

Insect Pollinators in Disturbed Landscapes: Ecological Patterns and Conservation Solutions

Dr. Grégoire NOEL, 01/26/2026

WEC Seminar



Acknowledgments



Prof. Ben Baiser



Prof. Eric C. Hellgren



Who am I?



Belgian citizen in scientific mobility in USA



Who am I?



Université Libre de Bruxelles

2015: Bio-engineer Msc in Agricultural Sciences



Université de Liège

2016-2023: PhD as Teaching assistant in the Entomology Laboratory

2023-2025: Researcher in the Entomology Laboratory

University of Florida

2025-2026: Postdoc fellowship



Some of my achievements



CHIBA UNIVERSITY

Prof. Ayako Nagase



Urban Forestry & Urban Greening 79 (2023) 127794



Contents lists available at ScienceDirect

Urban Forestry & Urban Greening

journal homepage: www.elsevier.com/locate/ufug



Prof. Scott MacIvor



Pollen meta-barcoding reveals different community structures of foraged plants by honeybees (*Apis mellifera* L.) along space-time gradient in Japan

Grégoire Noël^{a,1}, Arnaud Mestrez^{a,1}, Philippe Lejeune^b, Frédéric Francis^a, Junko Kawai^c, Masayuki Miwa^d, Koichi Uehara^c, Ayako Nagase^{c,*}

^a Functional and Evolutionary Entomology – Gembloux Agro-Bio Tech (University of Liège), Passage des Déportés 2, 5030 Gembloux, Belgium

^b TERRA Teaching and Research Centre (Forest is Life), Gembloux Agro-Bio Tech, University of Liège, Passage des Déportés 2, 5030 Gembloux Belgium

^c Graduate School of Global and Transdisciplinary Studies, Chiba University, 1-33 Yayoi-cho, Inage-ku, Chiba, Japan

^d Center for Environment, Health and Field Sciences, Chiba University, Kashiwa-no-ha 6-2-1, Kashiwa, Chiba, Japan



Arthropod-Plant Interactions (2025) 19:44
<https://doi.org/10.1007/s11829-025-10149-x>

ORIGINAL PAPER



Temporal dynamics of plant and fungal communities based on pollen sampled from honey bee hives in Southern Ontario, Canada

Alicia Decolle^{1,2} • Ayako Nagase² • J. Scott MacIvor³ • Bertanne Visser⁴ • Frédéric Francis¹ • Grégoire Noël¹

Received: 25 September 2024 / Accepted: 22 April 2025 / Published online: 10 May 2025
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Some of my achievements

PLOS ONE



RESEARCH ARTICLE

Planting date in South Kivu, eastern DR Congo: A real challenge for the sustainable management of *Spodoptera frugiperda* (Lepidoptera: Noctuidae) by smallholder farmers

Marcellin Cuma Cokola^{1,2*}, Grégoire Noël², Yannick Mugumaarhahama³, Rudy Caparros Megido², Espoir B. Bisimwa¹, Frédéric Francis²

¹ Faculty of Agriculture and Environmental Sciences, Department of Crop Sciences, Université Evangélique en Afrique, Bukavu, South Kivu, DR Congo, ² Functional and Evolutionary Entomology, Gembloux Agro-Bio Tech, Liege University, Liege, Belgium, ³ Faculty of Agriculture and Environmental Sciences, Unit of Applied Biostatistics, Université Evangélique en Afrique, Bukavu, South Kivu, DR Congo

* marcellin92cokolacuma@gmail.com, m.cokola@uliege.be



Ms. Tia Finaritra Ravalison



Prof. Marcellin Cokola Cuma



Fall armyworm

Some of my achievements

Building **the first** numerical entomological collections in Madagascar

<https://zabibikely.odoo.com/>



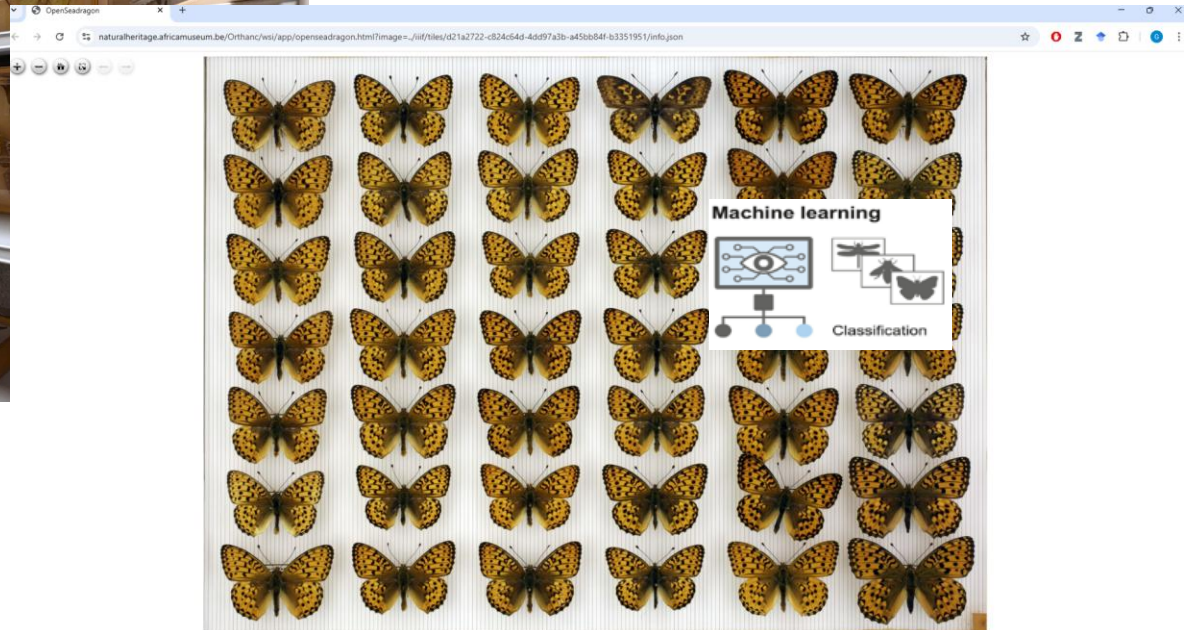
Trachelophorus giraffa (Jekel, 1860)



Some of my achievements

Scientific coordination

Digitization of Gembloux Agro-Bio Tech Insect collections (~ 10k boxes;
6 millions of specimens)





Apoid wasp

Let's begin !



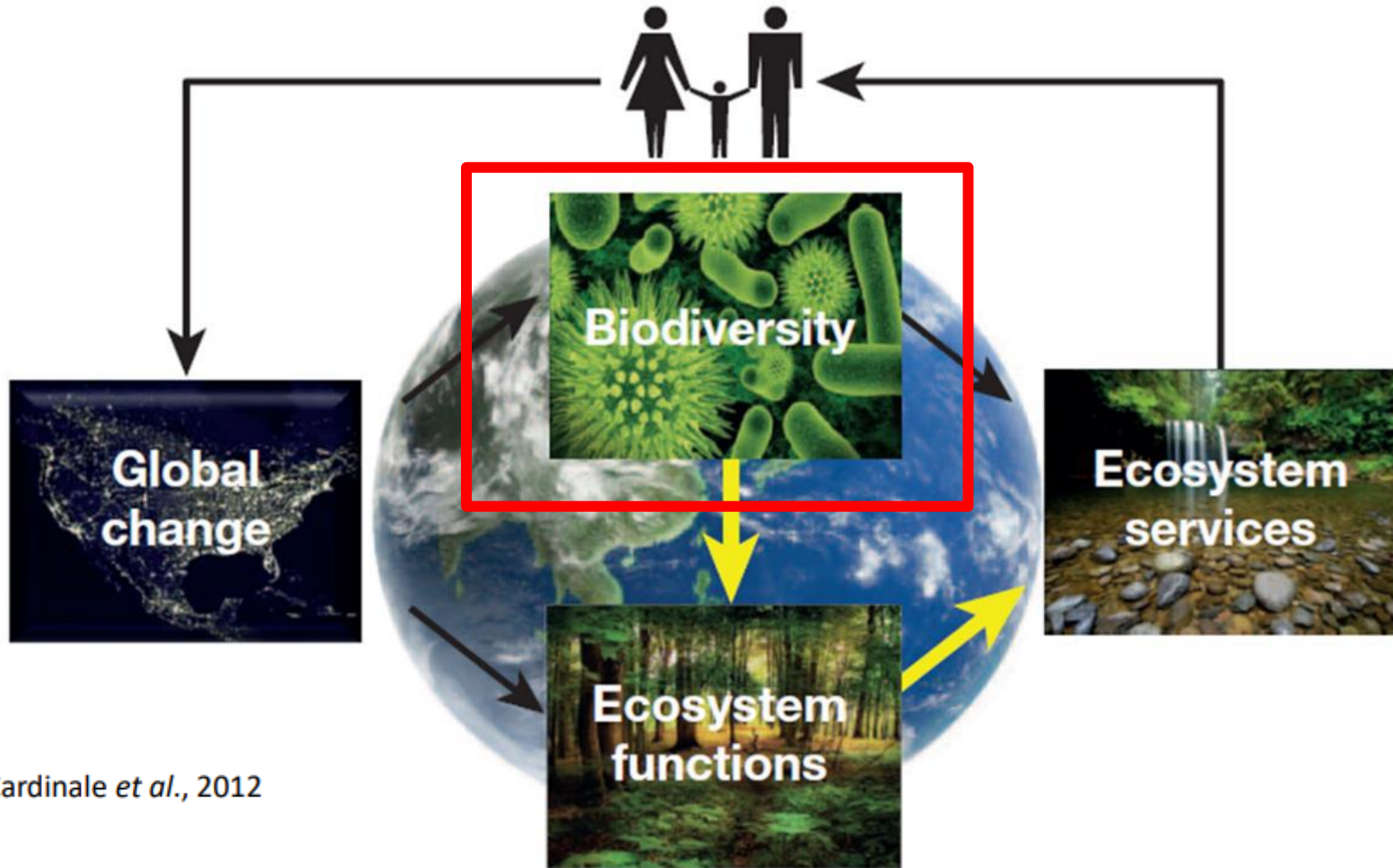
Wild bee

Hoverfly



Biodiversity collapse

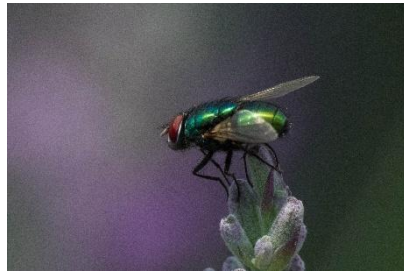
Biodiversity collapse



Cardinale *et al.*, 2012

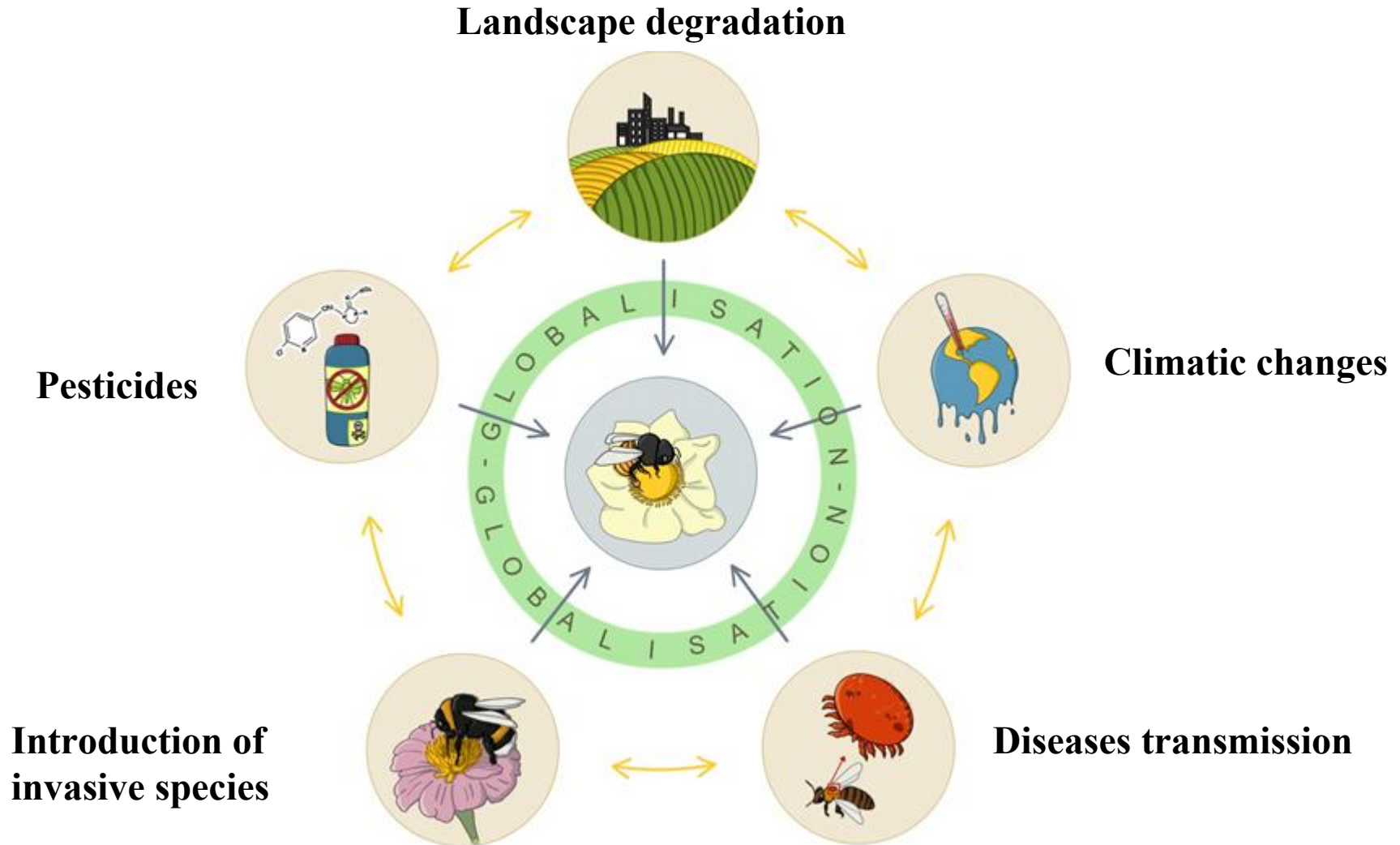


Biodiversity ?



Pictures @ H. Luttenschlager
& J. Mignon

Insect pollinator decline is multifactorial !



Noël G. *et al.*, 2018

<https://popups.uliege.be/2030-6318/index.php?id=4096>

Landscape degradation



Depletion in floral
resources

Depletion in nesting sites

Potts S. et al., 2010



Halictus scabiosae (Rossi 1790)

Pollen



Andrena cineraria (L.)

Nectar



Andrena vaga Panzer 1799

Underground



Osmia cornuta (Latreille 1805)

Aboveground

Crédit photo @ J. Bonnet & @
G. Noël



Pollination

What is it ?

Ecosystem service =

153 billion €/year (World)
Value from 2005, Gallai *et al.* 2009

252 million €/an (Belgium)
Value from 2010; Jacquemin *et al.* , 2017

Bonnet (2020)

*Andrena
haemorrhoides*
J. Bonnet

The diversity of insect pollinators

Hymenoptera



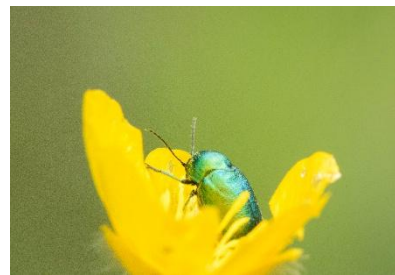
Diptera



Lepidoptera



Coleoptera



The protagonists

Bees

400+ sp. in Belgium
2000+ sp. in Europe
20 000+ sp. in World

Vegan diet

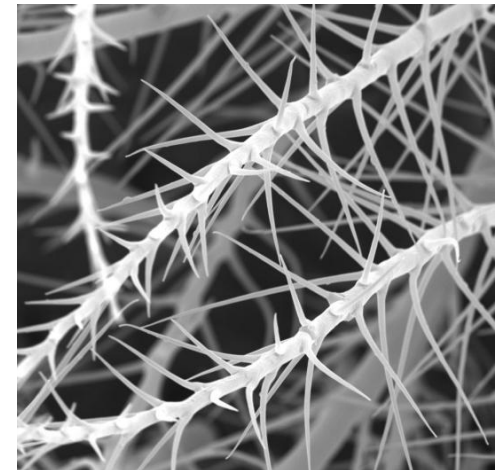
Generalist (Polylectic)



Specialist (Oligolectic/Monolectic)



Bryonia dioica

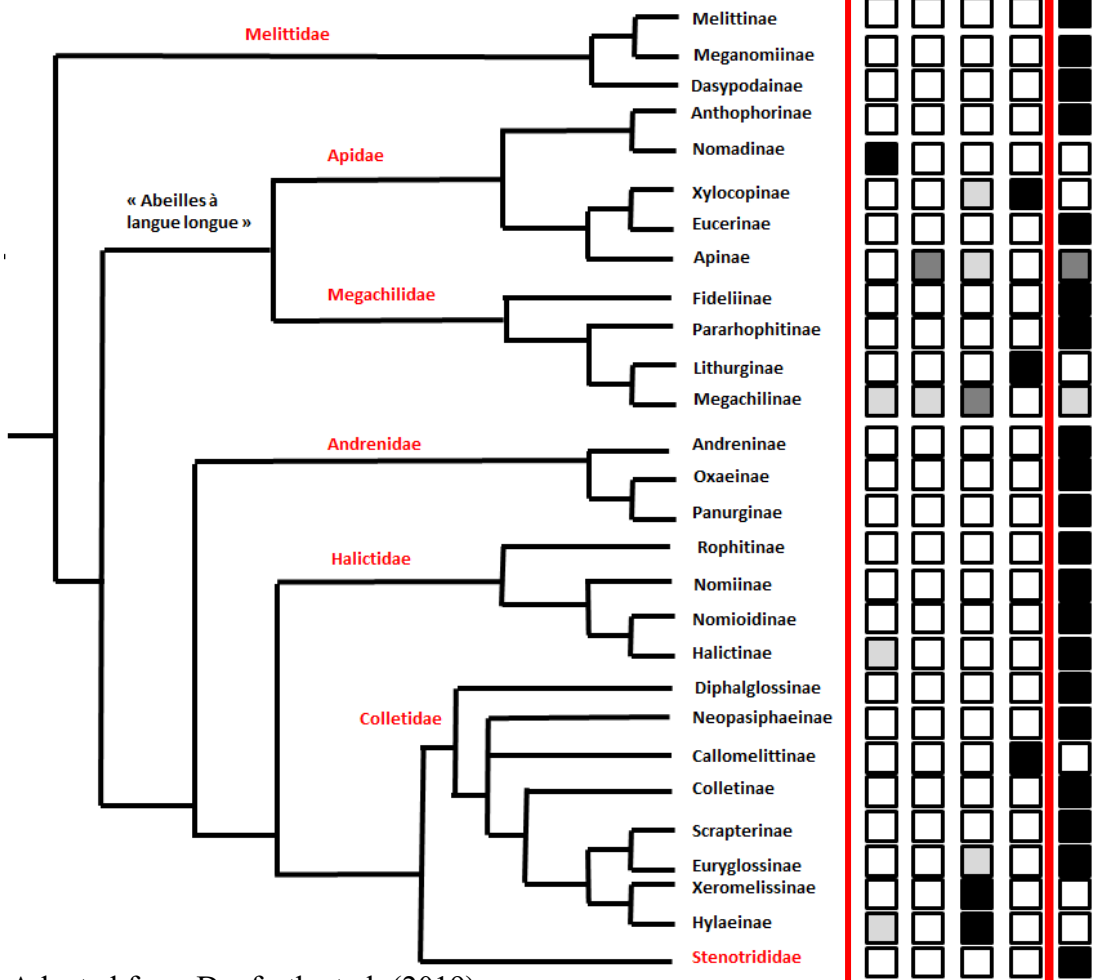


Pictures @ H. Luttenschlager and A. Pauly
(2022)

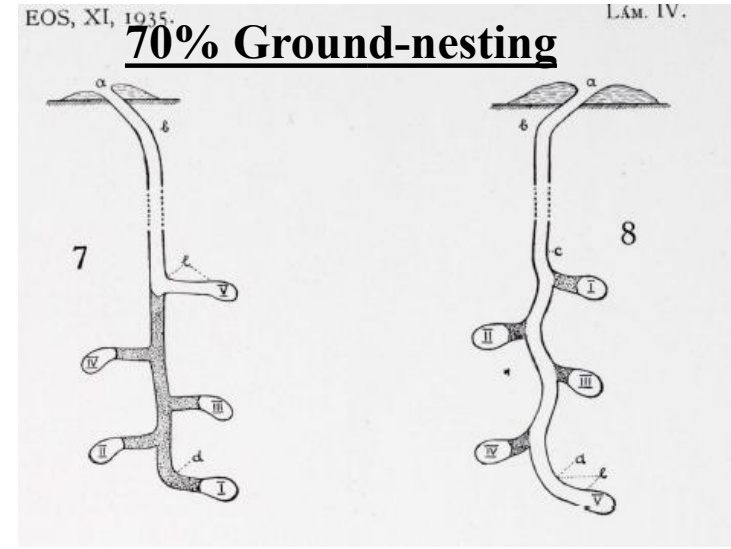
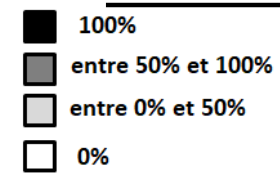
The protagonists

Bees

Nesting strategies



~25% Above ground nesting



Malyshev (1935)

Adapted from Danforth et al. (2019)

The protagonists

Hoverflies

357+ sp. in Belgium

6000+ sp. in World

Multiple ecosystem services → distinct roles related to the individual stage !



Epsirphus balteatus De Geer

Eristalis sp.



The protagonists

Apoid wasps

199+ sp. in Belgium

Ecosystem services:

- Pollinator at adult stage
- Biological control by predatory to feed their offspring



Philanthus triangulum

Presentation structure

4 study cases based on field assessments in disturbed landscapes

Agricultural Environments

1. The effects of local farmsteads at the beginning of their ecological transition on the wild bees and hoverfly biodiversity
2. The effect of customized flower-strips in intercropping systems on the wild bees and hoverfly biodiversity



Pollinators



Urban Environments

3. The effect of habitat diversification of a natural reserve in Capital of Belgium on the wild bees and hoverfly biodiversity
4. The effect on impervious surface such as pavement on nesting sites for Apoidea species?

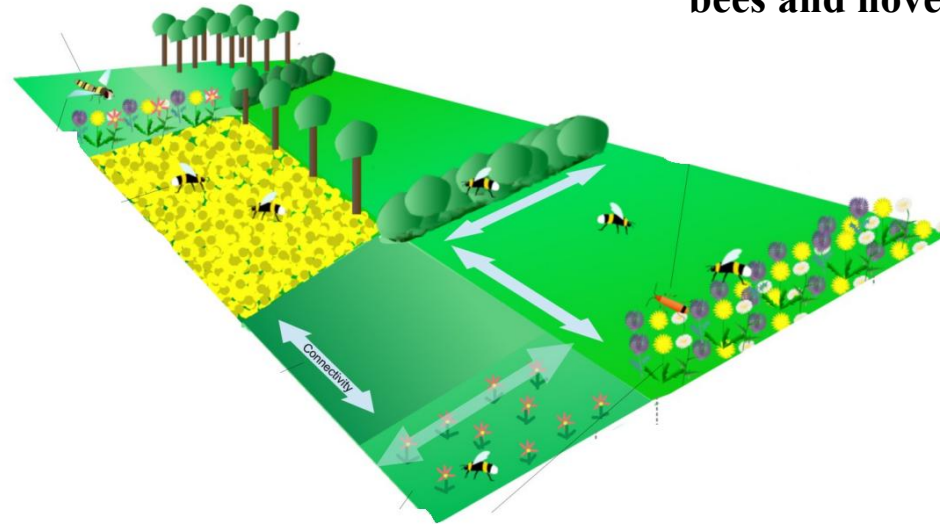
1) Distribution of wild bee and hoverfly communities within farms undergoing ecological transition



Farmstead in their beginning of ecological transition

- Agroecology can be an alternative
 - Habitat diversification
 - Impact at which spatial and temporal scales ?

Do local farmsteads at the beginning of their ecological transition promote wild bees and hoverfly diversity?



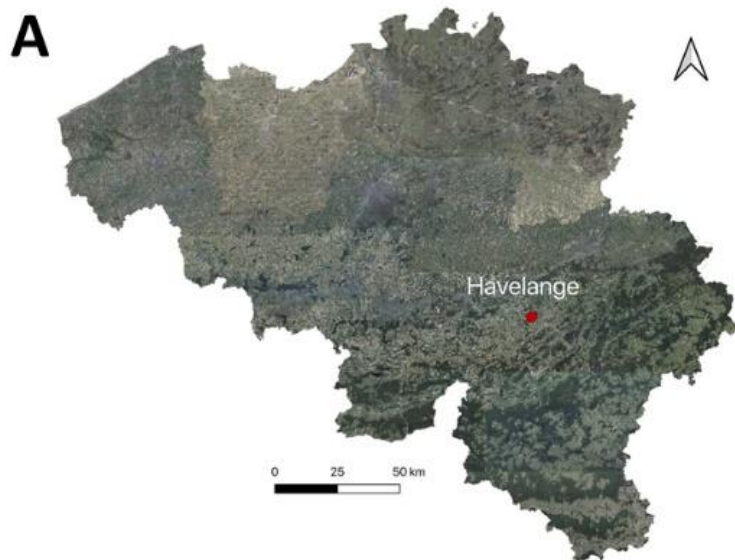
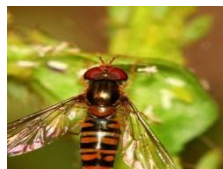
Nomada sp.
J. Bonnet

Experimental design – Temporal and spatial scales

- Sampling effort over 2 years 2018-2019



Pollinators

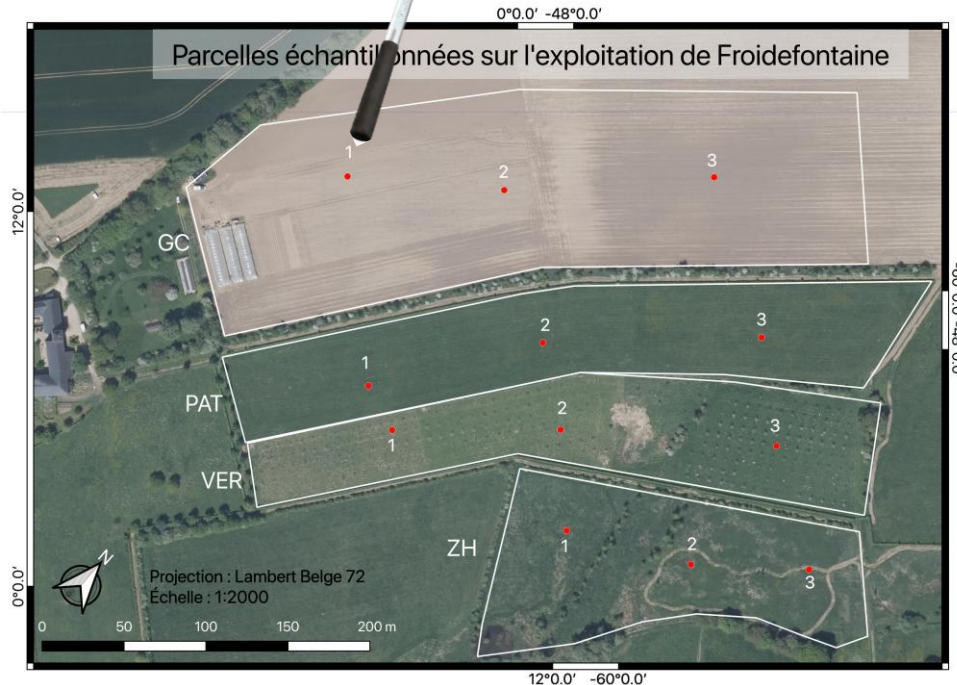


Experimental design – Collection methods

Pollinators



Colored pantraps



→ Complementarity

Experimental design – Habitat diversification

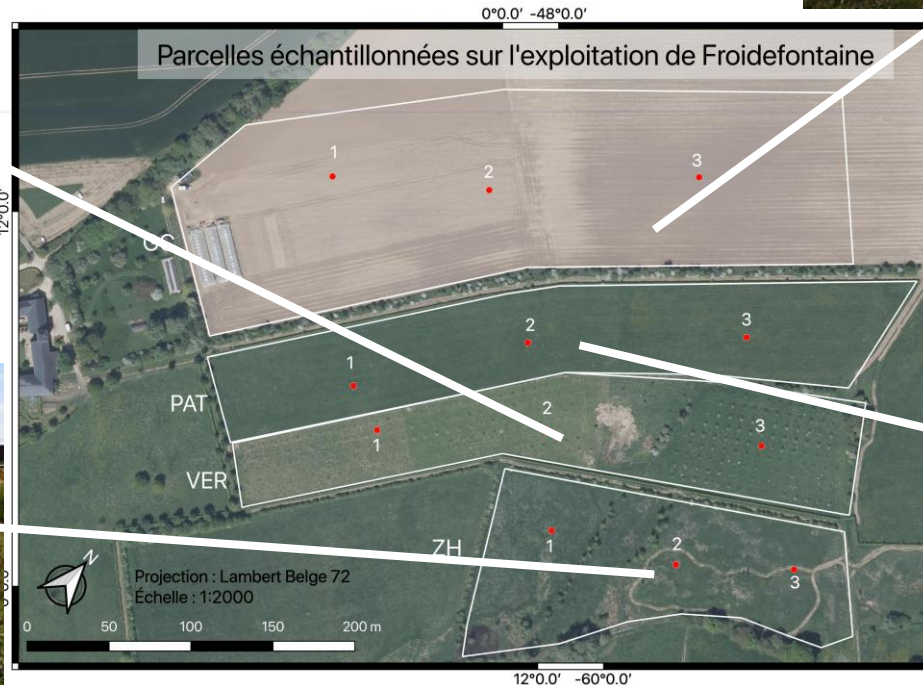
Pollinators



Crop (GC) – A. Danel



Orchard (VER) – J. Bonnet



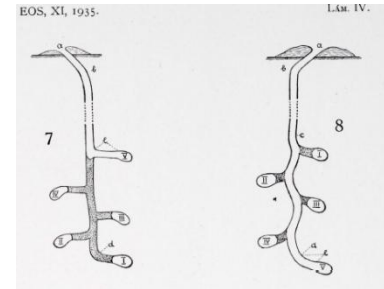
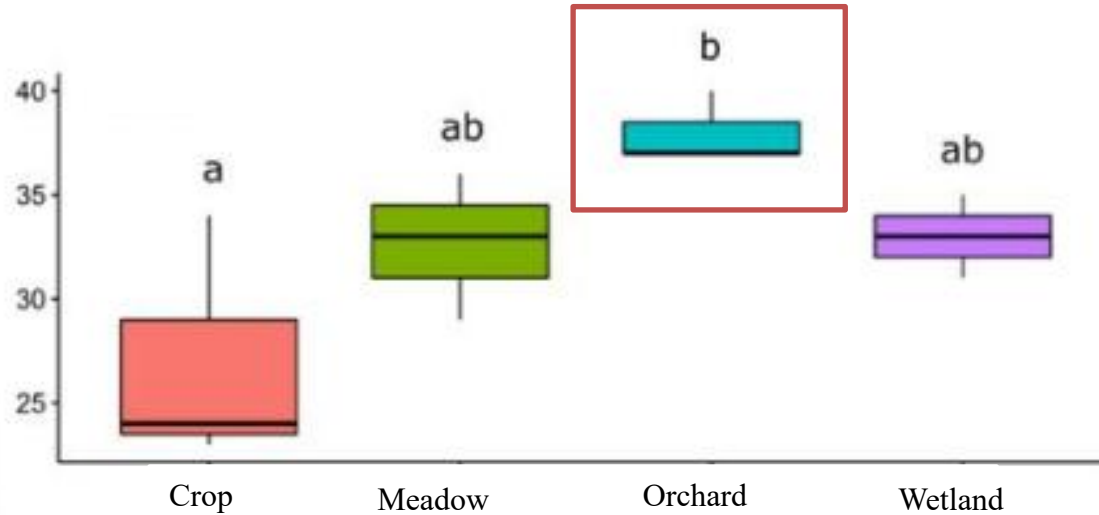
Meadow (PAT)
– J. Bonnet



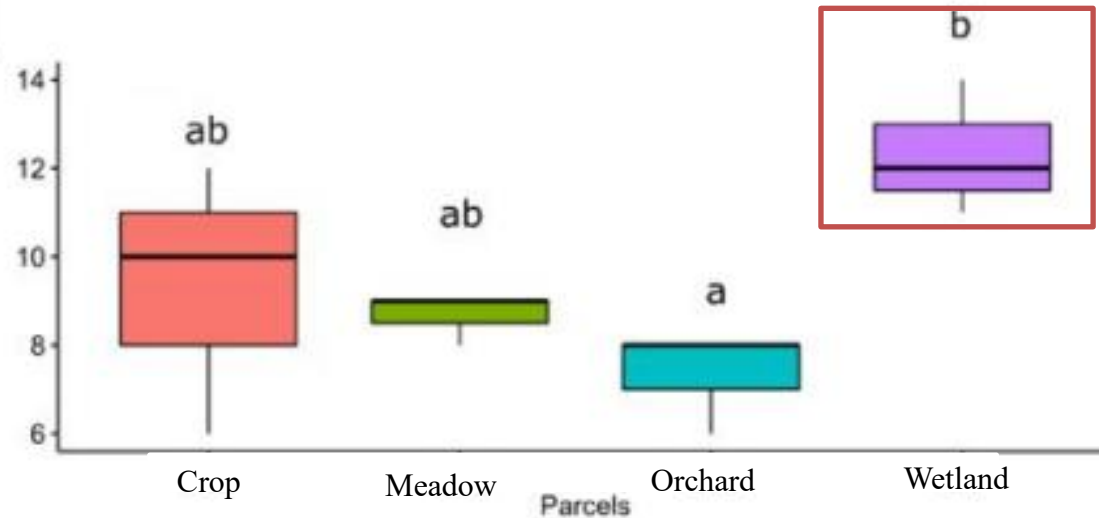
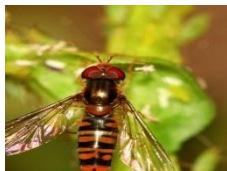
Wetland (ZH) – A. Danel

Results

- 4,303 bees and 1,998 hoverflies specimens
- 92 + 9 bee species (94% polylectic, 5,1% cuckoo, 0,9% oligolectic) and 31 hoverfly species (100% polylectic)



Species richness



Results – Wild bees

- ~ 1/4 of the national bee diversity (i.e., ~ 400 bee species)

Common species

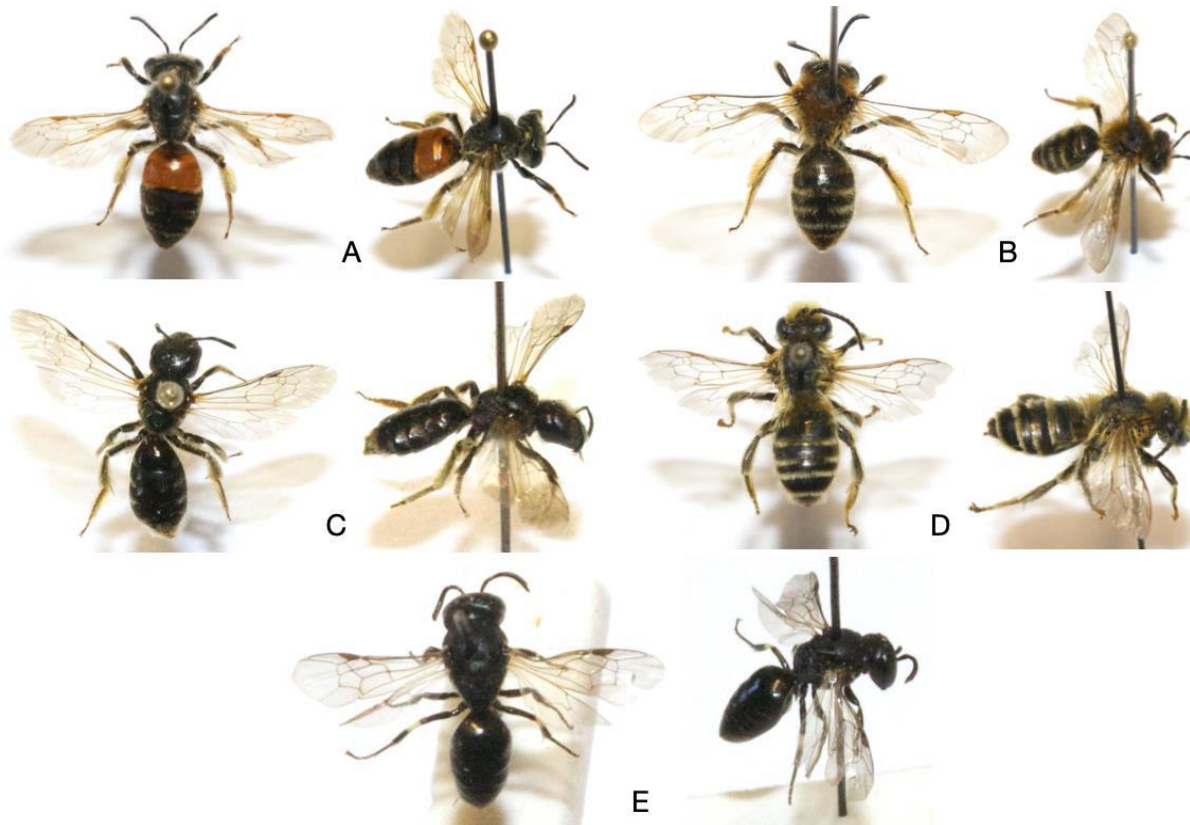
60 %

Andrena cineraria
Andrena haemorrhoa
Andrena flavipes
Andrena nitida
Lasioglossum calceatum
Lasioglossum pauxillum



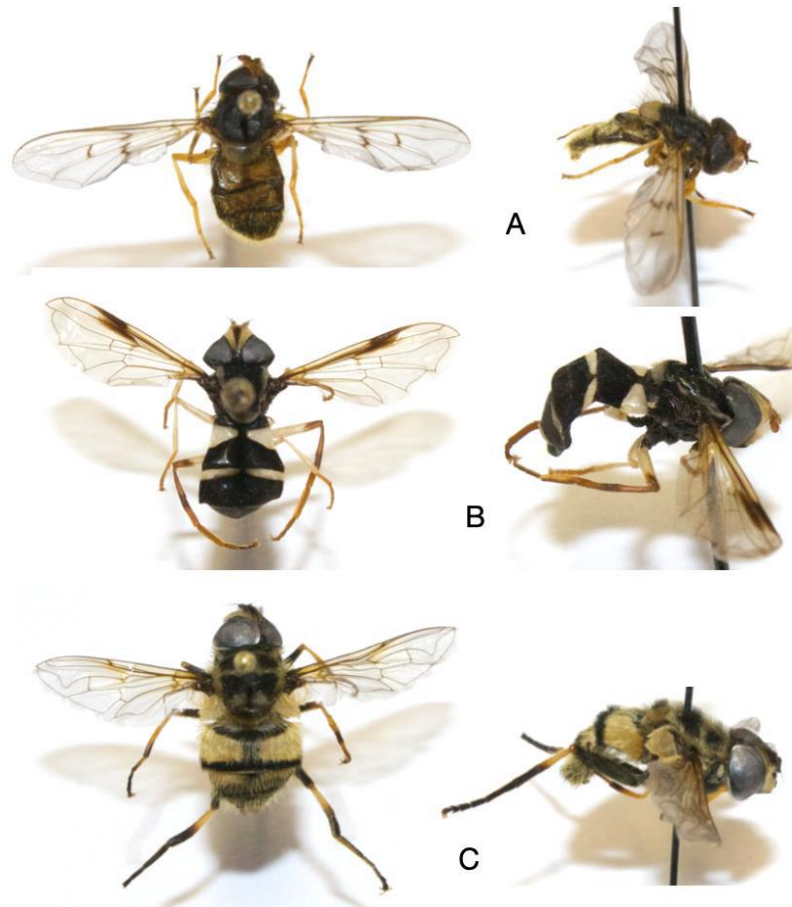
Results – Wild bees

- Uncommon, rare polylectic species were sampled
- Specialist species = 13 species, 24 specimens



Results – Hoverflies

- *Sphaerophoria scripta*, *Eristalis tenax* and *Episyrphus balteatus* ~ $\frac{3}{4}$ of total abundance
- Some uncommon syrphids : *Xanthogramma pedissequum*, *Myathropa florea*, *Ferdinandea cuprea*



Impact of agroecological transition

- High diversity of the wild bees and hoverflies at the early stage of the farm transition
- Some conserved species are rare or red-listed
- Good observation station



Pollinators



2) Flower strips in wheat intercropping system



Introduction

PNAS

RESEARCH ARTICLE

AGRICULTURAL SCIENCES

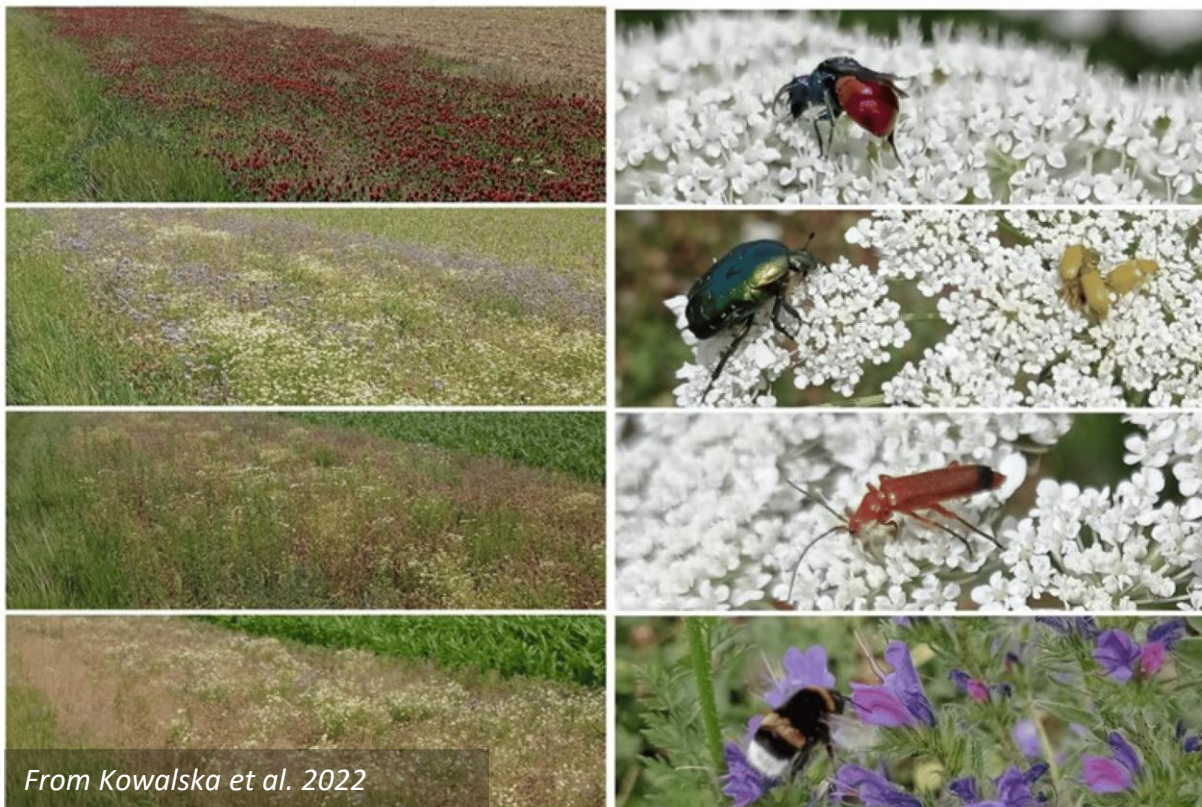
OPEN ACCESS



Complex agricultural landscapes host more biodiversity than simple ones: A global meta-analysis

→ **How to design the flowerstrips ?**

Estela Estrada-Carmona¹, Andrea Sánchez^a, Roseline Remans^b, and Sarah de Groot^a
Cite by: Aun Agawal, University of Michigan Ann Arbor, Michigan, MI, United States, February 24, 2022, accepted July 1, 2022



From Kowalska et al. 2022

(A)

(B)

Flower strips in wheat intercropping system

How customized flower strips in intercropping systems influenced wild bee and hoverfly communities?



Floral resources

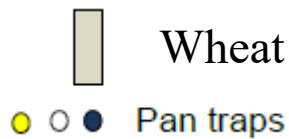
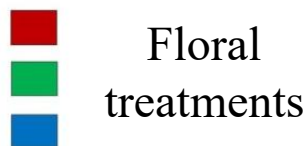
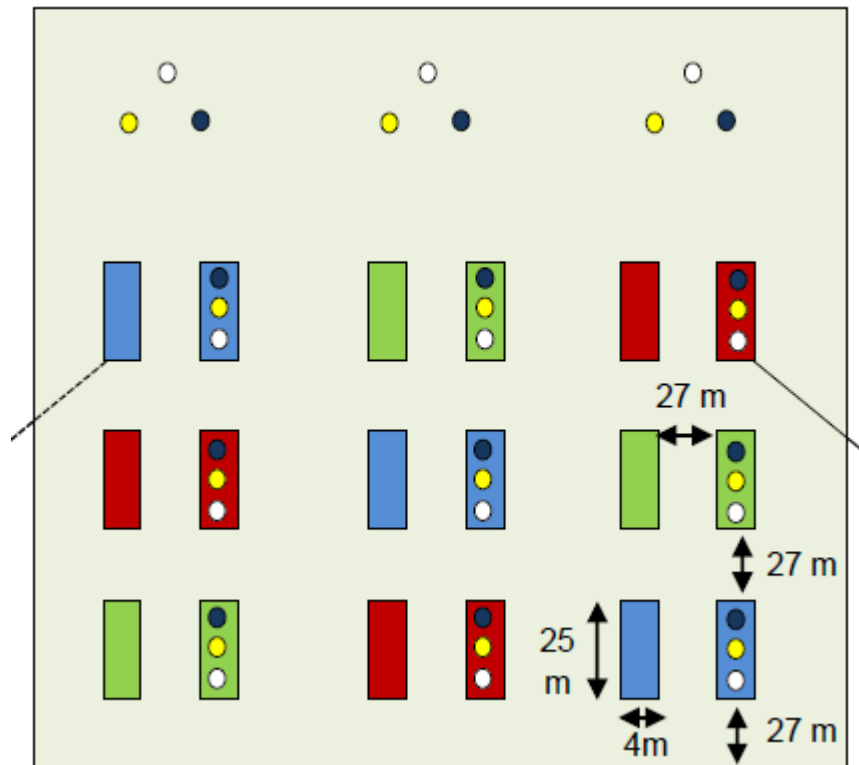


Pollinators

Experimental design

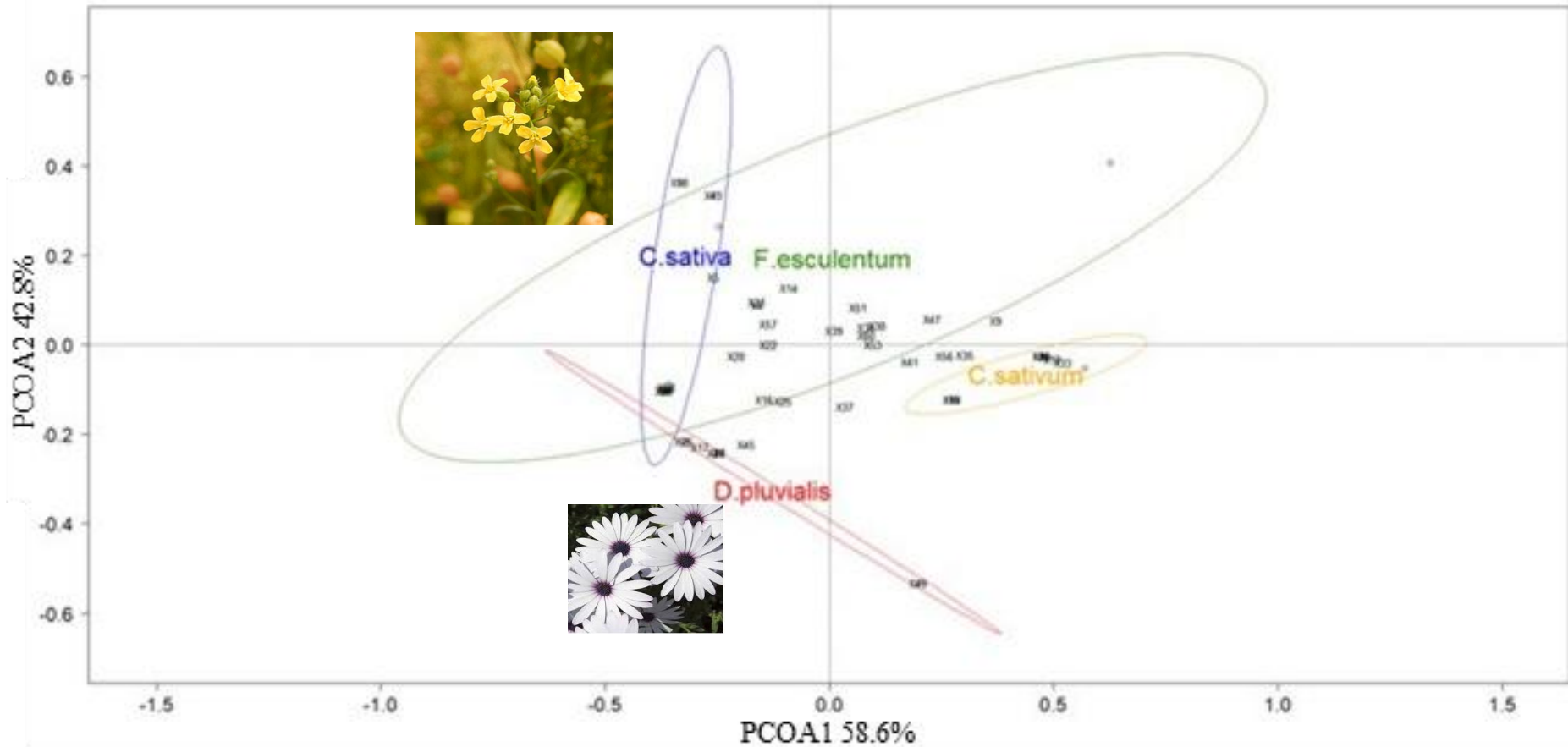
Study Site :

Setting of flower stripes in fields with different floral applications:
2 monospecies treatment (1,2) and 1 multispecies treatment (3)
From May to July 2017



Results

- 1184 pollinator individuals belonging to 61 species: 18 species were hoverflies (583 individuals) and 43 species were bees (601 individuals).



Intercropping systems



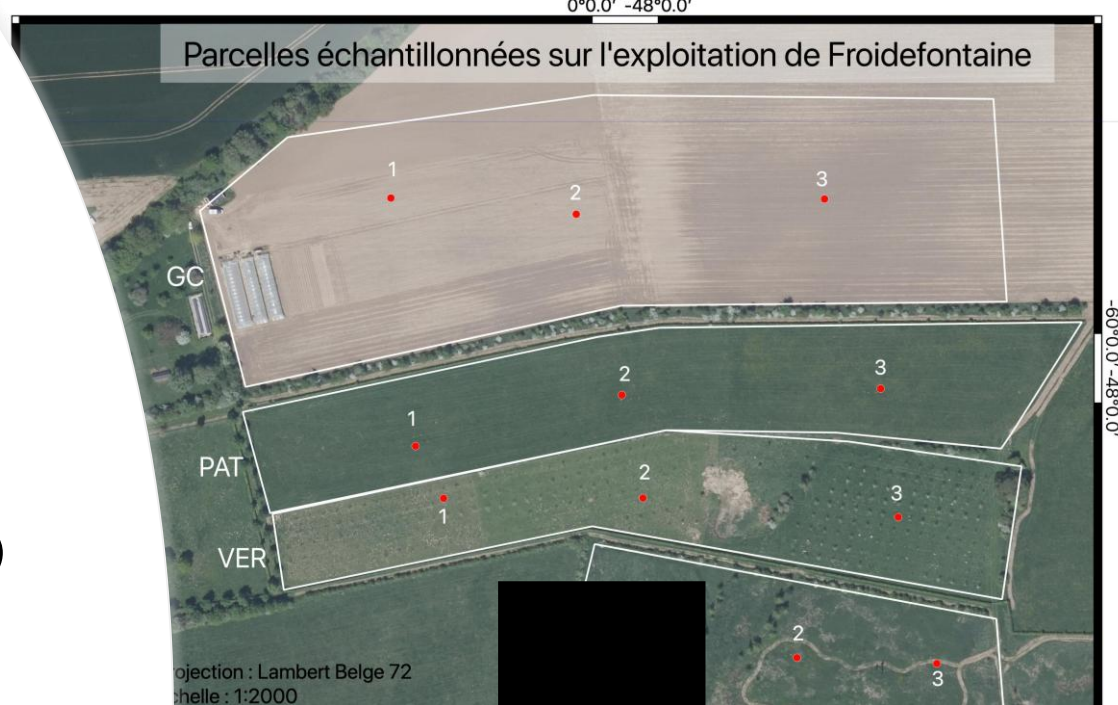
Floral resources



Pollinators

- Attract pollinators and some which are under conservation status
- Diversity of flower attract their own communities

Switch from agricultural to urban environment

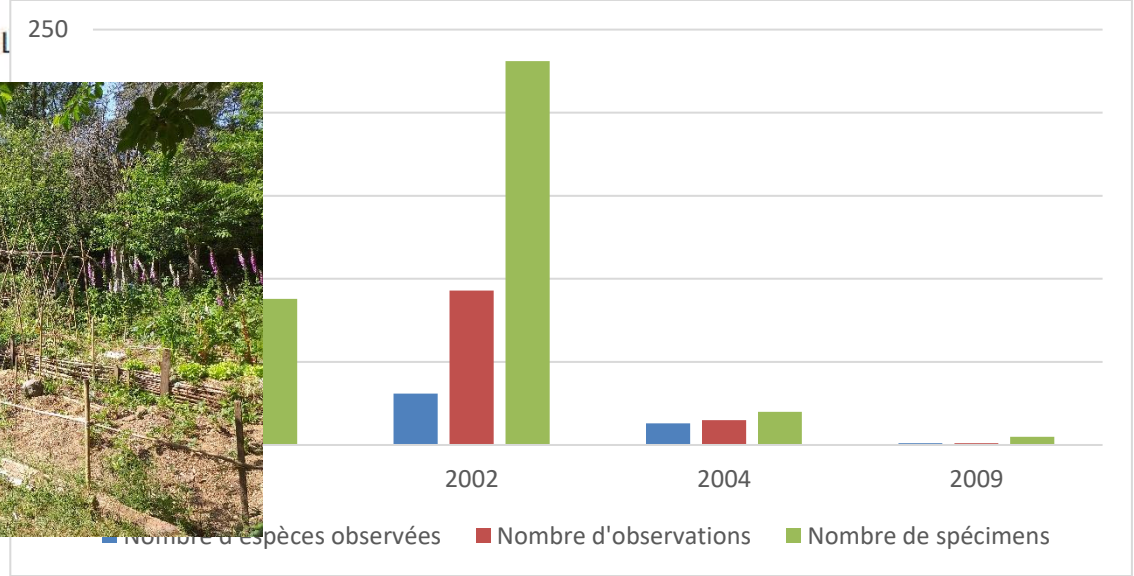


Water(Gator)-Break

3) Distribution of wild bee and hoverfly communities within a natural reserve of city-capital



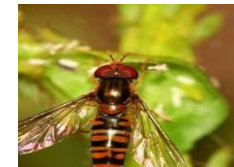
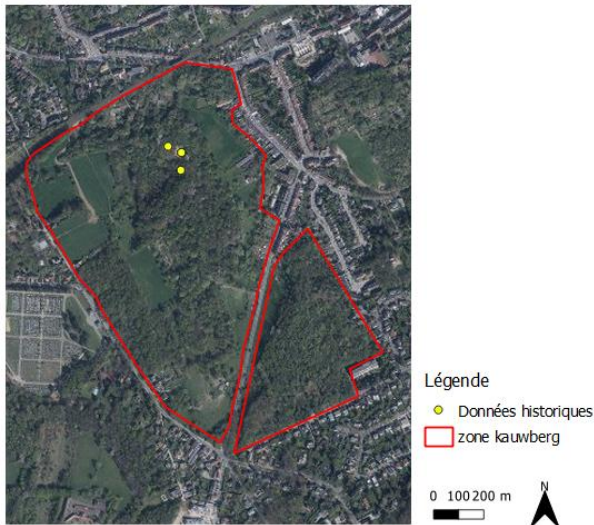
History of the site



Wild and known community gardens

Natural reserve in Brussels

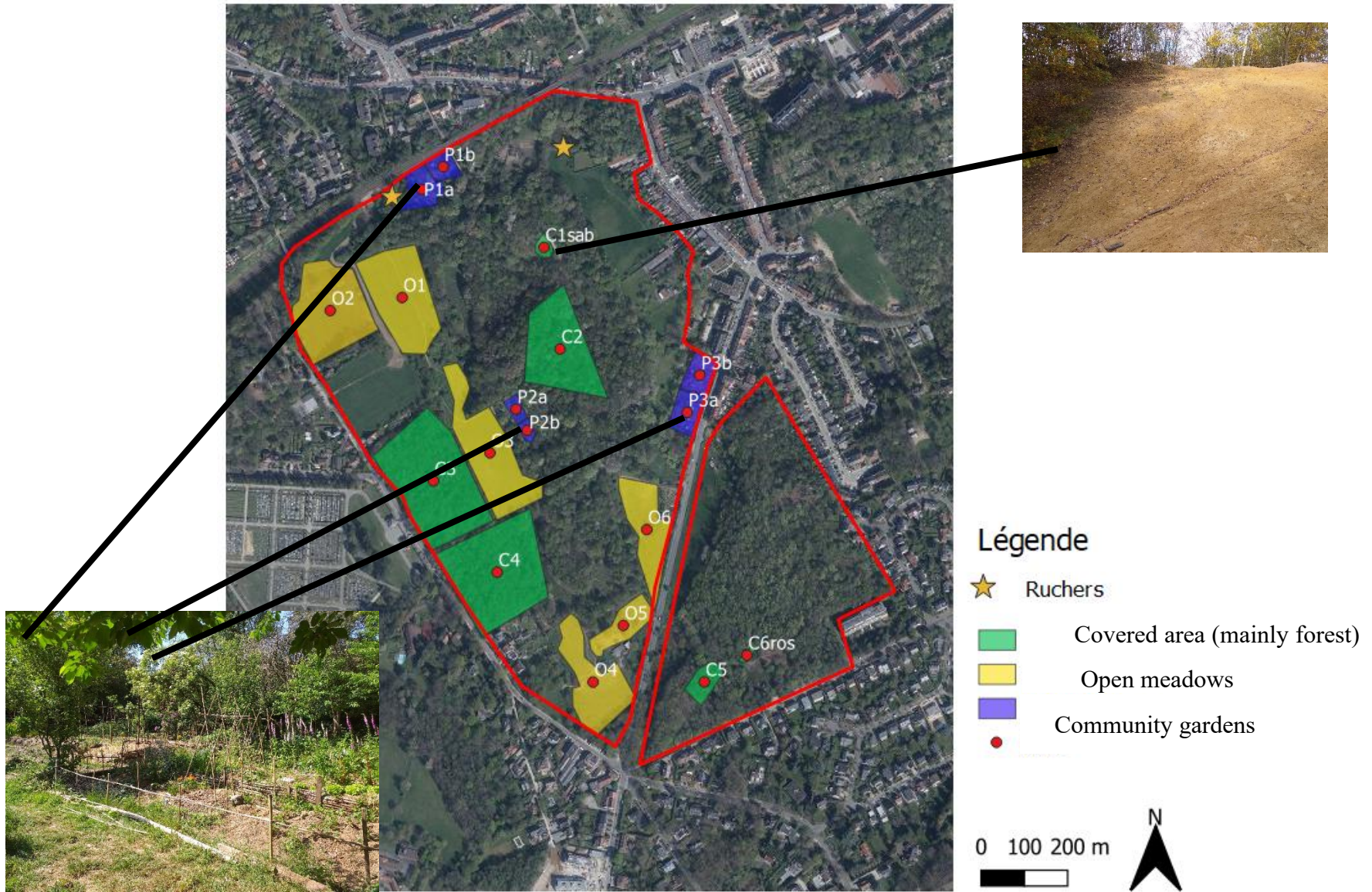
**How the communities of wild bees and hoverflies
are organized in a natural reserve for Brussels ?**



Landscape heterogeneity

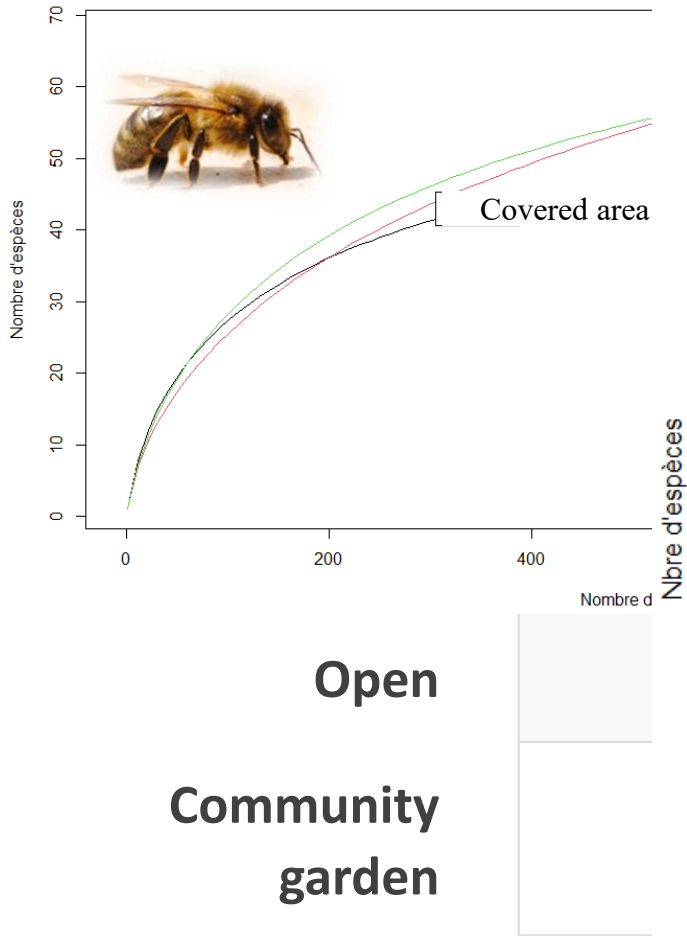
Pollinators

Experimental design – Deep Sampling

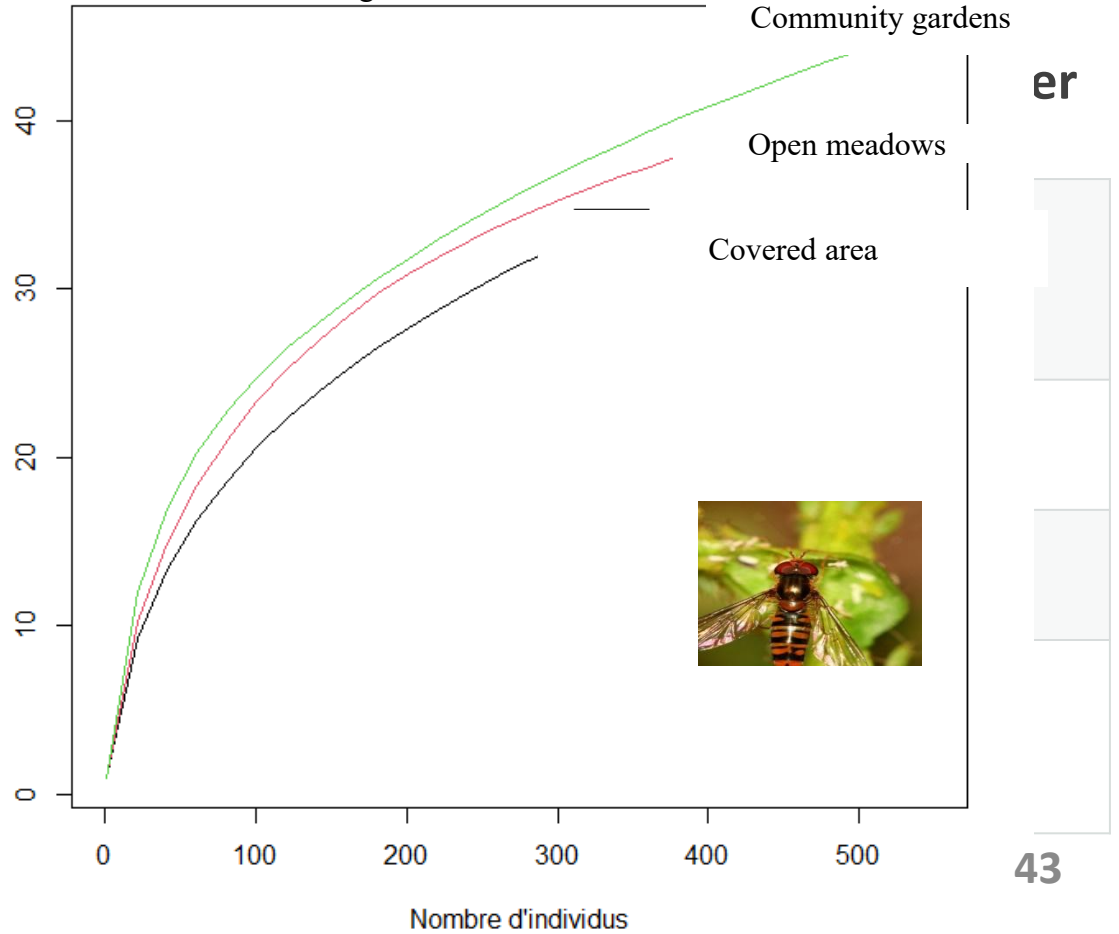


Results for all pollinators

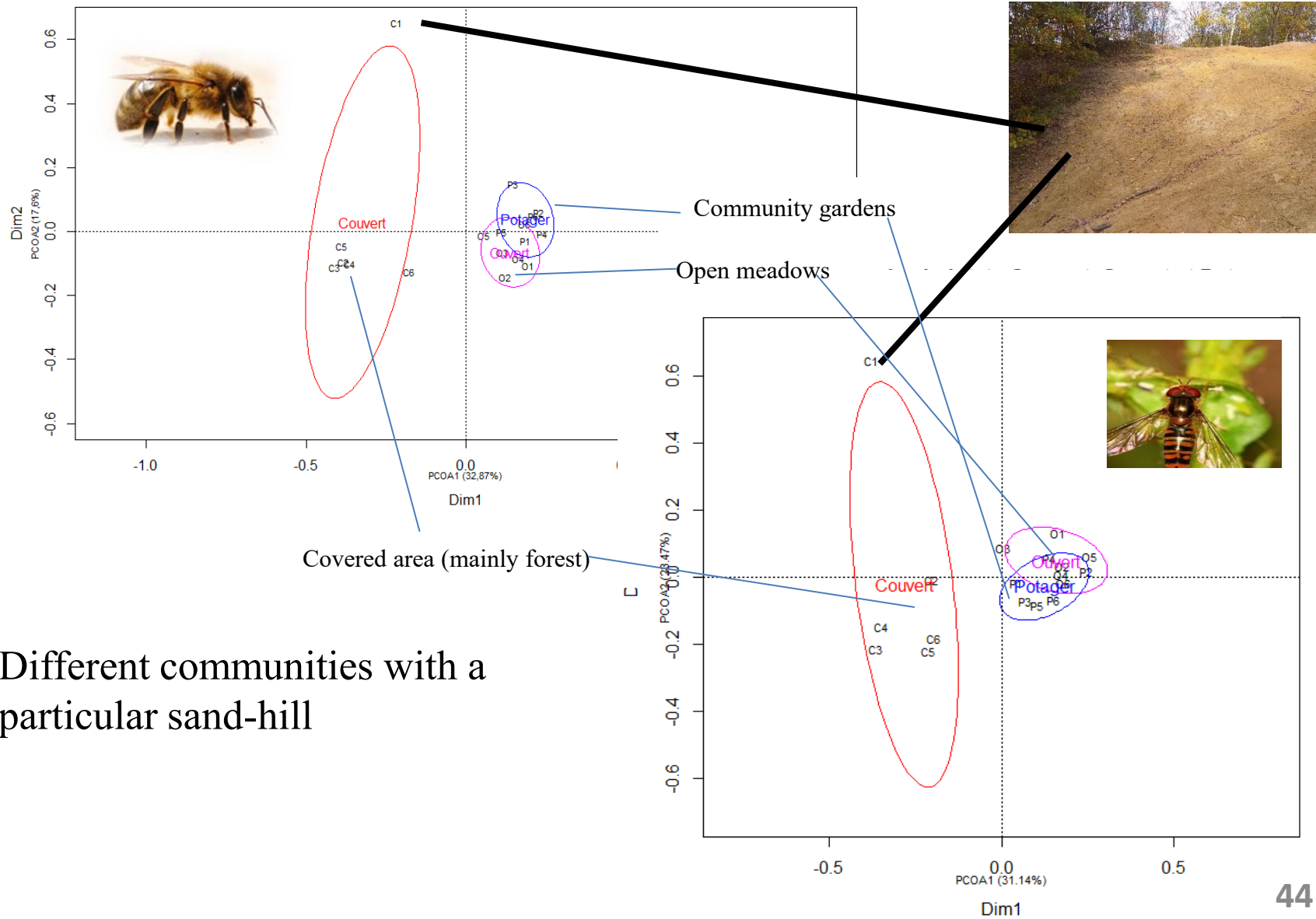
Courbe de rarefaction par habitat (2020)



Open meadows
Community gardens
Covered area



Results – Similar patterns for bees and hoverflies



- Different communities with a particular sand-hill

Application to conservation



Sand-hill protection of the natural reserve



Andrena vaga



Community garden to preserve inside the natural reserve



Halictus scabiosae



4) The role of urban pavement as nesting site for wild bees and apoid wasps



Urban areas= « impervious for biodiversity/ ecologically poor »?

OPEN ACCESS Freely available online

PLOS ONE

Decreasing Abundance, Increasing Diversity and Changing Structure of the Wild Bee Community (Hymenoptera: Anthophila) along an Urbanization Gradient

Laura Fortel^{1*}, Mickaël Henry^{1,2}, Laurent Guilbaud¹, Anne Laure Guirao¹, Michael Kuhlmann³, Hugues Mouret⁴, Orianne Rollin^{2,5}, Bernard E. Vaissière^{1,2}



Conservation Biology



Essay

The city as a refuge for insect pollinators

Damon M. Hall,^{1*} Gerardo R. Camilo,² Rebecca K. Tonietto,¹ Jeff Ollerton,³ Karin Ahrné,⁴ Mike Arduser,⁵ John S. Ascher,⁶ Katherine C. R. Baldock,⁷ Robert Fowler,⁸ Gordon Frankie,⁹ Dave Goulson,⁸ Bengt Gunnarsson,¹⁰ Mick E. Hanley,¹¹ Janet I. Jackson,³ Gail Langellotto,¹² David Lowenstein,¹² Emily S. Minor,¹³ Stacy M. Philpott,¹⁴ Simon G. Potts,¹⁵ Muzafar H. Sirohi,³ Edward M. Spevak,¹⁶ Graham N. Stone,¹⁷ and Caragh G. Threlfall¹⁸

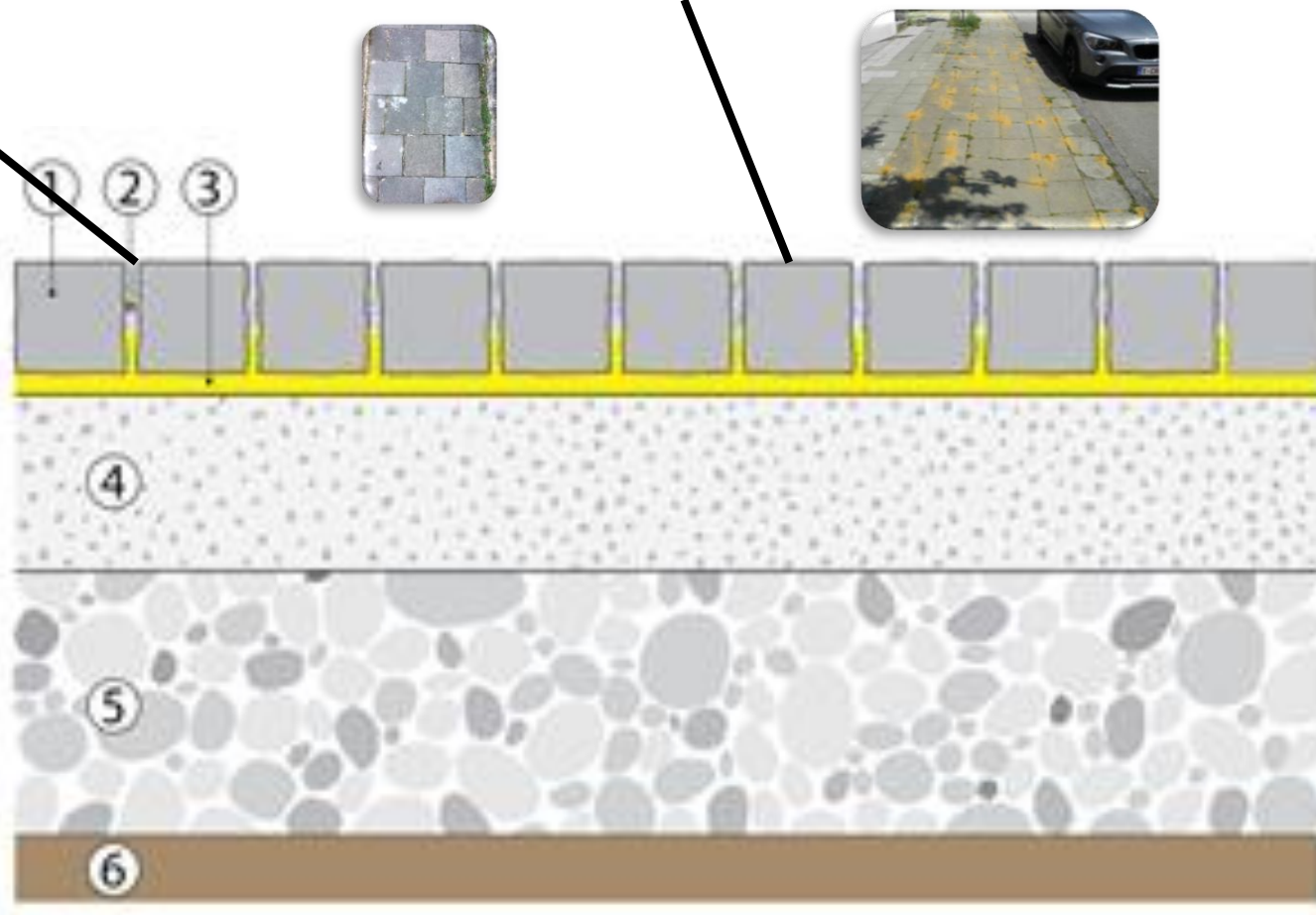


What is a pavement « of Brussels » ?

Joint

Pavement = Concrete slab or sandstone setts

Sand foundations in different layers, with different textures



Pavements in Brussels

Can the pavements of a big city can promote the biodiversity of ground-nesting pollinators ?

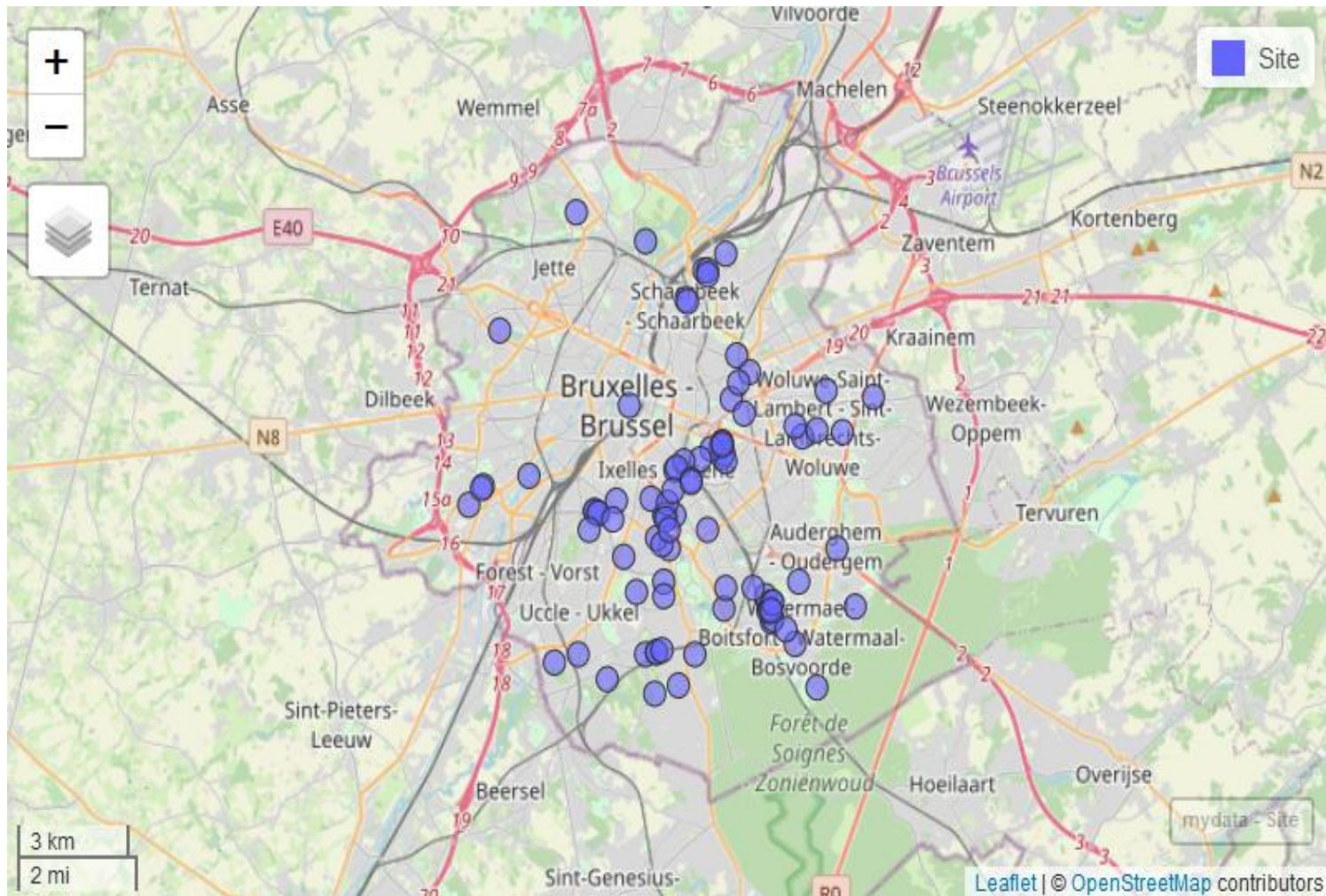


« New » nesting sites

Pollinators

49

Map – Citizen-science site



Discovery



OMG !



Results

- 22 species



Philanthus triangulum



Andrena vaga



Lindeniuss pygmaeus

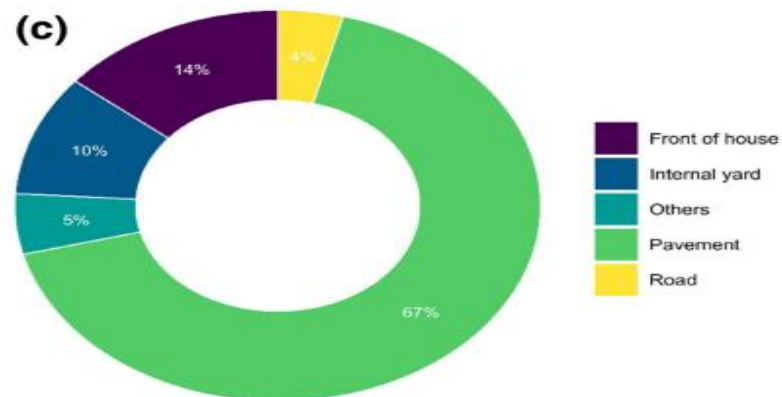
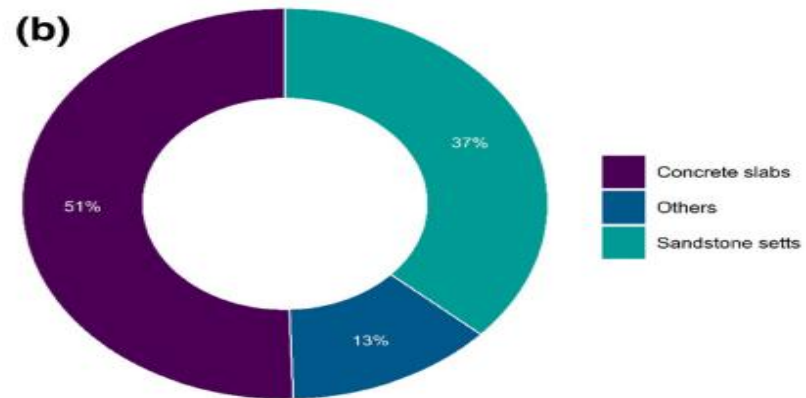
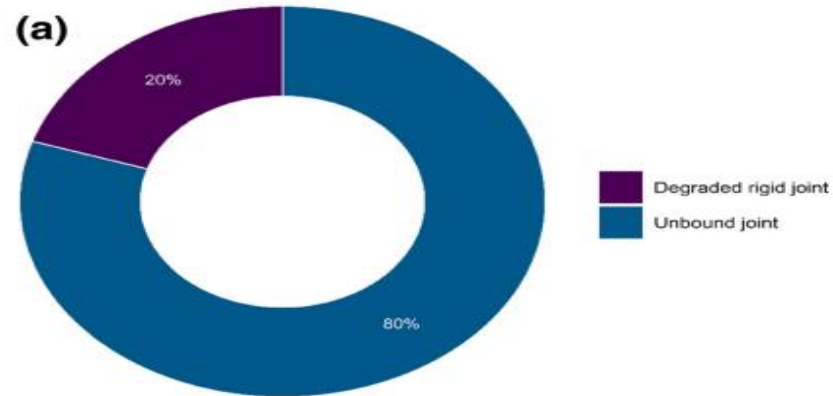


Cerceris arenaria



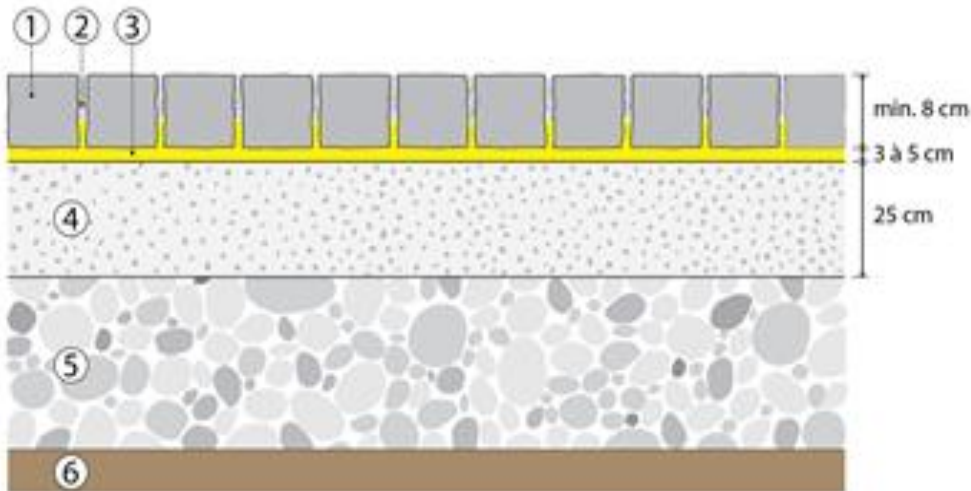
Lasioglossum fulvicorne

Pavements features

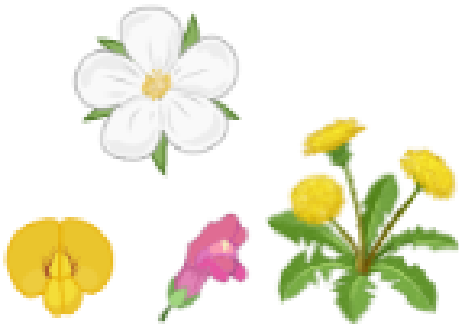


Study specifications

- Concrete slabs or sandstone pavers with unbound joint of 1 cm + urban specifications
- Insufficient comfort level → Potential urban redevelopment
- Communication campaigns for **multifunctional/hybrid pavement**



Summary and take-home message



Summary – Conservation Solutions

Agricultural Environments

1. Agroecology is proven to be in favor of insect pollinator by the diversification of habitats
2. Flower-strip in intercropping is already a solution to favor pollinator; the question is to develop their efficiency in an agriculture 2.0.
3. Keeping natural reserve with heterogeneity of habitat in cities can favor the insect pollinator biodiversity
4. Urban construction such as pavement can be “re-designed” to become more suitable nesting sites for insect biodiversity

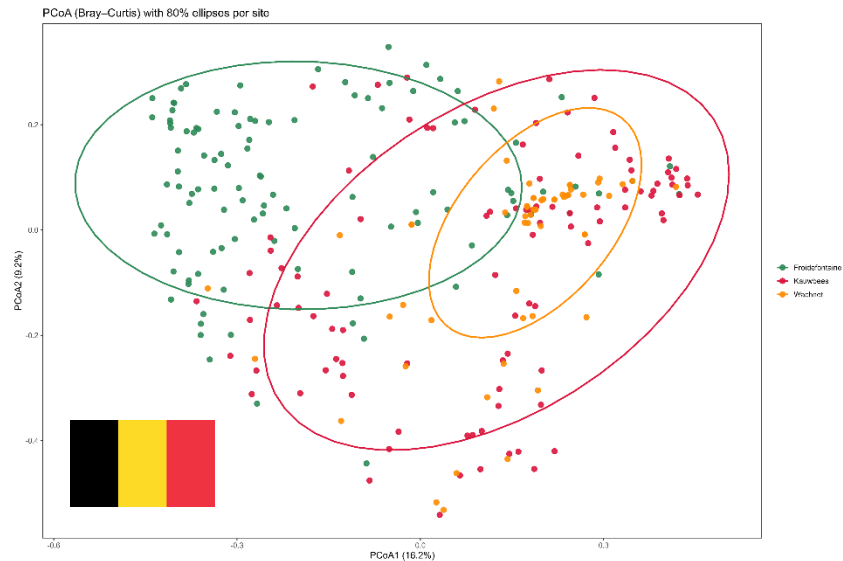
Urban Environments

Take-home messages

- Low spatial coverage study but deep sampling
 - ➔ Discovering species which are in conservation status (thank to our red-lists)
- Interesting heterogeneity of habitats at these low spatial scales
 - ➔ High biodiversity compared to other study
- “Biodiversity inherently seeks solutions; our responsibility is to optimize the conditions for its success”

What's next for me !

Syrphid's eden garden Project



Sand-hill insect pollinators project



Credit picture @ Rob Meyer & Robert Emond

- Improve my skills to leverage “big data” from GBIF or Inaturalist
- Expand my analytical skills in community ecology

I would thank all people who were included in the study cases

Prof. Frédéric Francis
Clara Amy
Alix Calderan
Sylvain Everaerts
Anouk Daneels
Violette Van Keymeulen
Julie Bonnet
Marie Lamarre
Pauline Crasson
Enora Flamion
Jeannine Bortels
Ottavia Chiandotto
Alain Pauly
Alexis de Liedekerke



Prof. Frédéric Francis

Université de Montpellier d'Annevoie
Thomas James Wood
Frank Van de Meutter
Laurent Sertheyn
Dr. Yvan Barbier
Sylvie Smets
Olivier Van Damme
Dr. Sophie Lokatis
Dr. Séverin Hatt
Dr. Roel Uyttenbroeck
Julien Ruelle

Thank you for your attention !

