*

Picture sources:
https://www.infoflora.ch/
https://umweltplattform.ch/de/essbare_pflanzen/plantago-lanceolata-846539_1920/#iLightbox[postimages]/0

Study sites

Overview Study Sites VOODOO and QUESSA



Study Sites

- QUESSA_buffer_1km_Radius
- VOODOO_buffer_1km_radius

Raumbezug
Name: CH1903+ LV95
PCS: CH1903+ LV95
GCS: GCS CH1903+
Datum: CH1903+
Projektion: Hotine Oblique Mercator Azimuth Center

Maßstab 1:259.695

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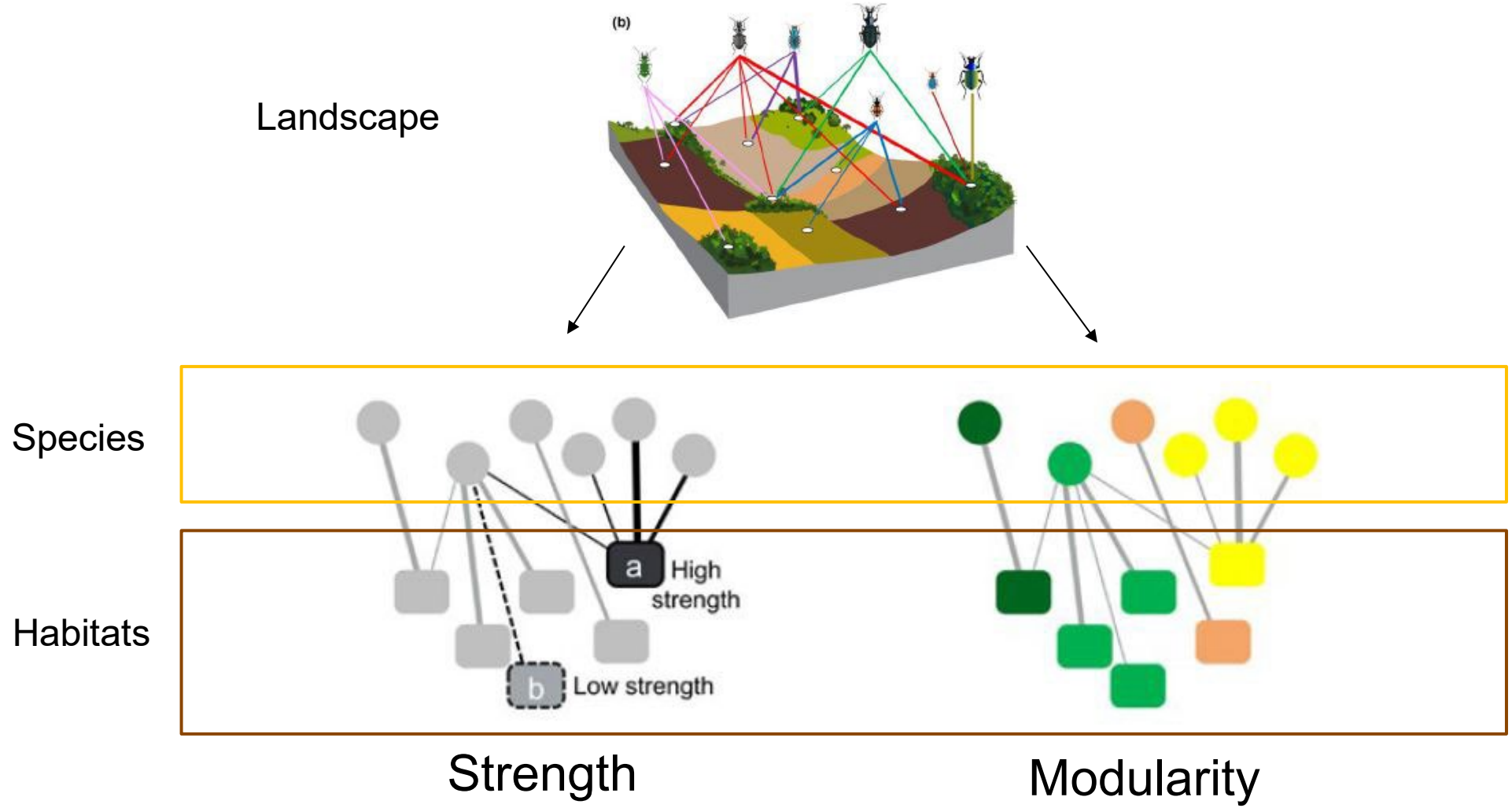
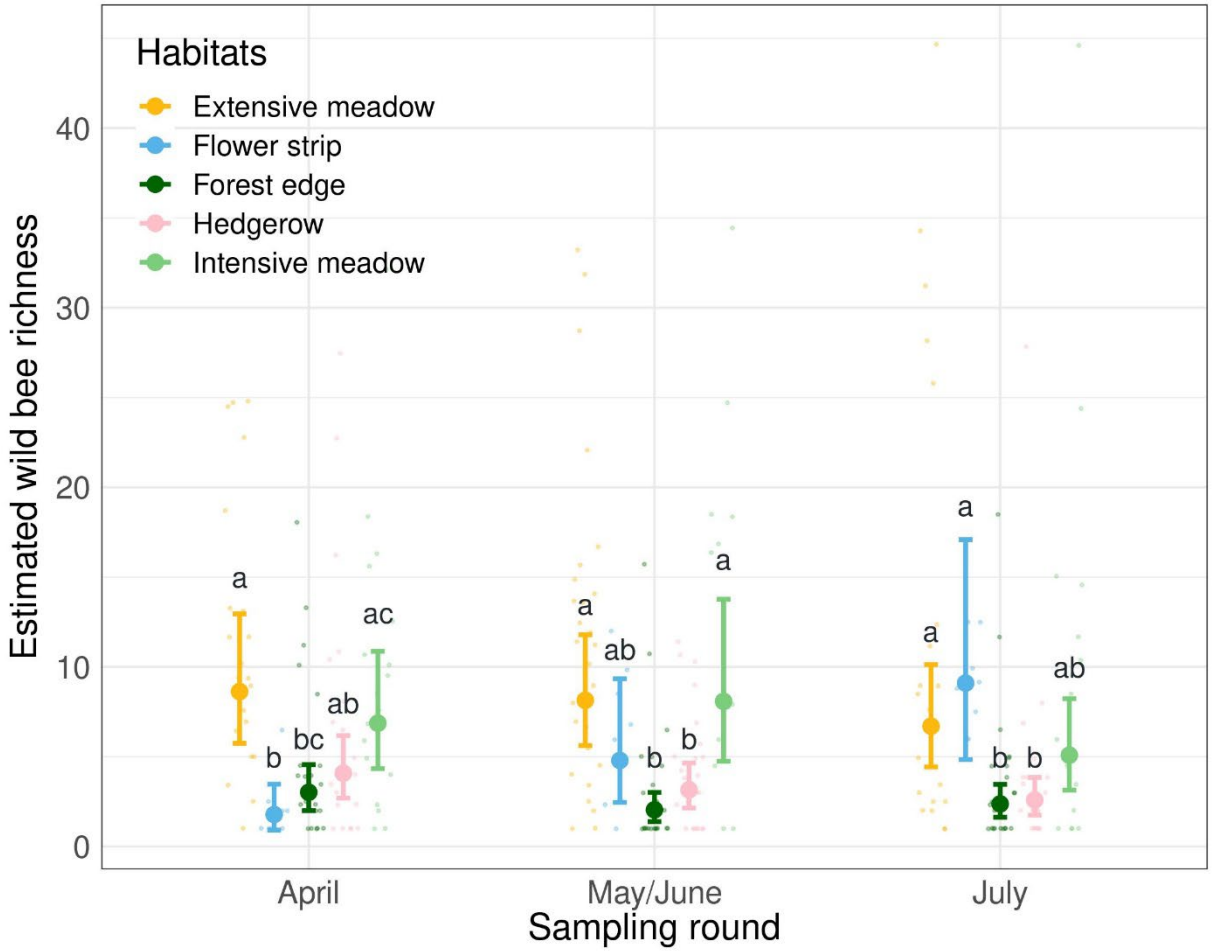
Species-habitat networks



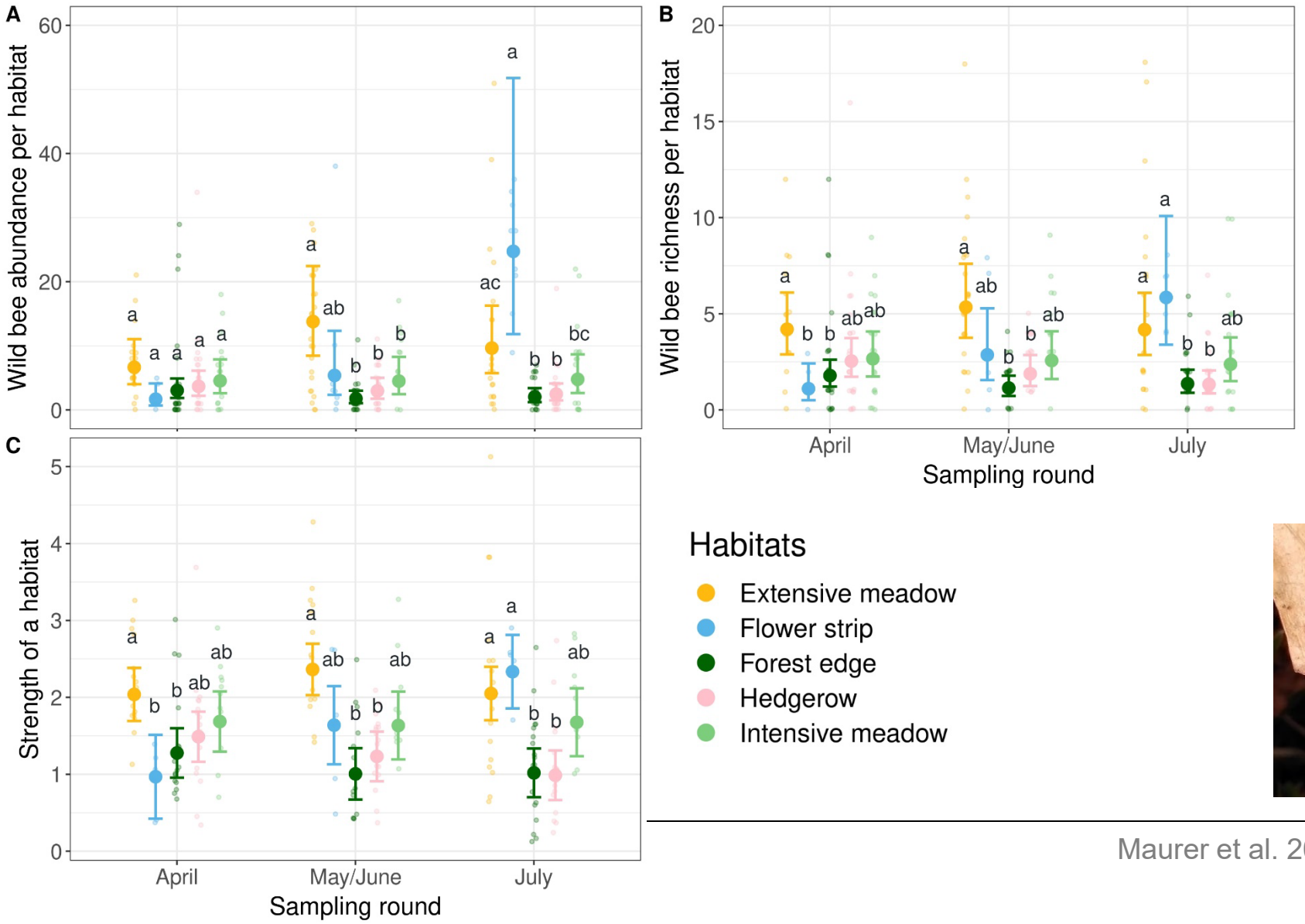
Marini et al. 2019

Estimated wild bee richness



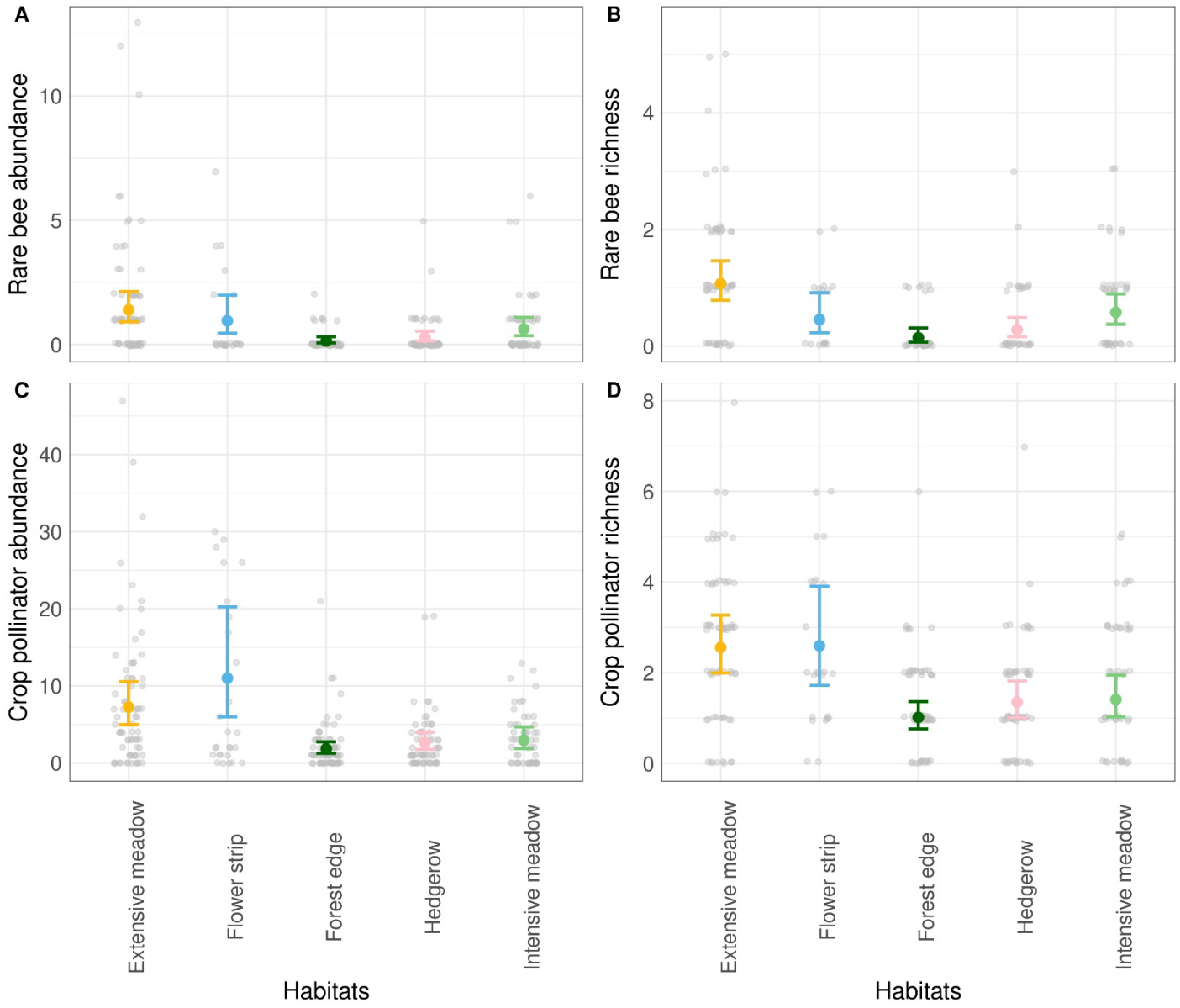
Agroscope

II. Habitat importance is depending on the season

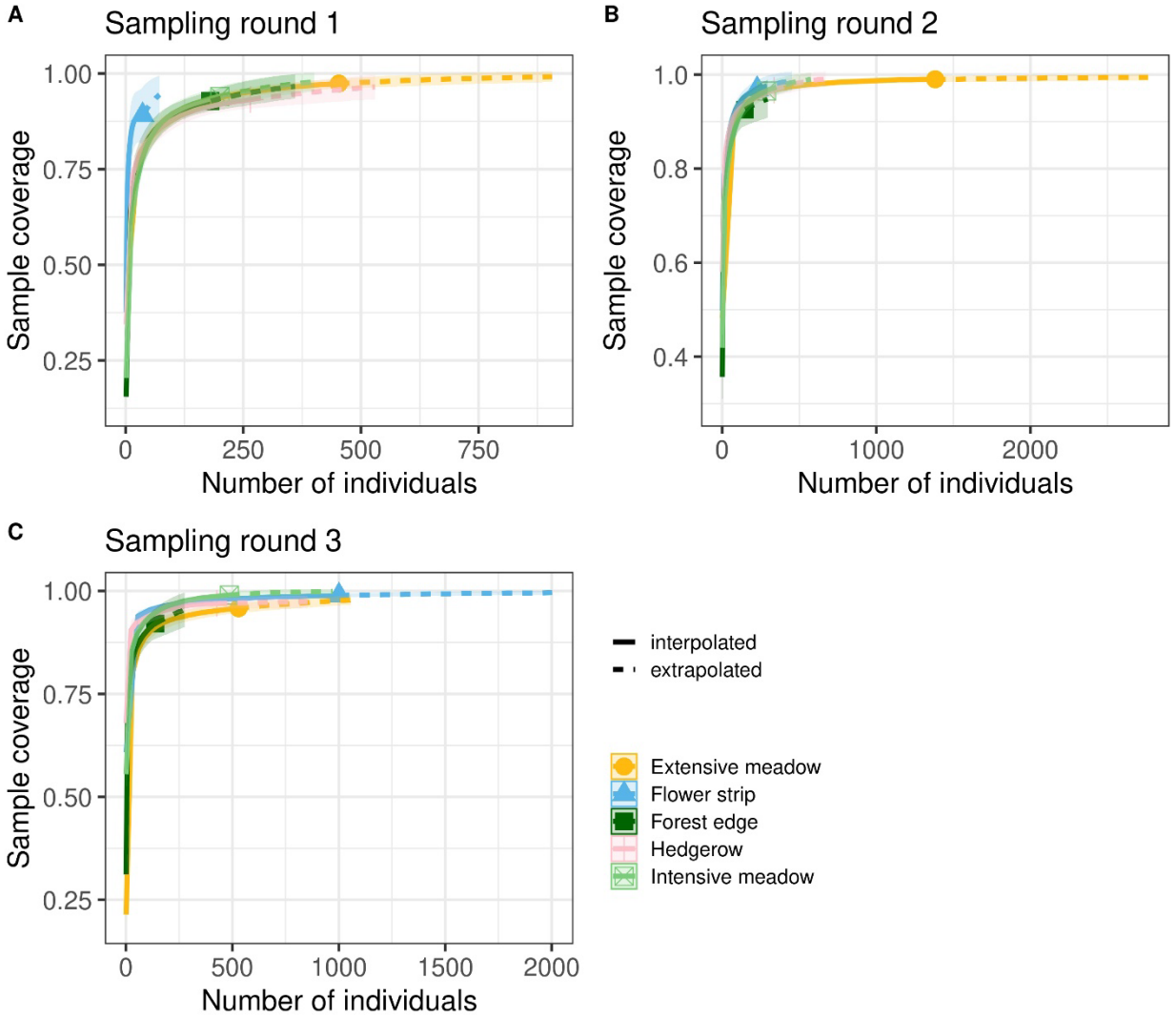


Maurer et al. 2022, J Applied Ecology

Dominant crop pollinators and rare species

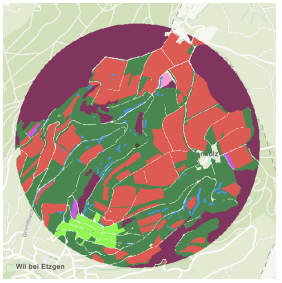


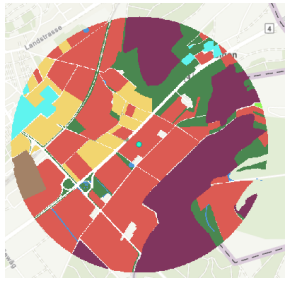
Coverage-based rarefaction curves

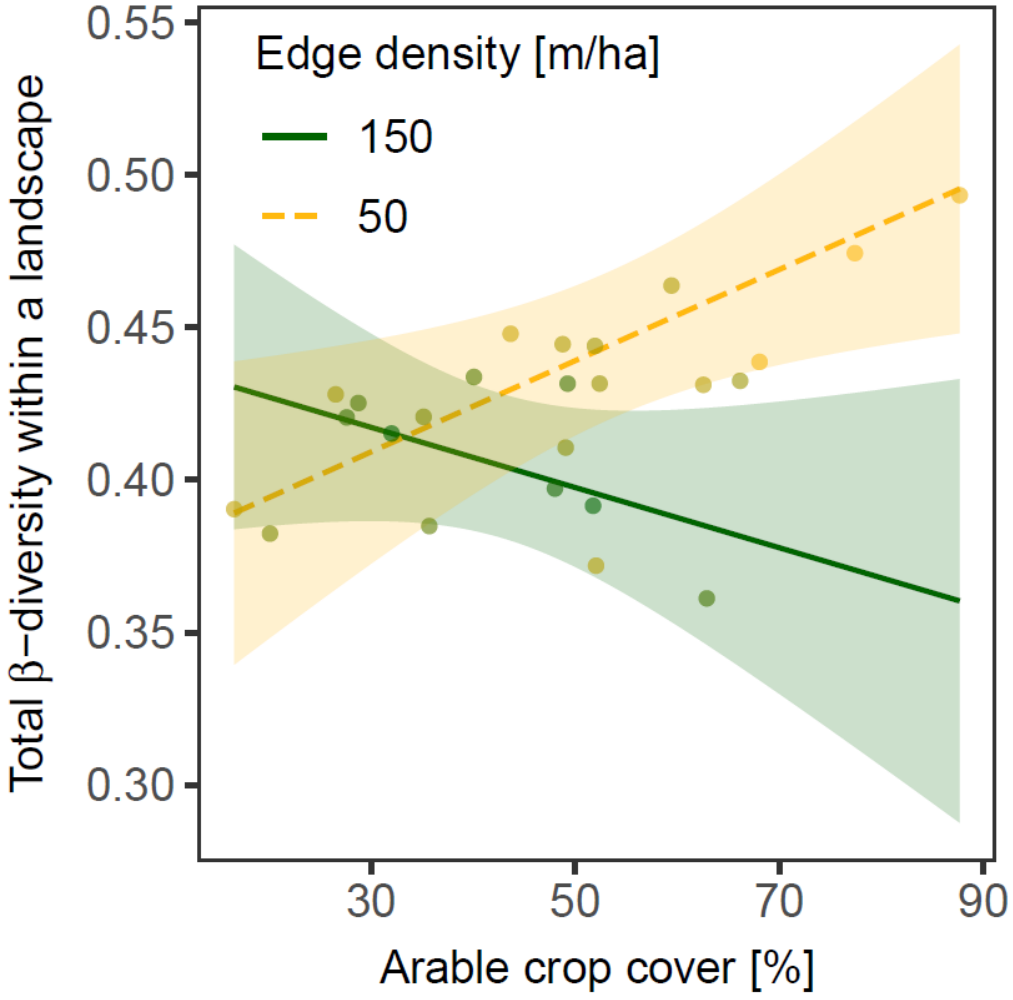


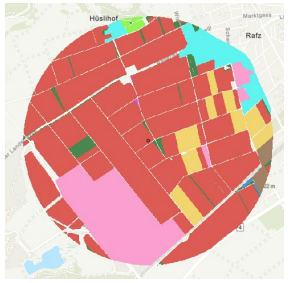
Based on Hill numbers, R package iNEXT, Hsieh et al. 2016

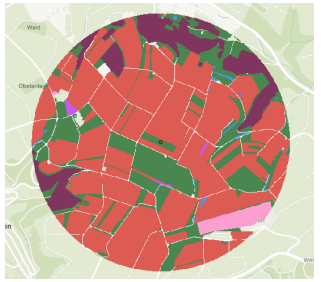
III. Drivers of β-diversity among habitats











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Safeguarding European wild pollinators

Environmental benefits of pollinator-friendly land management

Andree Cappellari, Lorenzo Marini

(University of Padova, Italy)

Forum for Agriculture, Brussels, 02/04/2025

This project receives funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101003476.

Pollinators and pollination

- Key part of biodiversity
- 70% of leading global food crops is dependent upon animal pollination (35% of global food production)
- Better yields, better quality

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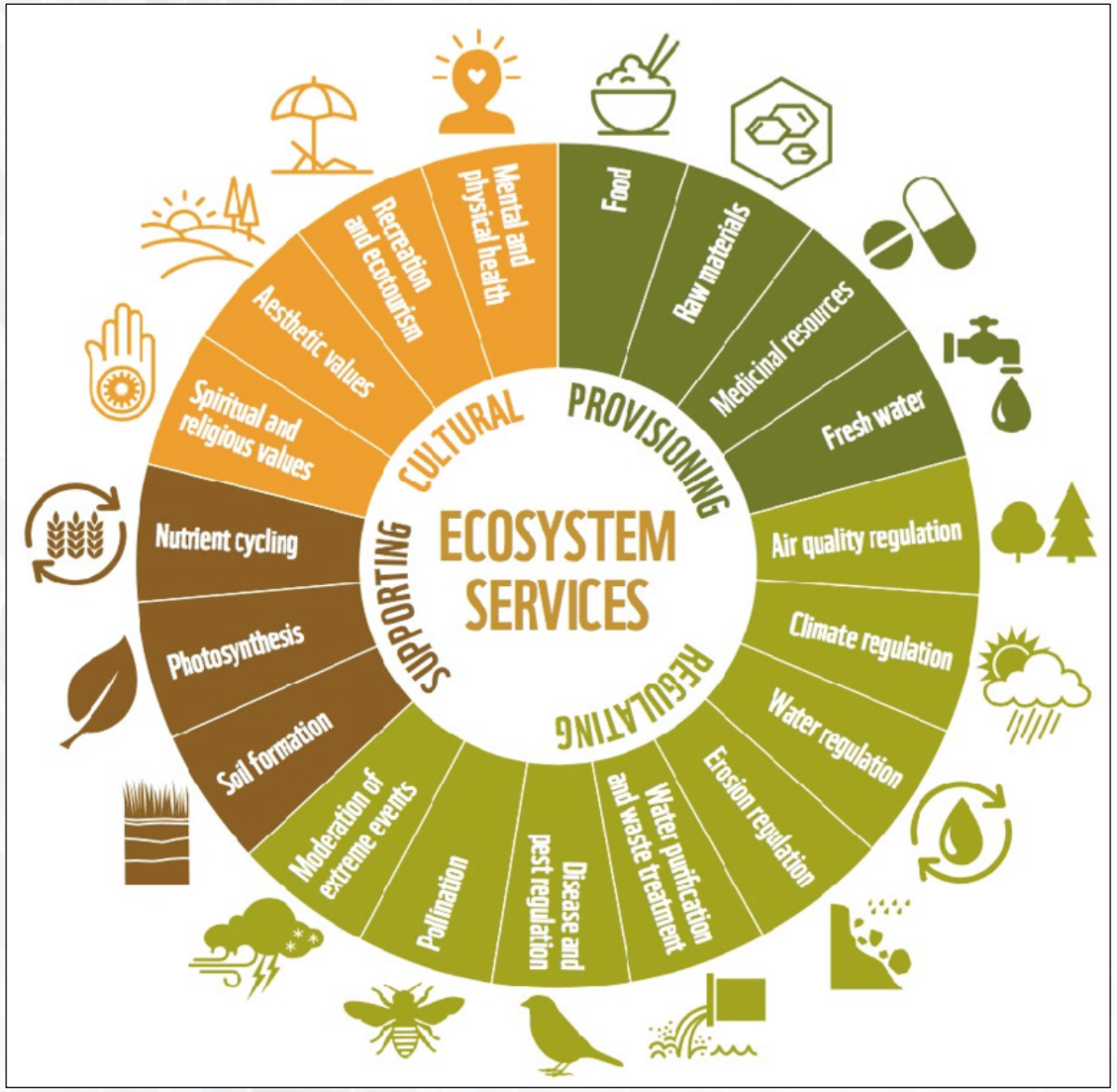
Ecosystem services



Benefits that humans derive from ecosystems

Relationships among ecosystem services:

- Co-benefits: +
- Trade-offs: -

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Pollinator-friendly areas in agricultural landscapes

- High flower cover and diversity
- Reduced pesticide use
- Specific habitats

Does this also reflect on other ecosystem services?

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Why is it important to study co-benefits?

Support multifunctional landscapes, balancing conservation and production

Maximize co-benefits and minimize trade-offs!

Farmers

- Boost crop yields, reduce pesticide use, improve soil and water health
- Manage field margins without losing productive land

Land managers & advisors

- Identify high-impact habitats to prioritize
- Promote cost-effective conservation actions

...but only a few studies

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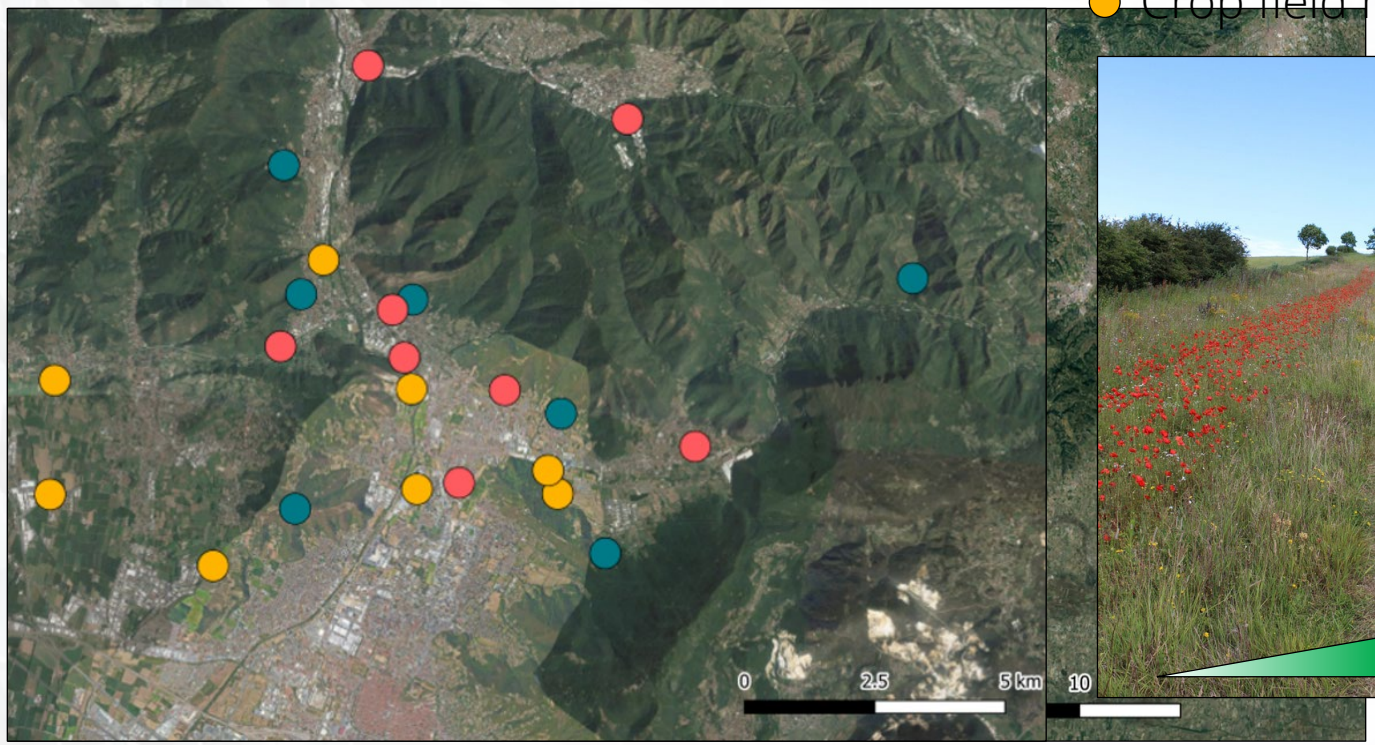
Our study: Aims and key questions

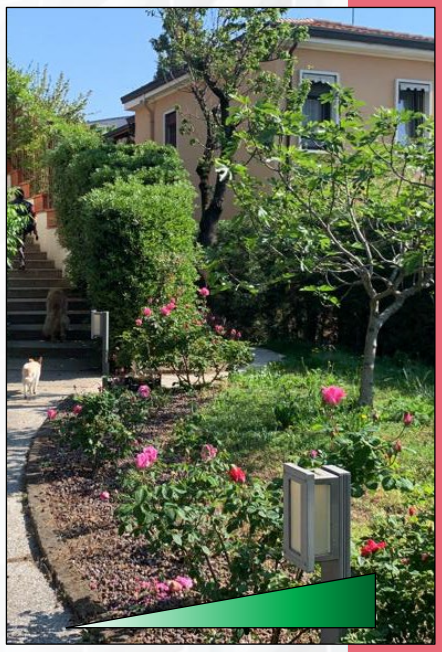
Promote pollination and other ecosystem services in agricultural landscapes

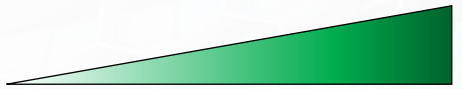
1) What is the role of **semi-natural patches**, **crop field margins**, and **urban green areas**, in supporting both wild pollinators and other ecosystem services?
2) Does improving local conditions for pollinators, *i.e.*, increasing **flower cover and diversity**, also boost other ecosystem services?

Our study: Sampling sites



Crop field margin Semi-natural patch Urban green area





Flower cover and diversity gradient

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Our study: Ecosystem services

Ecosystem multi-functionality

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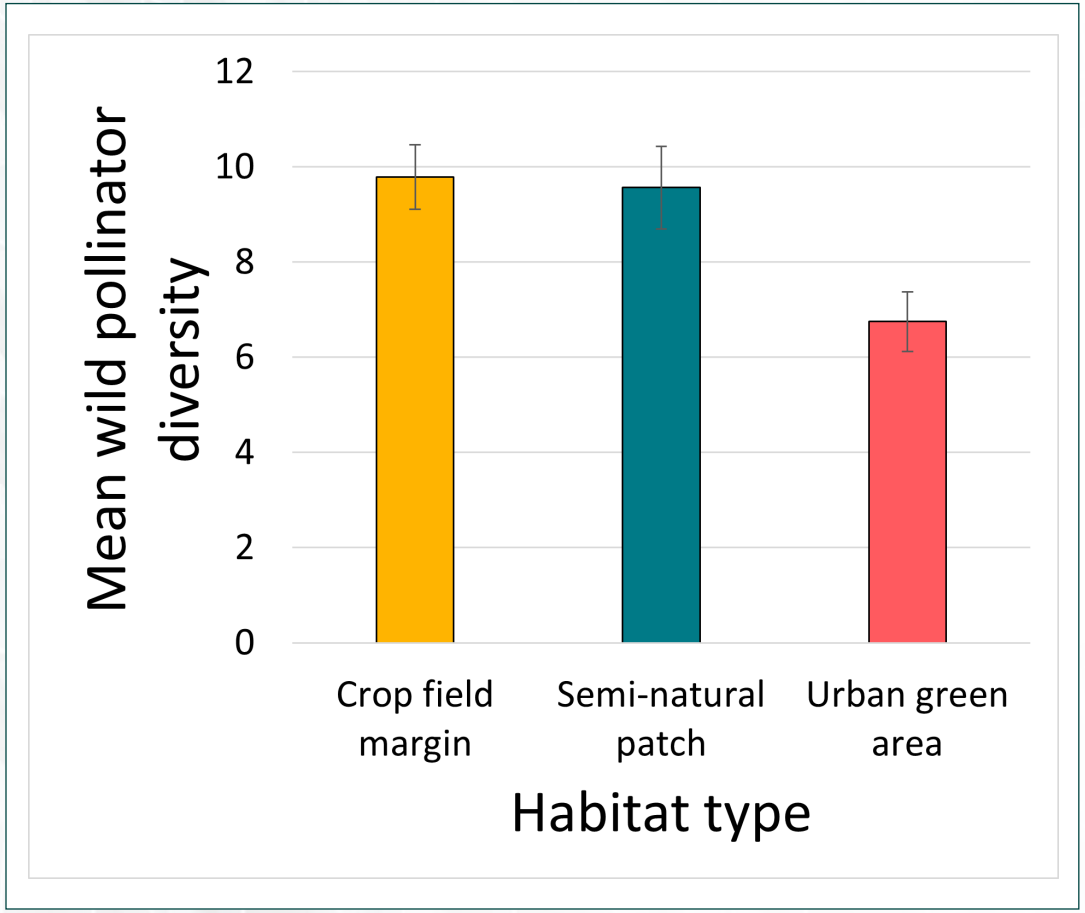
Results – Pollinators and habitats



Higher number of pollinator species in crop field margins and semi-natural patches

111 species

77 species

59 species

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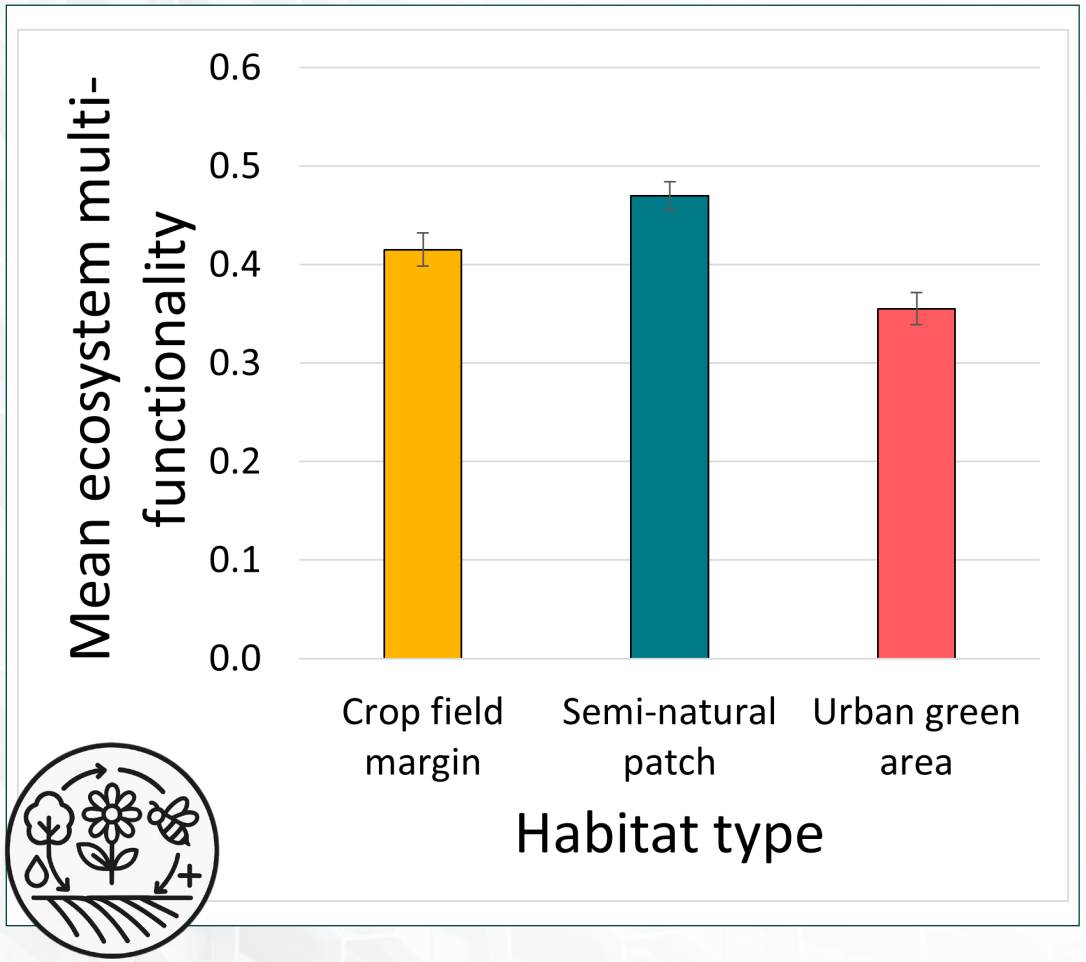
Results – Other ecosystem services and habitats



Semi-natural patches and crop field margins supported multiple ecosystem services

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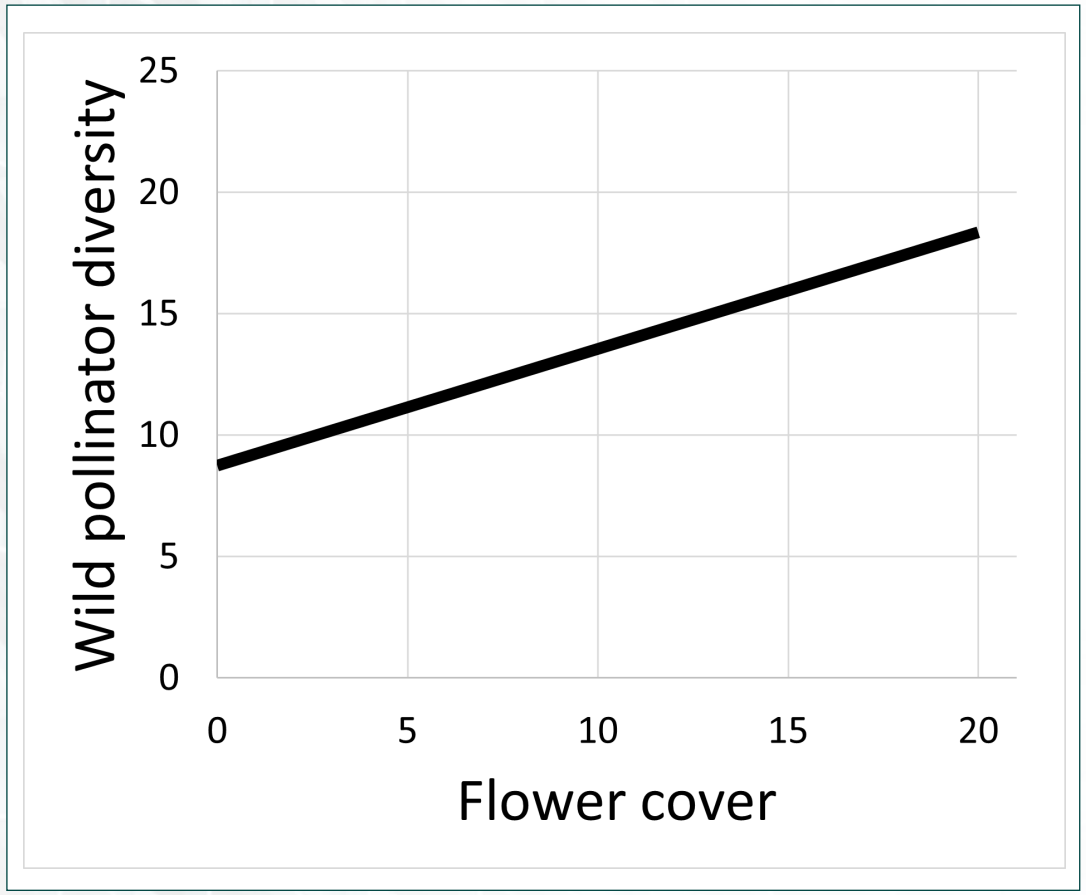
Results – Pollinators and flowers



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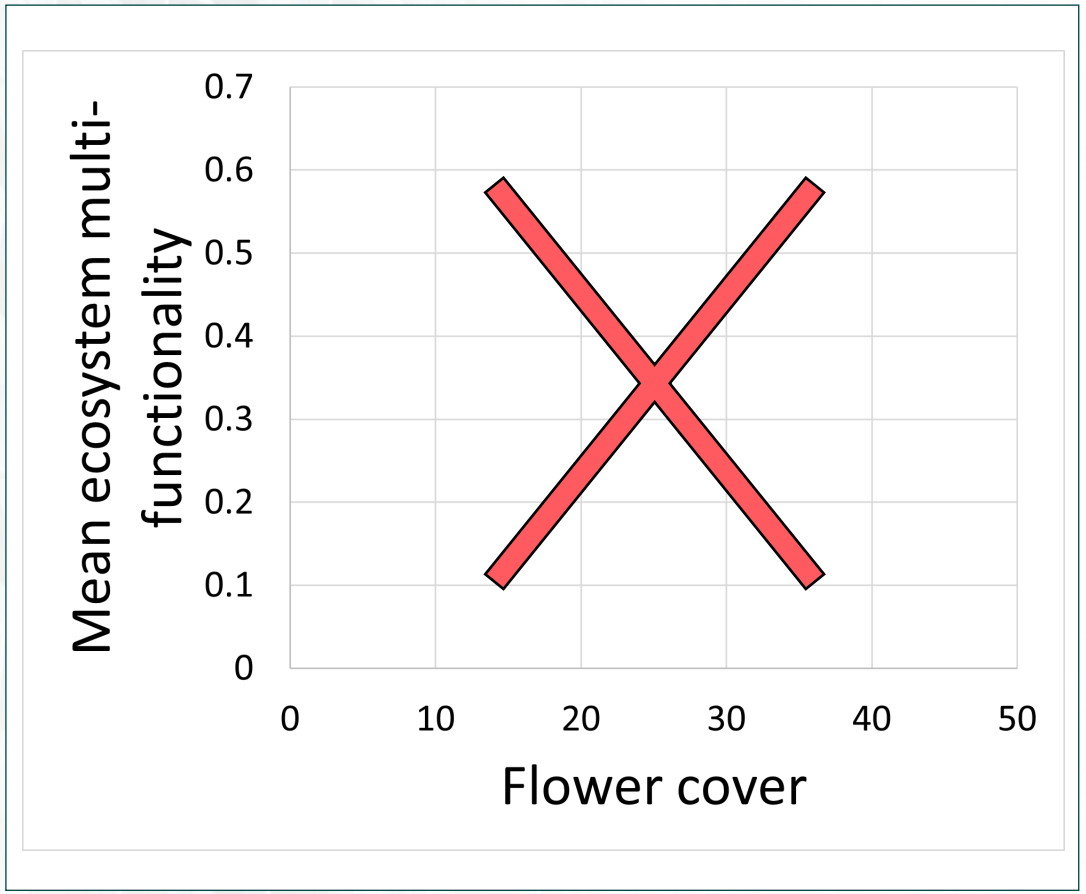
Results – Other ecosystem services and flowers



Increasing flower cover benefits pollinators, but it doesn't guarantee a higher provision of other ecosystem services

No one-size-fits-all!

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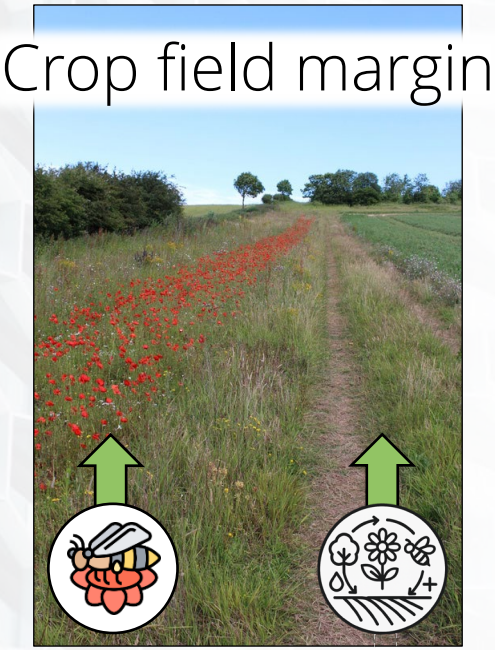
Take-home messages

Environmental benefits: Pollinator-friendly areas could do more than just help bees!

Crop field margin



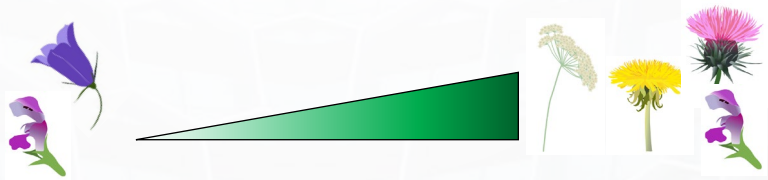
- Support both pollinators and pest predators
- Great benefits with minimal land use
- High-value strategy for farms

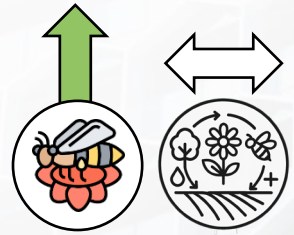
Semi-natural patch

- Support biodiversity
- Maximized co-benefits

Urban green area

- Good for awareness, but less for ecological functions





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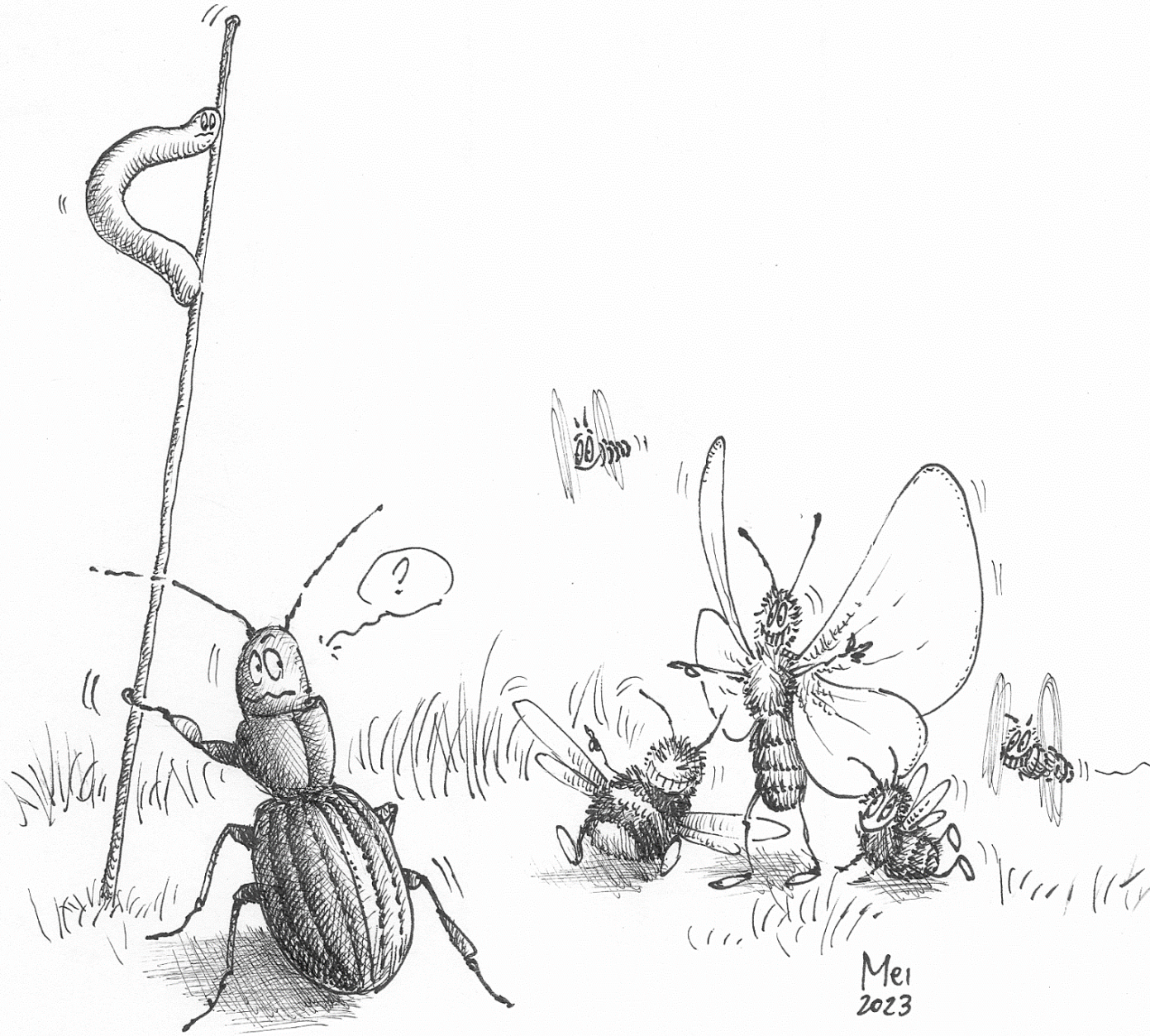
Safeguarding European wild pollinato

Thank you!

Andree Cappellari

andree.cappellari@unipd.it



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