

L'IMPACT DES PRATIQUES AGRICOLES EN SYSTÈME BIOLOGIQUE ET CONVENTIONNEL SUR LES CHAUVES-SOURIS :

zoom sur la réduction du travail du sol et de l'usage d'herbicides



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**Muséum
national
d'Histoire
naturelle**



Agrosciences • Ecologie des Territoires • Alimentation

île de France



Agricultures, Filières, Territoires



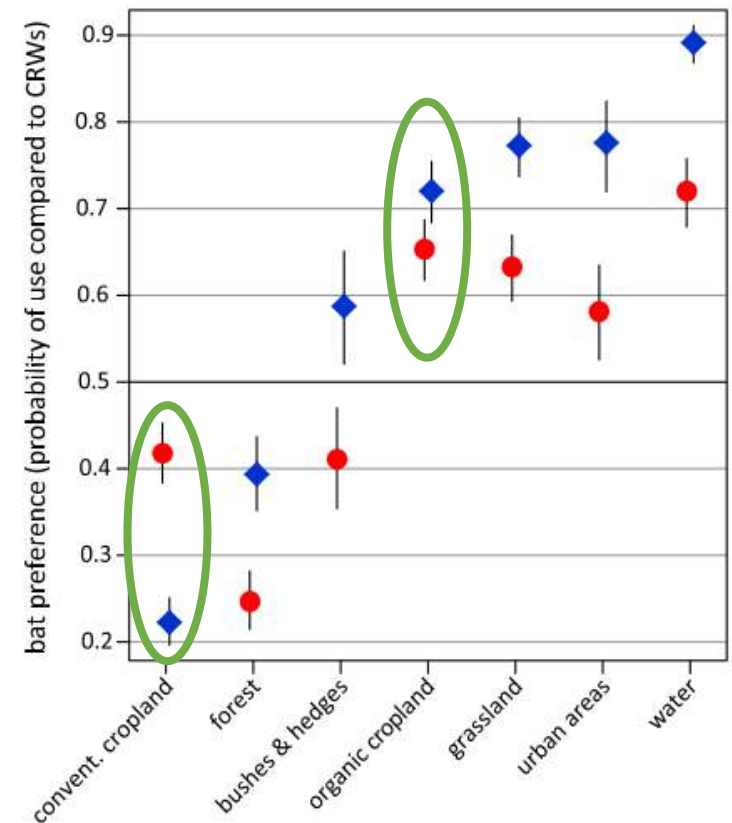
Centre d'Écologie et des
Sciences de la Conservation

Context

- Cropland take up $\sim 25\%$ of Europe area

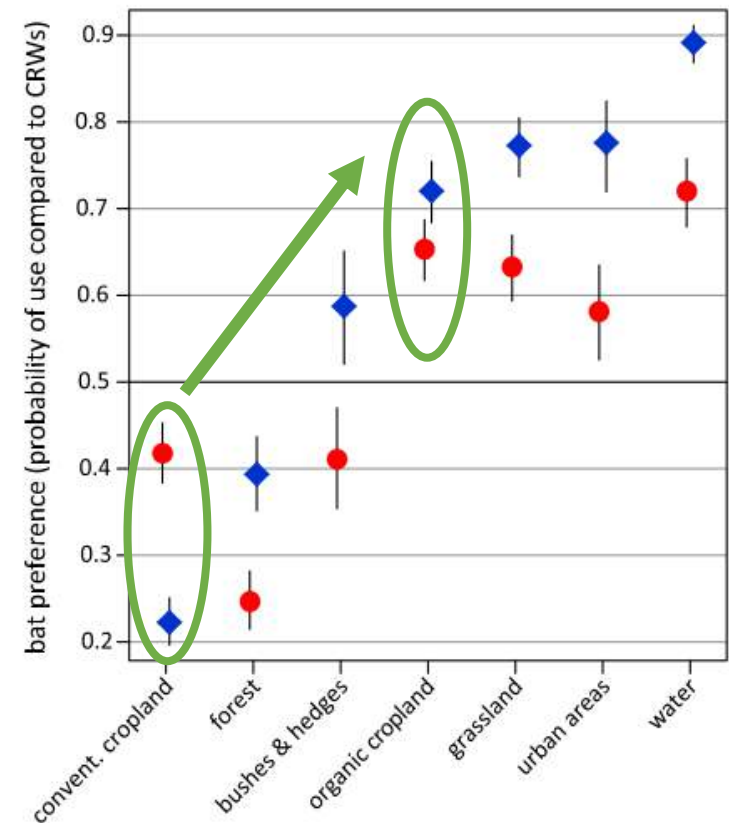
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- Used by bats in the same way that other habitats



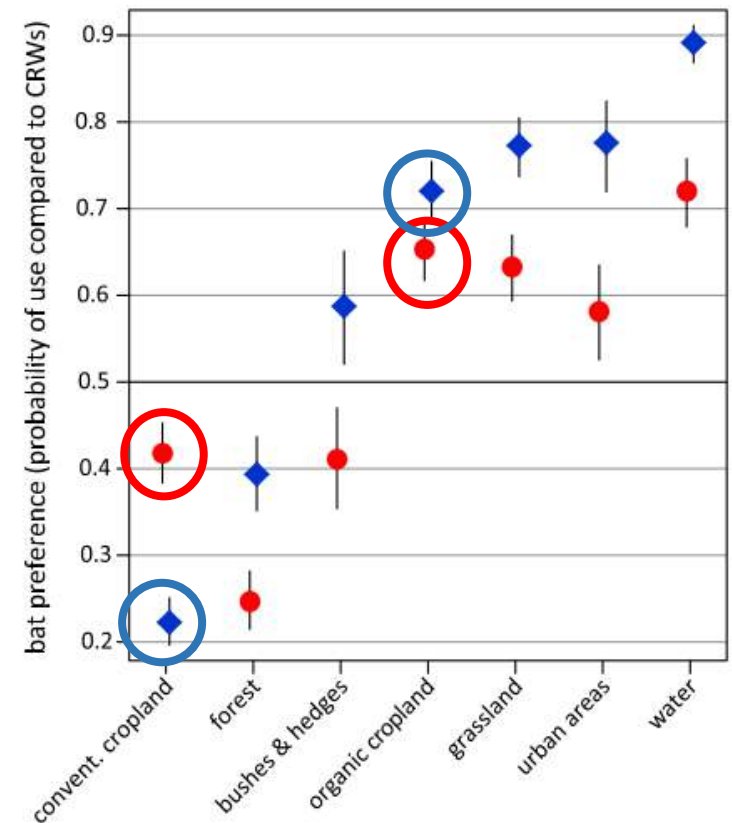
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- Sensitive to practice changes (conv. $\rightarrow$ organic)



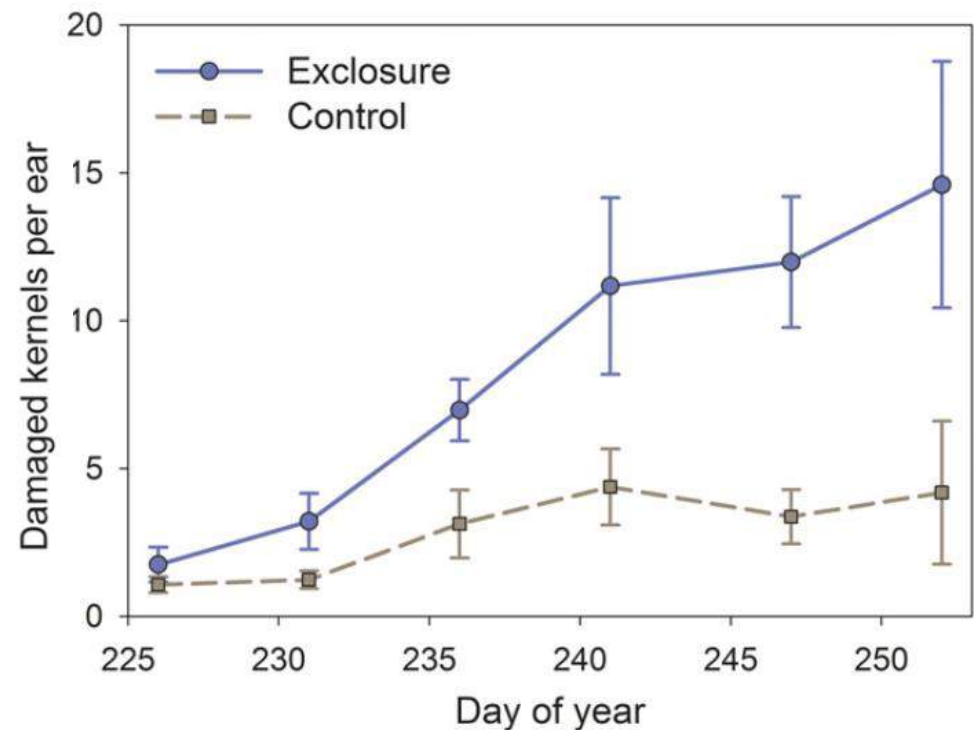
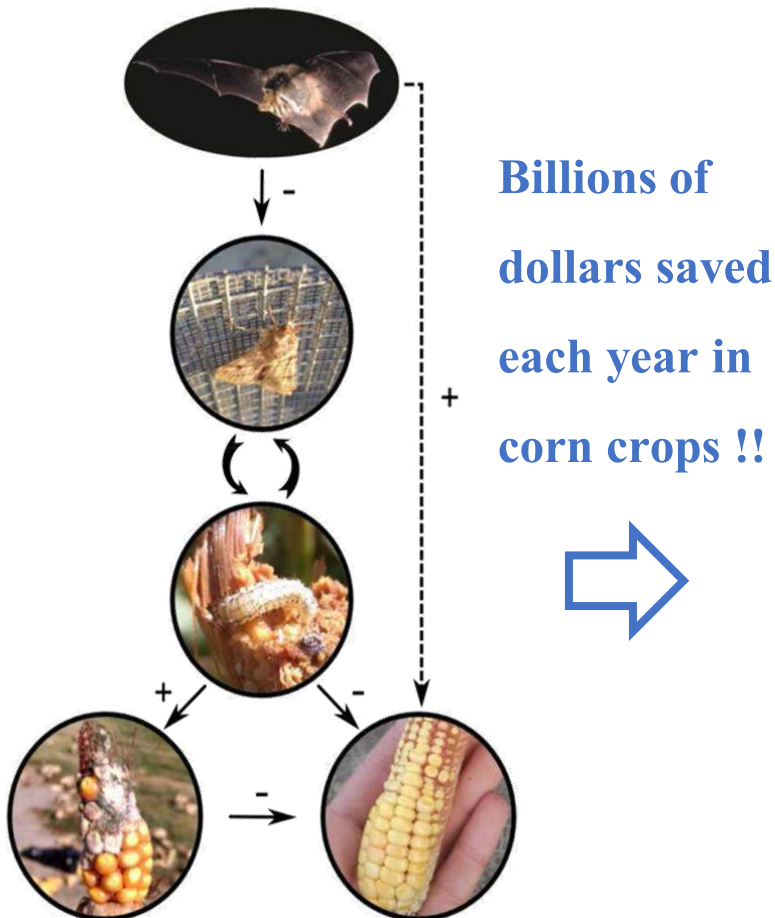
Context

- Cropland take up $\sim 25\%$ of Europe area
- Used by bats in the same way that other habitats
- Sensitive to practice changes (conv. $\rightarrow$ organic)
- Sex-dependant effect



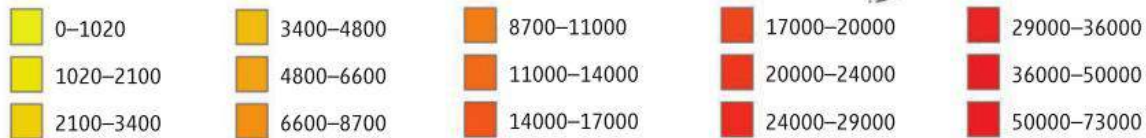
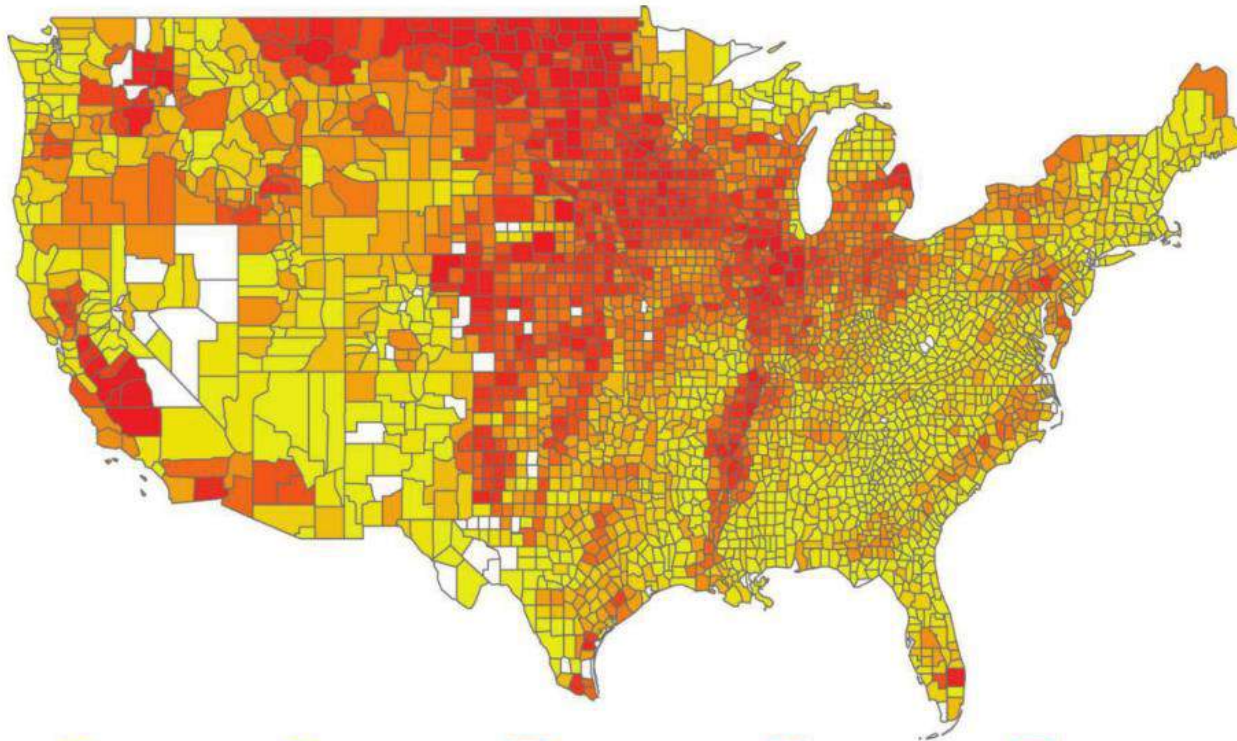
Context

- Excellent potential as bioindicators (Jones et al. 2009)
- Provide ecosystem services as apex predators



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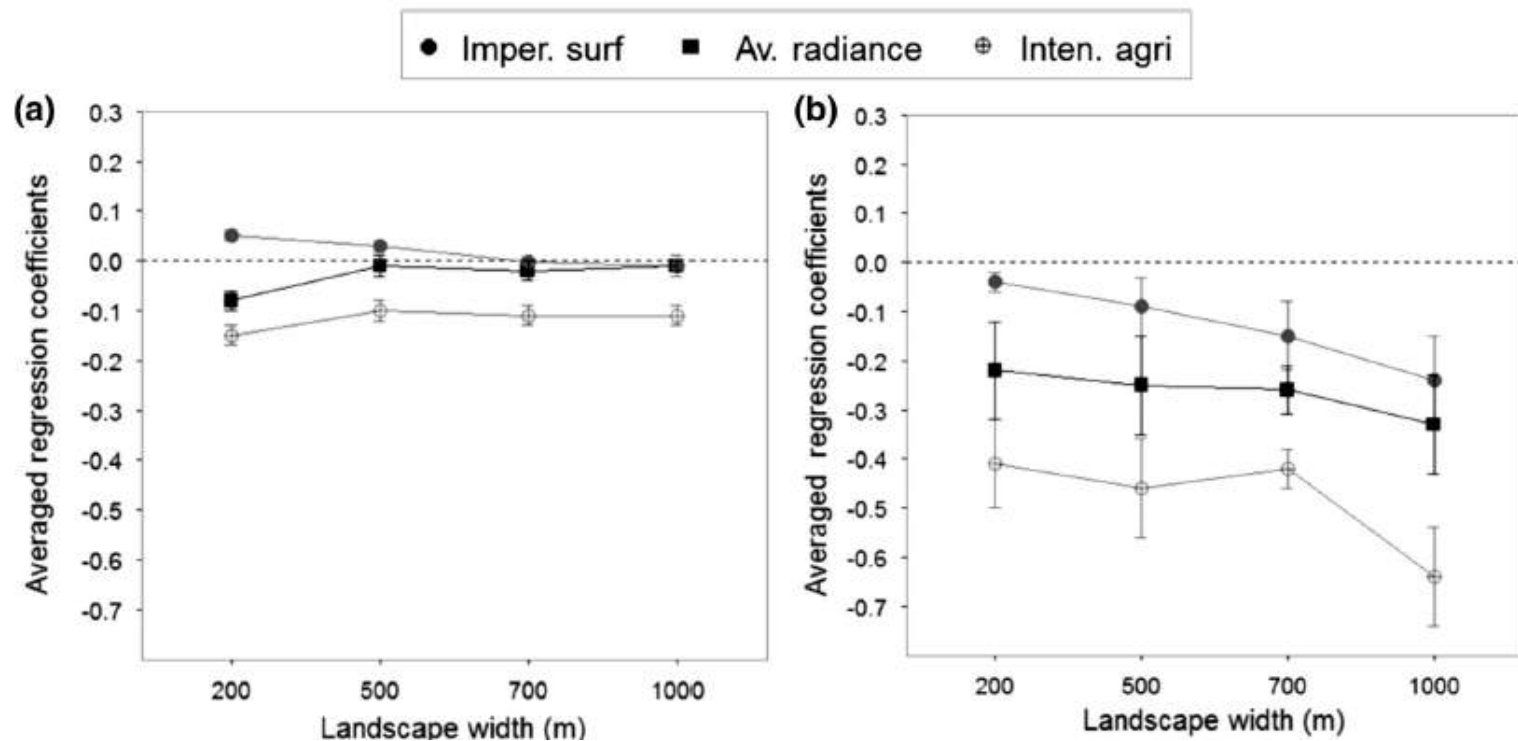
And even more
so for all crop
types !!

The worth of insectivorous bats. Estimated annual value of insectivorous bats in the agricultural industry at the county level. Values ($\times \$1000$ per county) assume bats have an avoided-cost value of $\sim \$74/\text{acre}$ of cropland (12). (See SOM for details.)

Boyles et al. 2011, Science

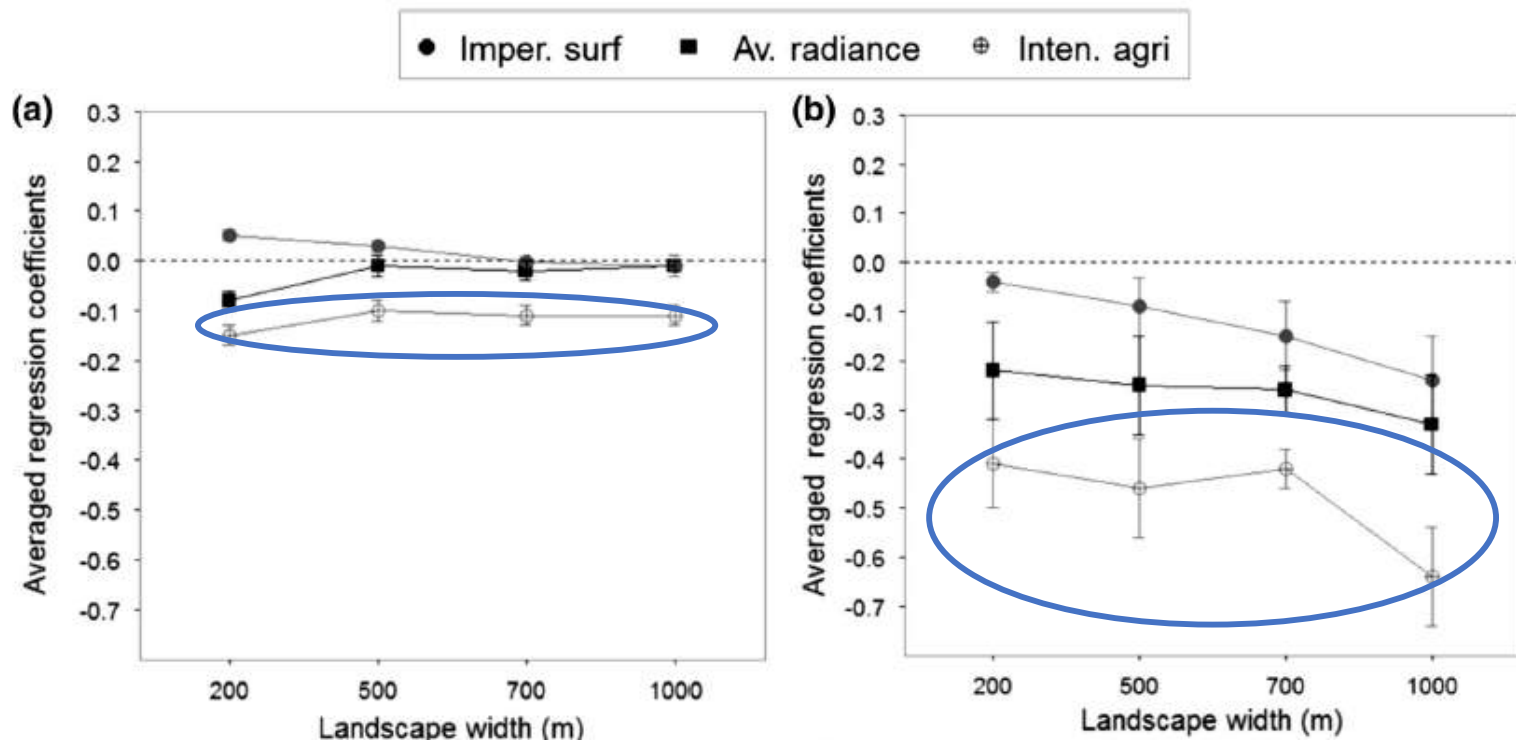
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- Farming intensification is a major concern compared to other threats (study at national scale in France)



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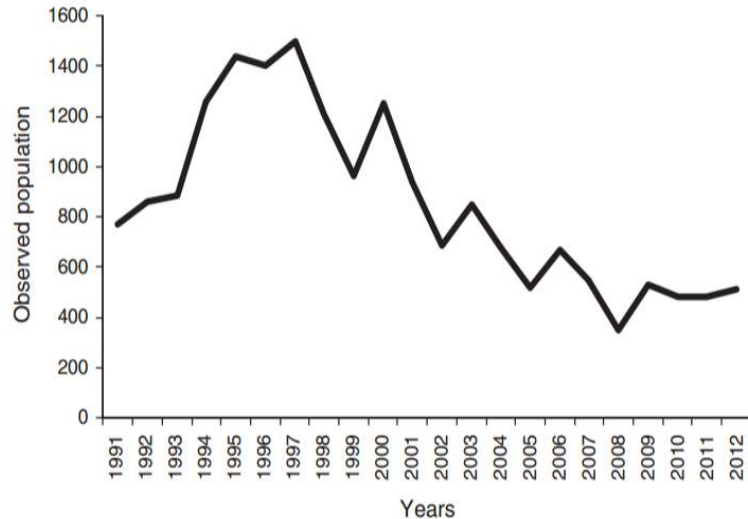


More negative effect than impervious surfaces and light pollution

Context

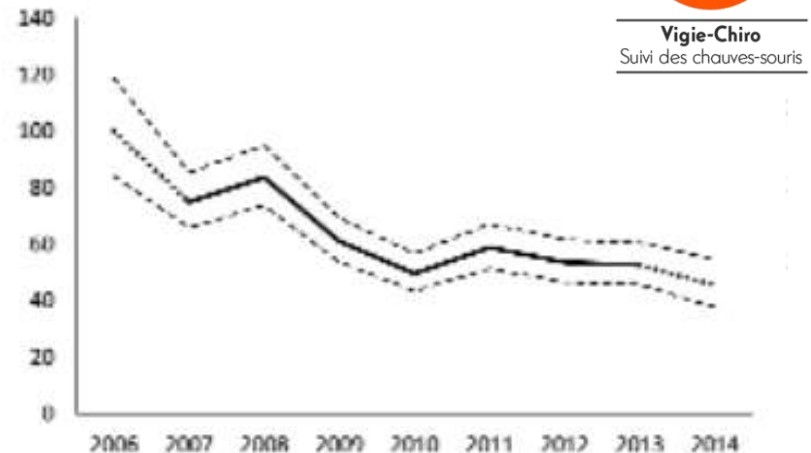
- Adverse conservation status (example for one of the most common bat species *Pipistrellus pipistrellus*)

Winter



Kerbiriou et al. 2015, Wildlife Research

Summer



Kerbiriou et al. 2015, Symbioses

Context

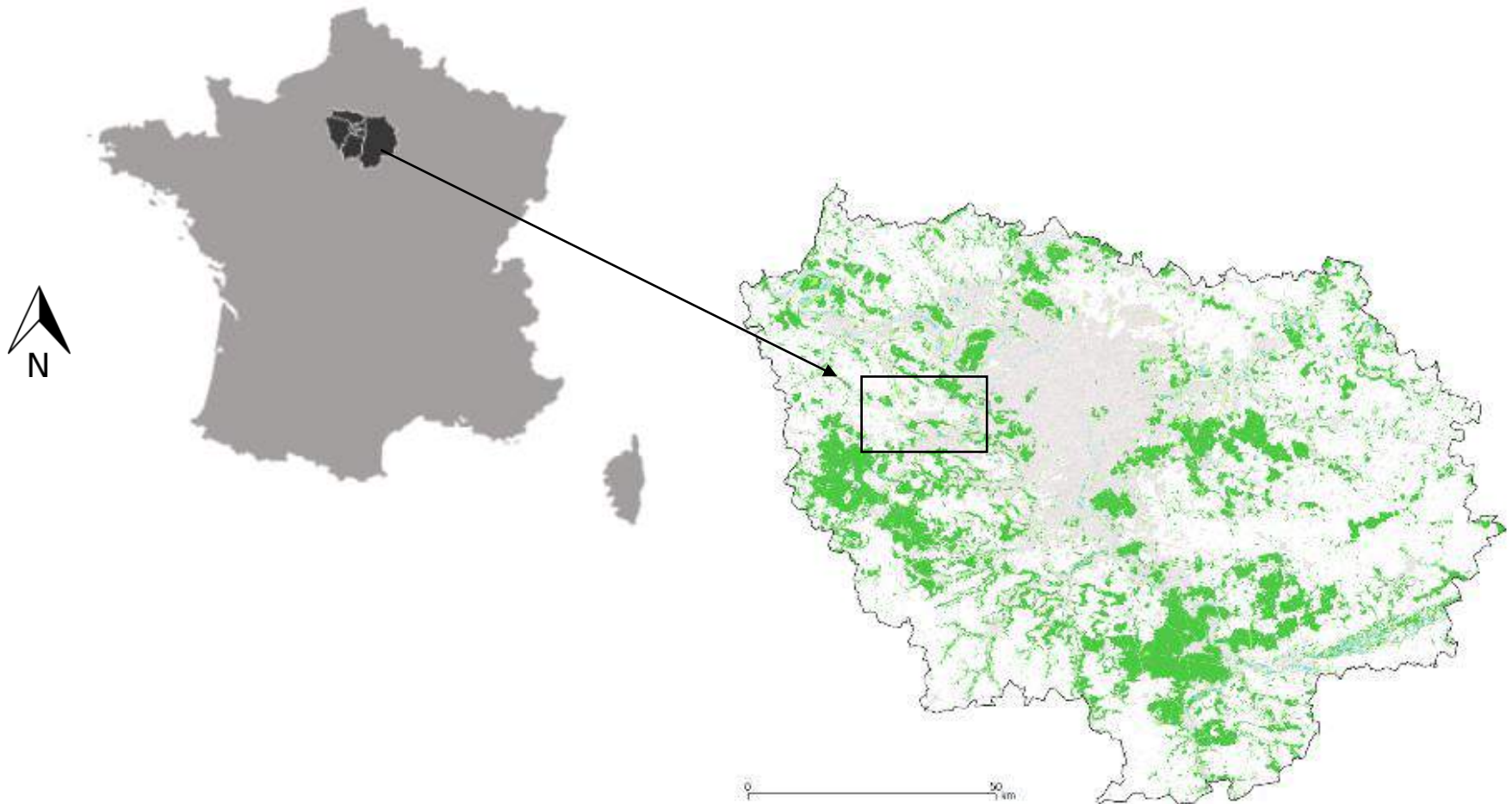
- Adverse conservation status (example for one of the most common bat species *Pipistrellus pipistrellus*)
- No studies on farming practice features and bats, only 2 conventional vs. organic large comparisons

Reference

Barré K., Le Viol I., Julliard R., Chiron F. & Kerbiriou C. (2018). Tillage and herbicide reduction mitigate the gap between conventional and organic farming effects on foraging activity of insectivorous bats. *Ecology and Evolution* (In press)

Methods

A small farming landscape in Ile-de-France region, one of the most productive of France



Methods

Reminder on soil management possibilities

Tillage (ploughing)

versus

Conservation tillage



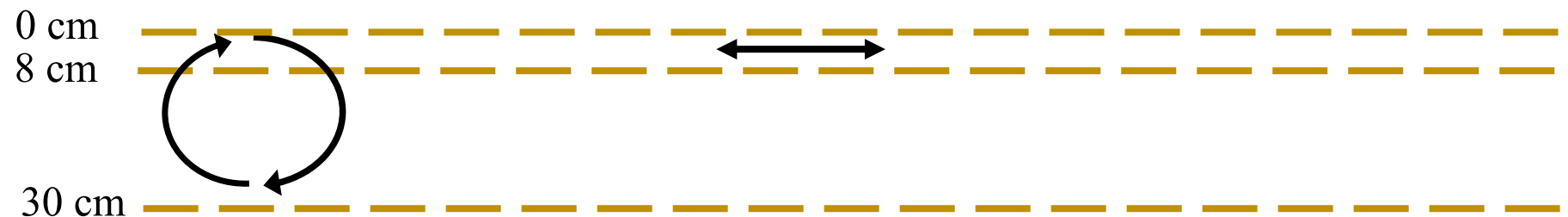
Inversion of soil



Superficial tillage only



No tillage (direct seeding)



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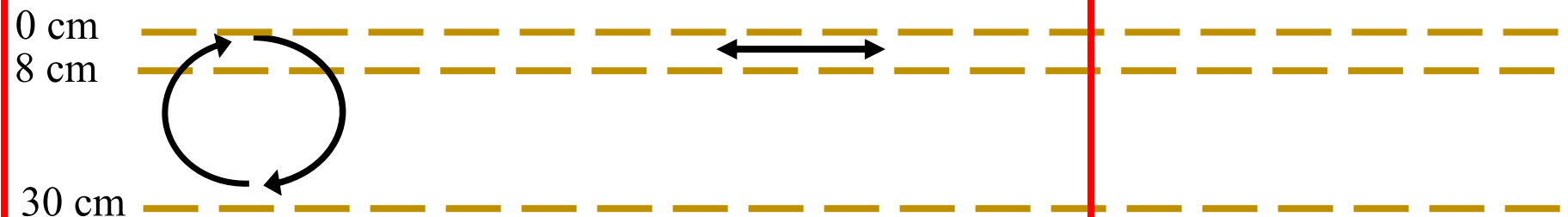
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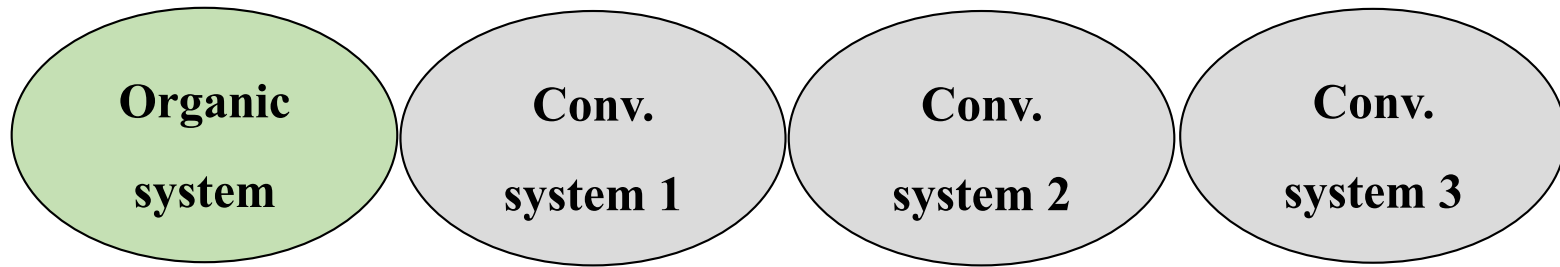


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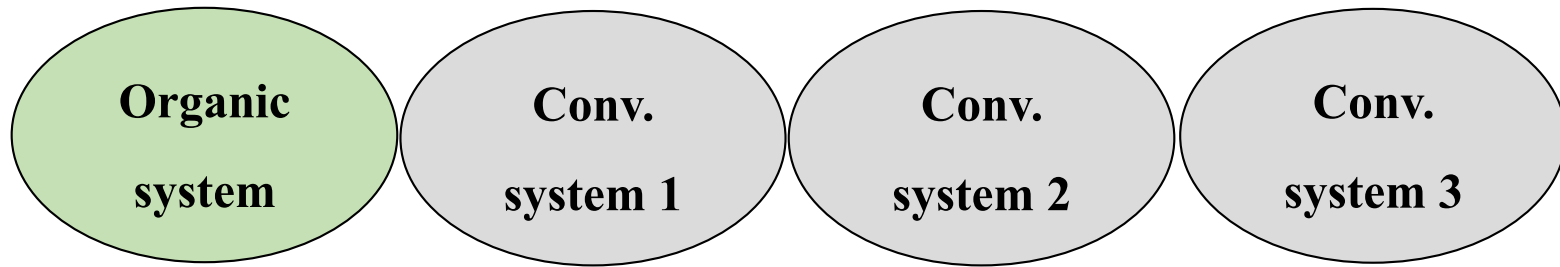
Methods

Presentation of farming systems studied



Methods

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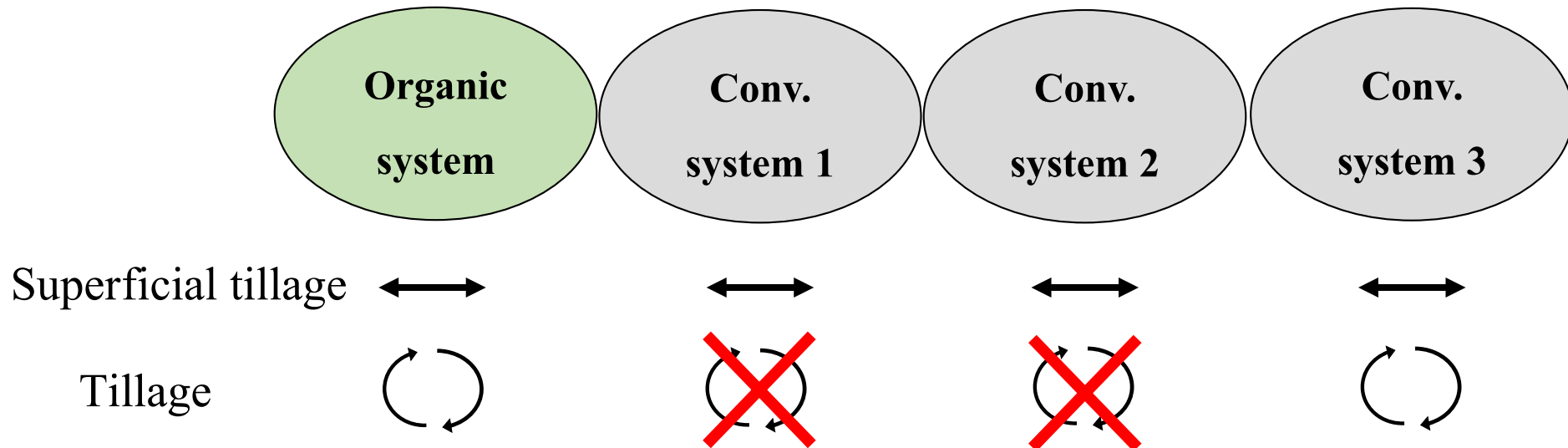


Superficial tillage ↔



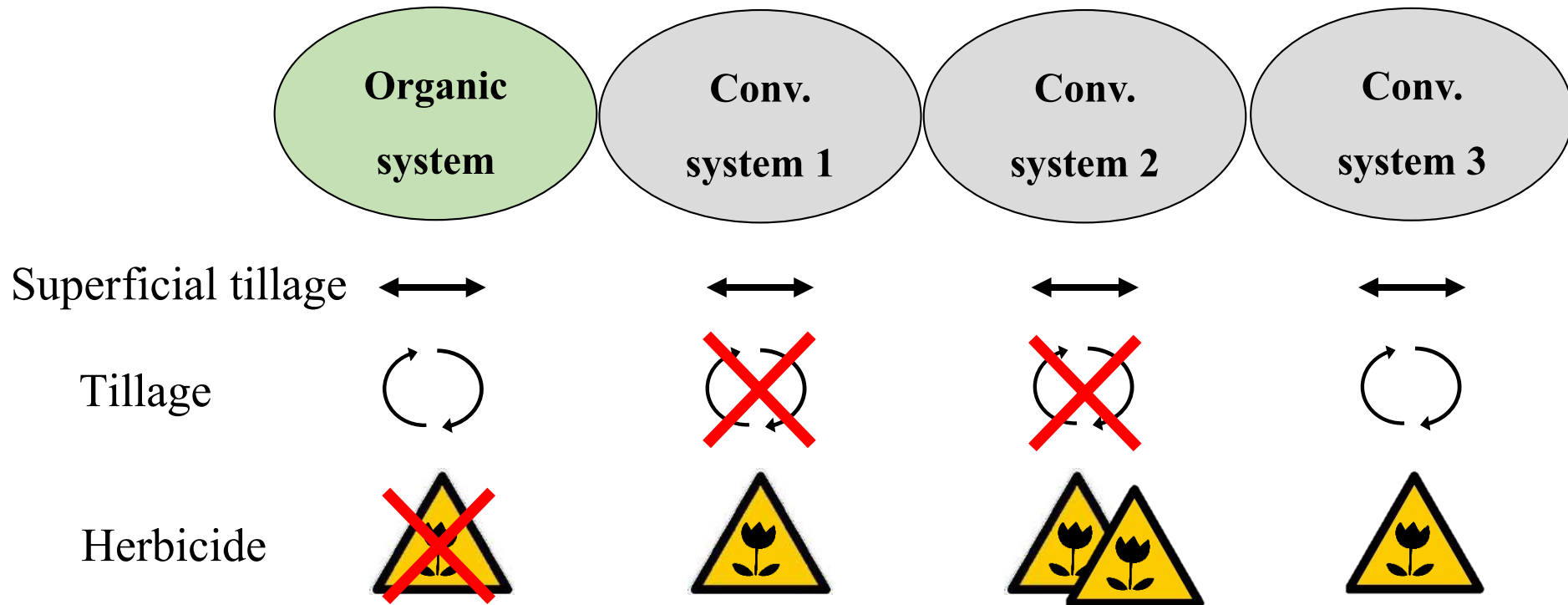
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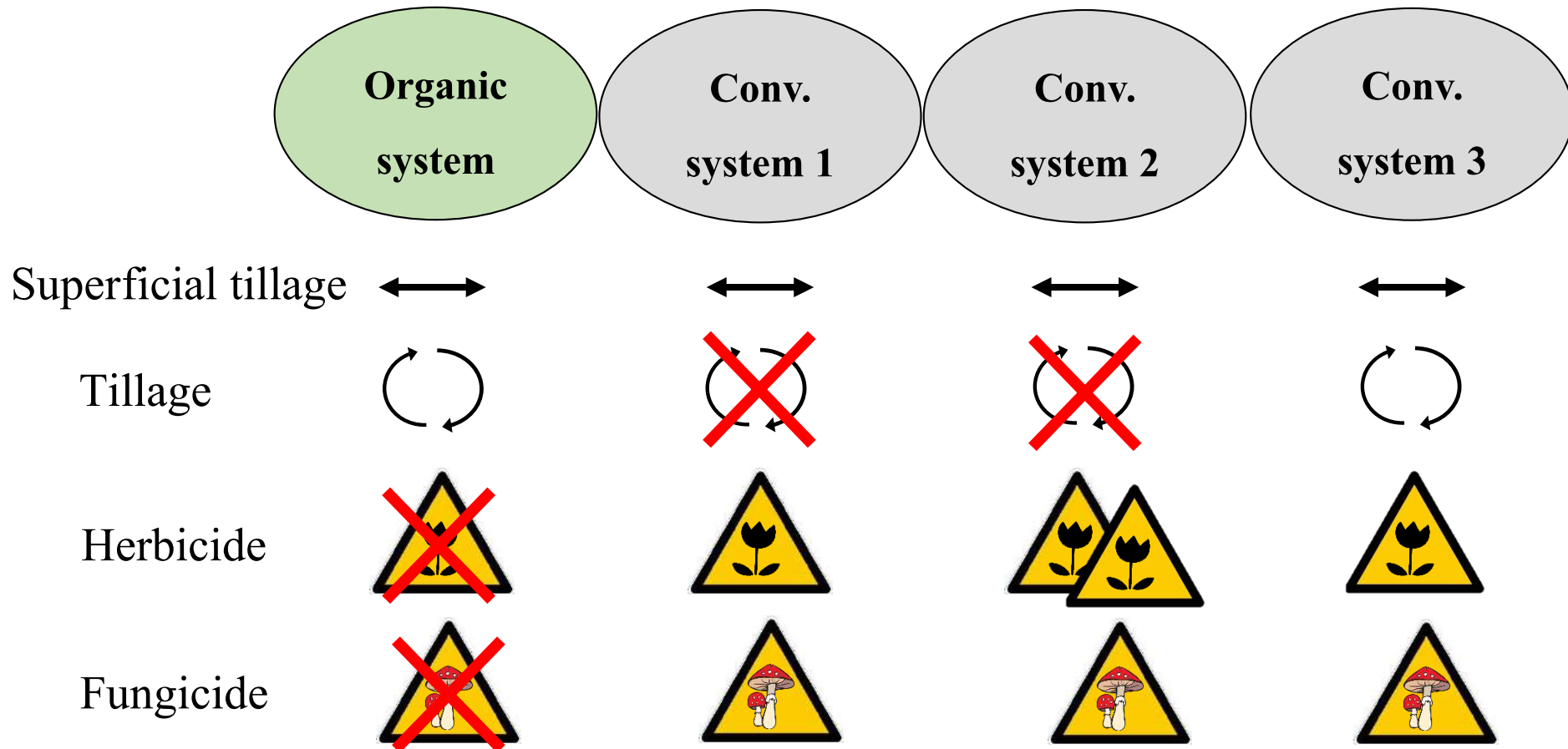
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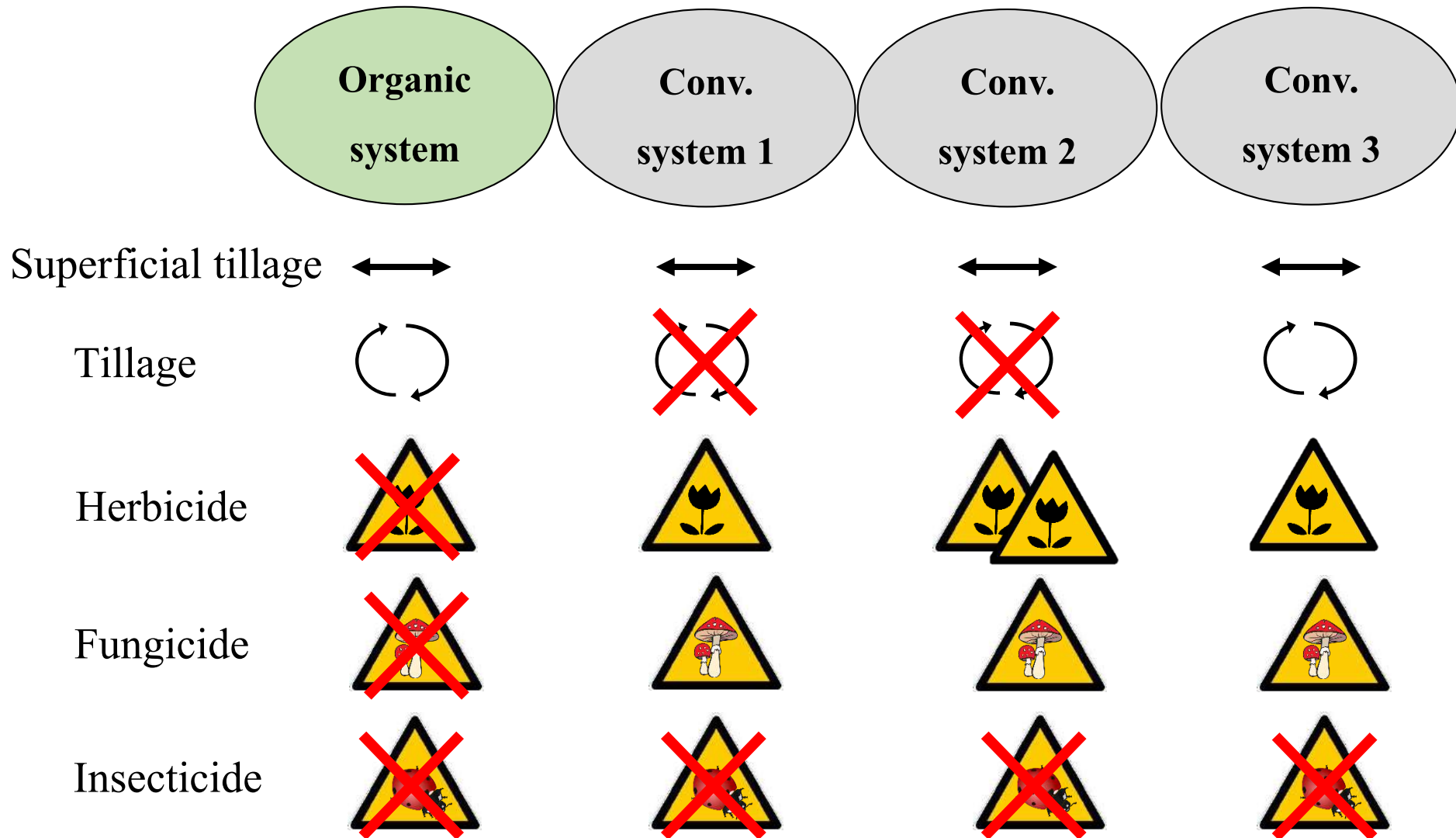
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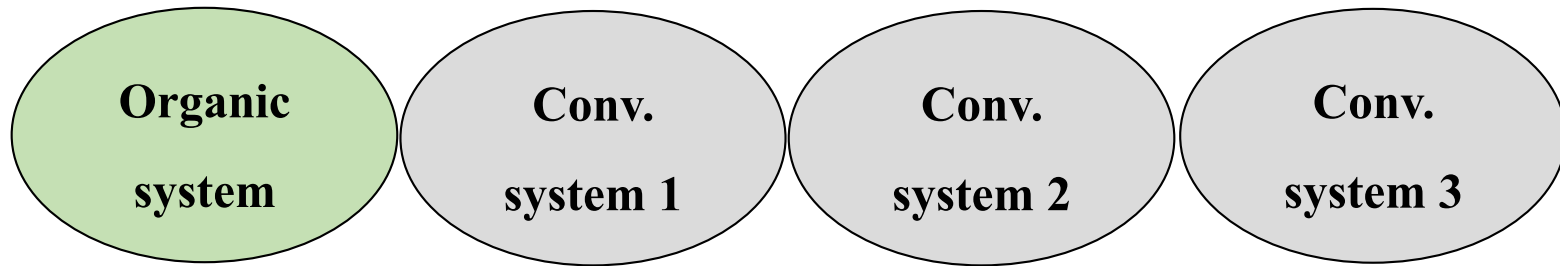
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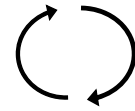
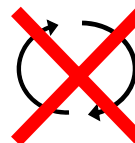
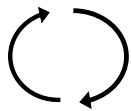
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Superficial tillage ↔



Tillage



Herbicide



Fungicide

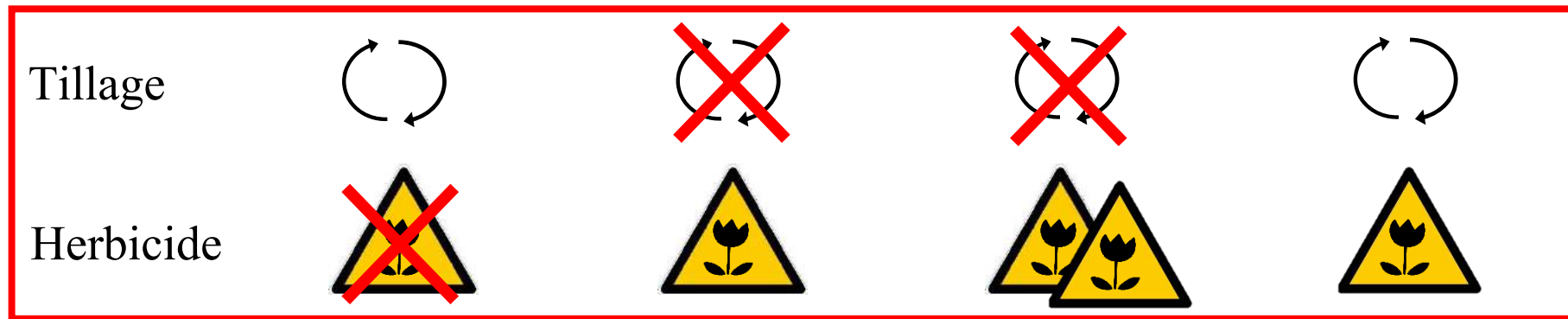
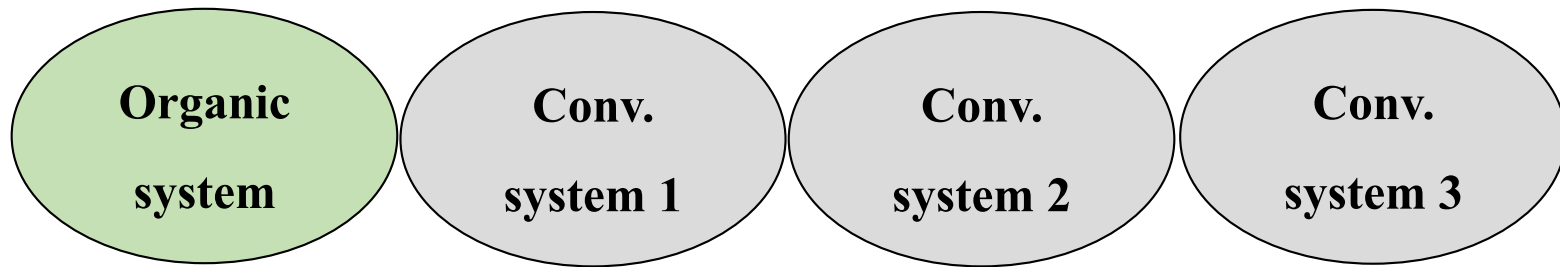


Insecticide



Methods

Presentation of farming systems studied on wheat fields



Organic tillage
(OT)

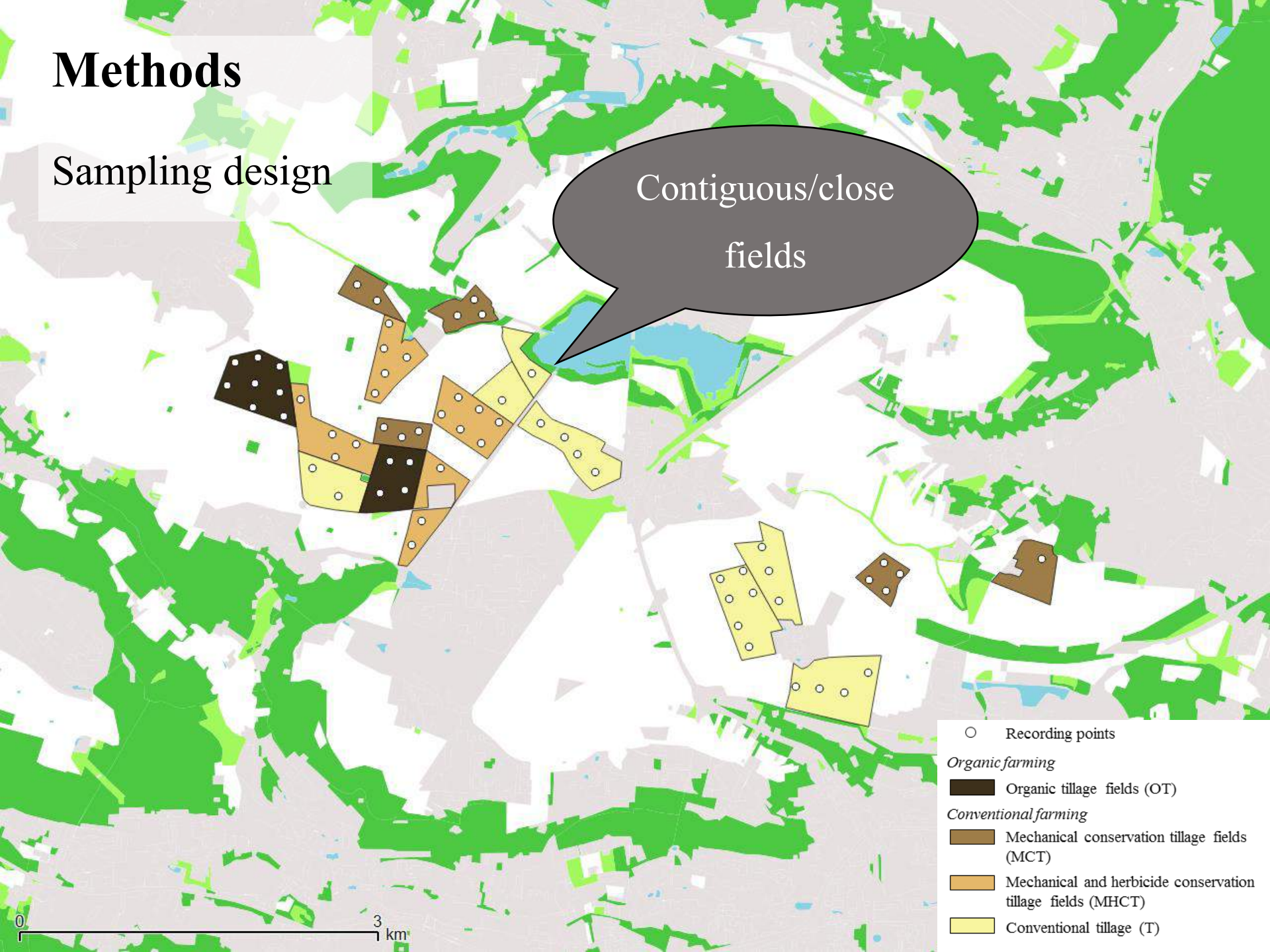
Mechanical
conservation
tillage (MCT)

Mechanical and
herbicide
conservation
tillage (MHCT)

Conventional
tillage (T)

Methods

Sampling design



Methods

Sampling design

Contiguous/close
fields

Sampling points inside
fields: edge effects
diminution

○ Recording points

Organic farming

■ Organic tillage fields (OT)

Conventional farming

■ Mechanical conservation tillage fields (MCT)

■ Mechanical and herbicide conservation tillage fields (MHCT)

■ Conventional tillage (T)

3 km

Methods

Sampling design



Simultaneous recordings
of all systems in June

○ Recording points

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Simultaneous recordings
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1st night

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3 km

Methods

Sampling design

Simultaneous recordings
of all systems in June:
2nd night

○ Recording points

Organic farming

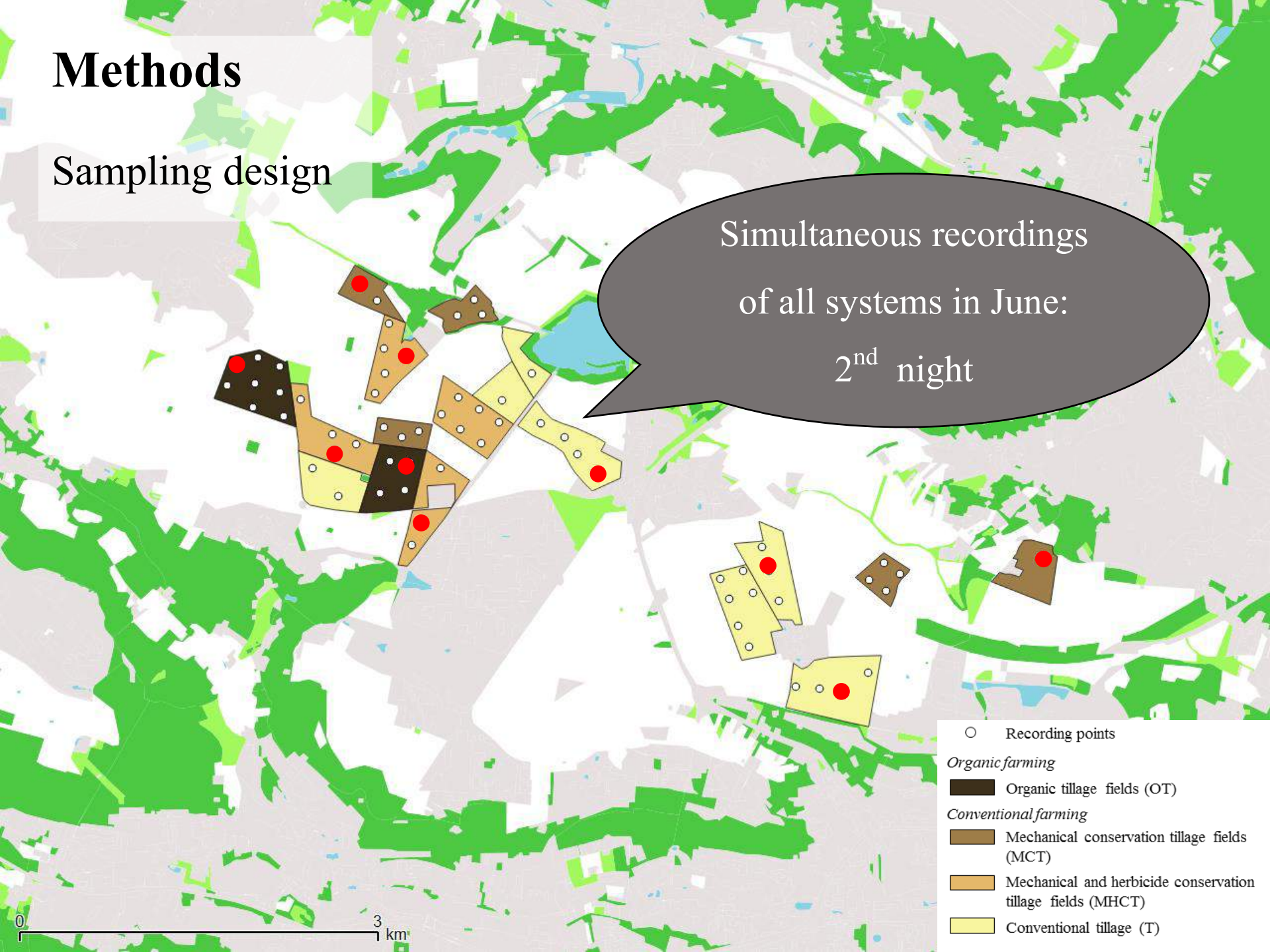
■ Organic tillage fields (OT)

Conventional farming

■ Mechanical conservation tillage fields (MCT)

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Methods

Sampling design

Etc... during 1 week on 64
points using automatic
recorders (SM2bat)



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○ Recording points

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Methods

Statistical approach

Generalized linear mixed models

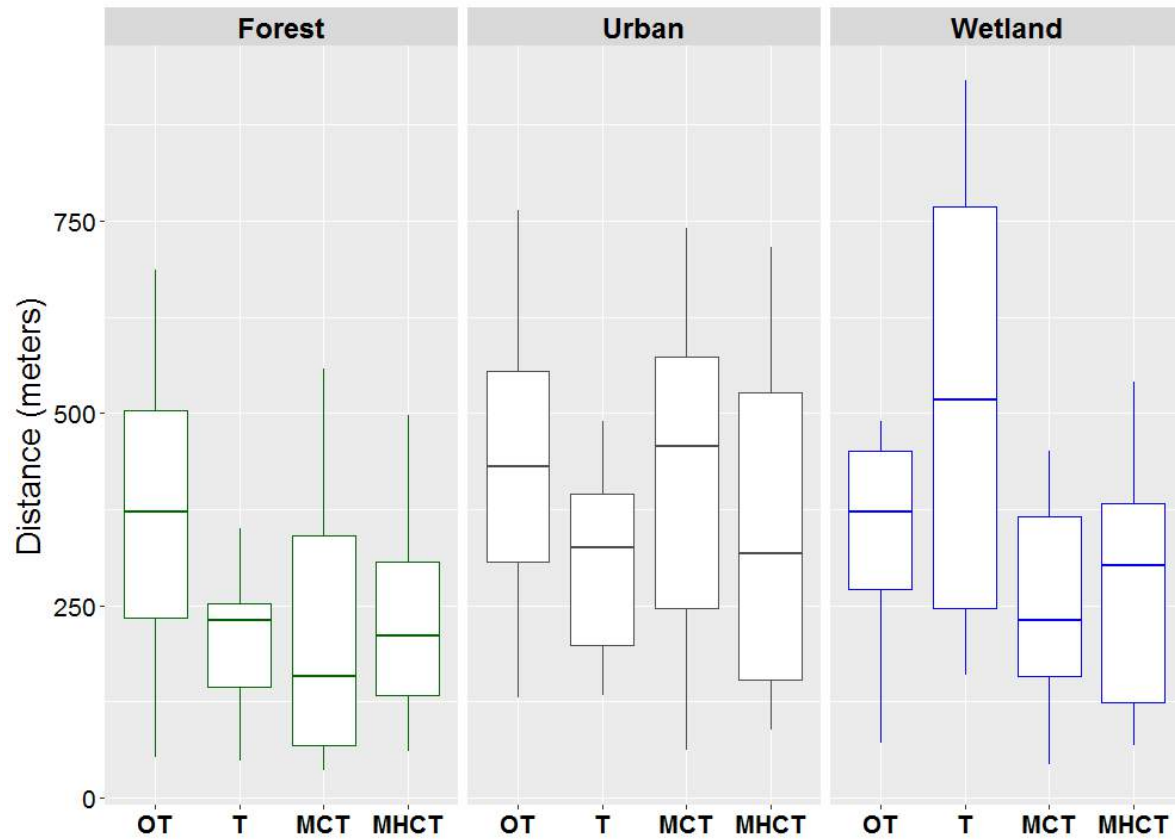
Species $\sim$ systems + environmental covariables + (1| night)

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Multi-model inference based on AICc

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Multi-model inference based on AICc



Averaging on delta AICc < 2

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Checking for best and full models :



A dispersion ratio between

0.75 and 1.4

Methods

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Multi-model inference based on AICc



Averaging on delta AICc < 2

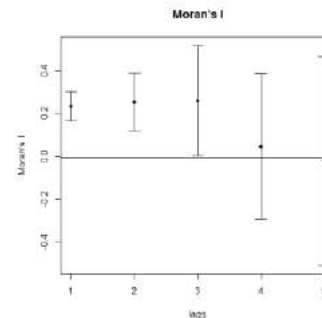


Checking for best and full models :

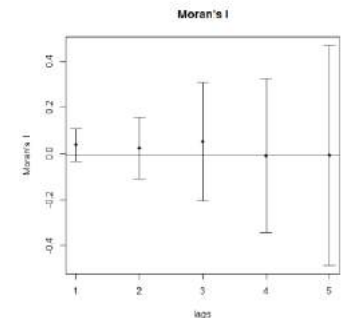


Correction of spatial autocorrelation

A dispersion ratio between
0.75 and 1.4



Modelling

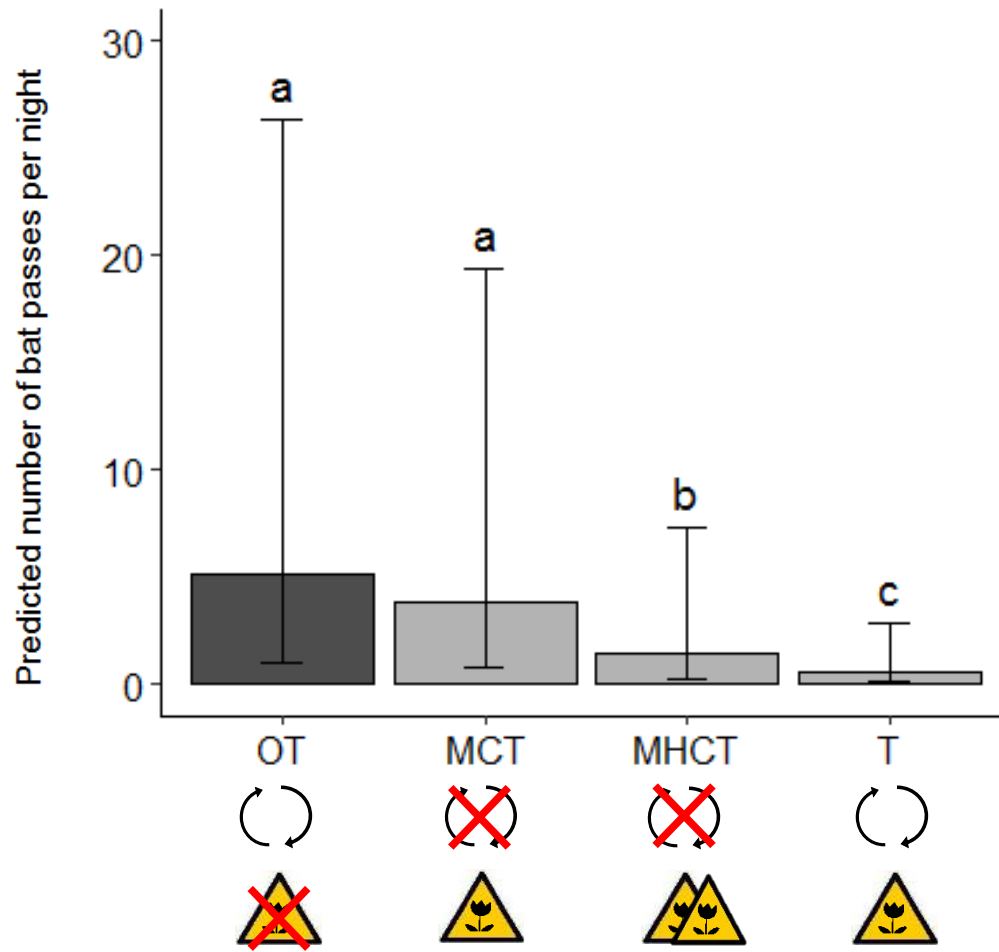


Raw data

Residuals

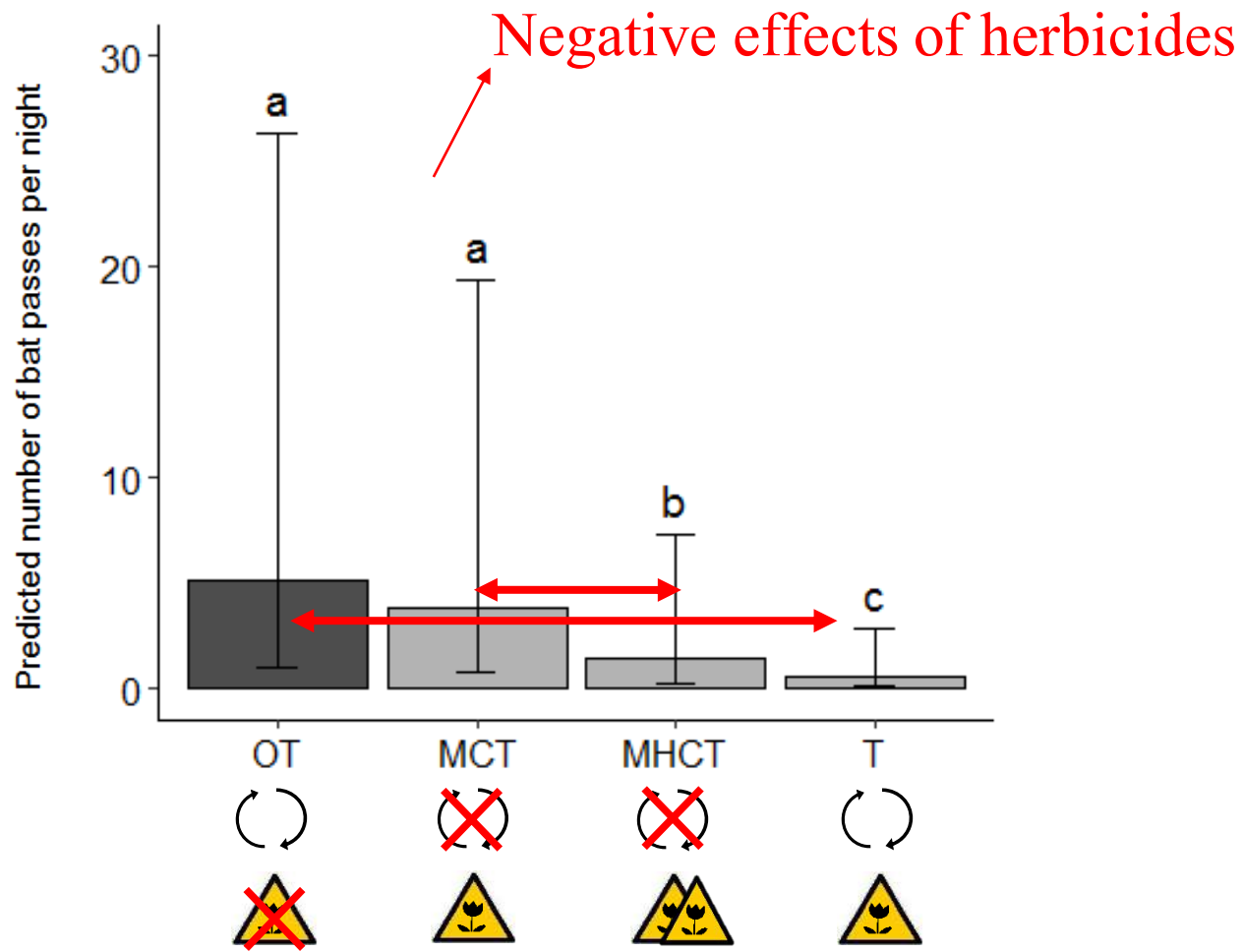
Results

All Pipistrellus ssp.



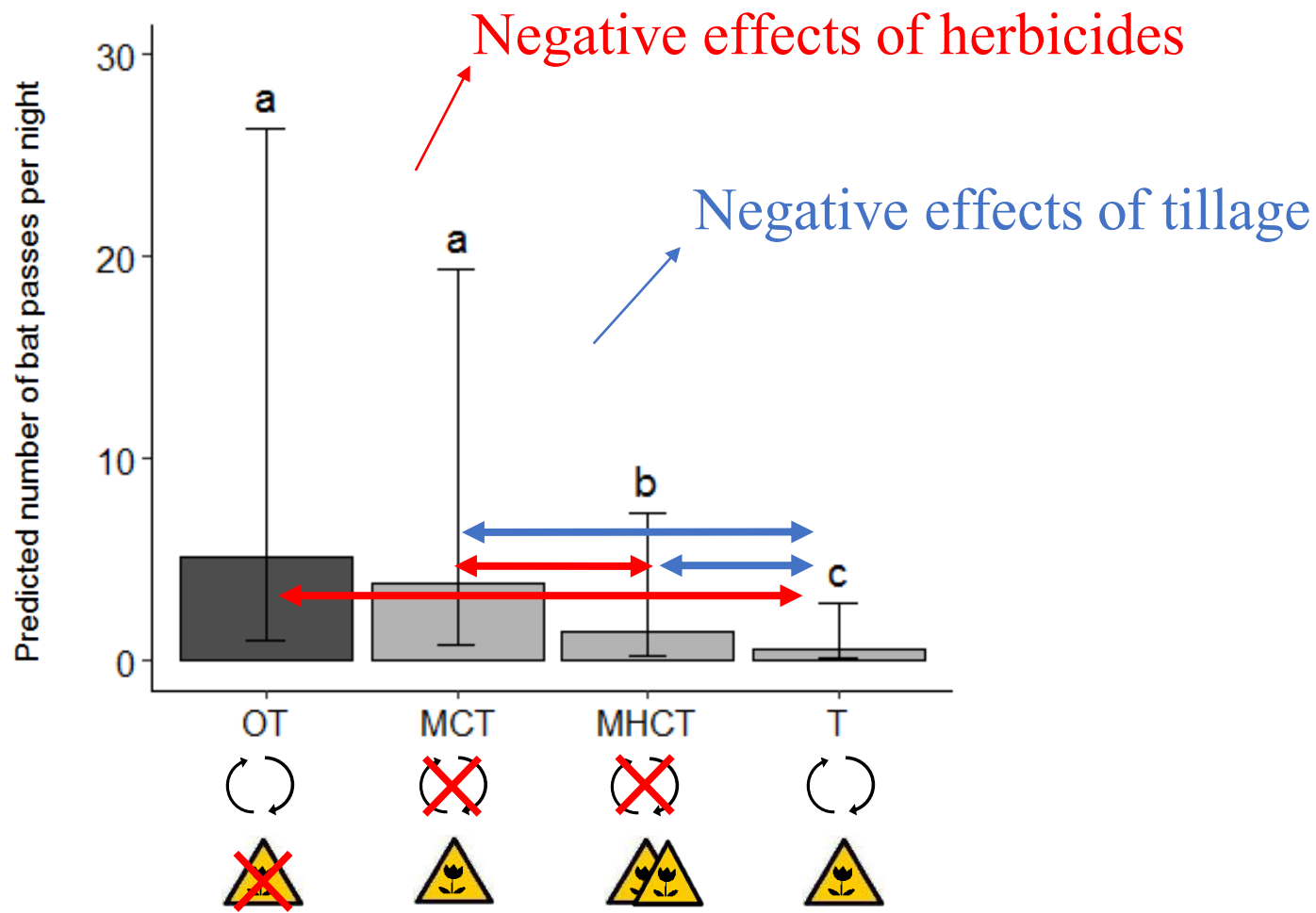
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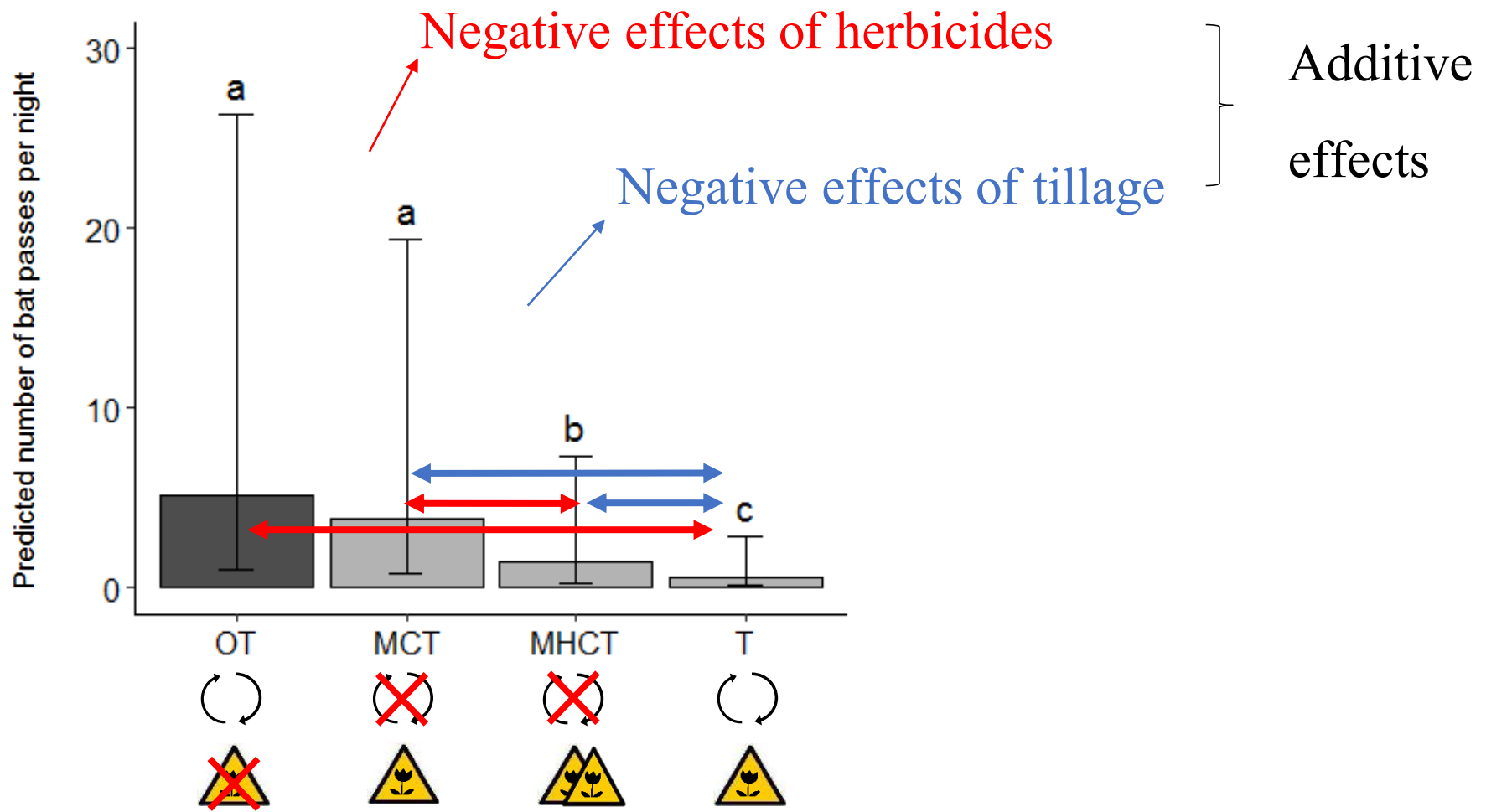
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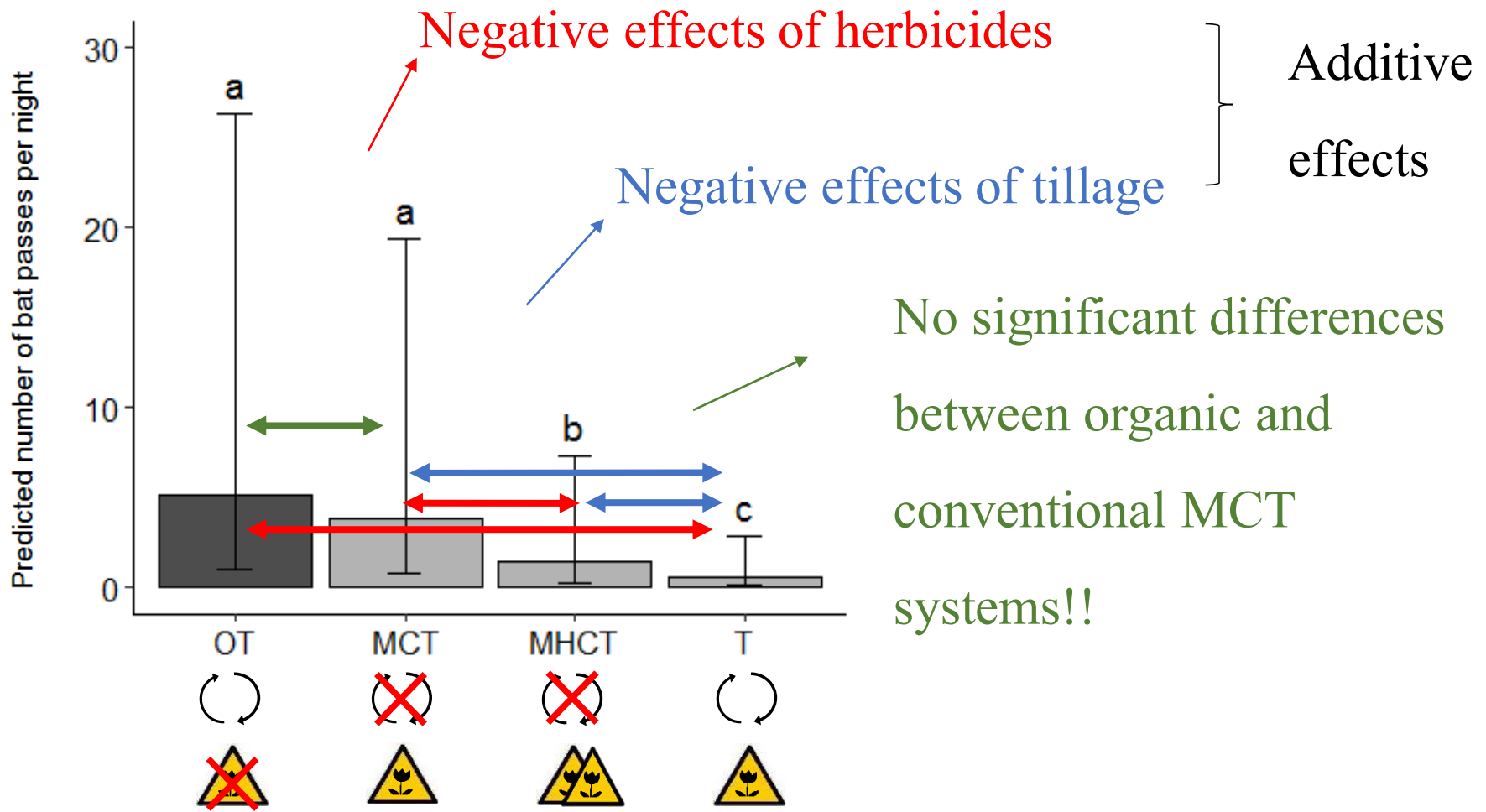
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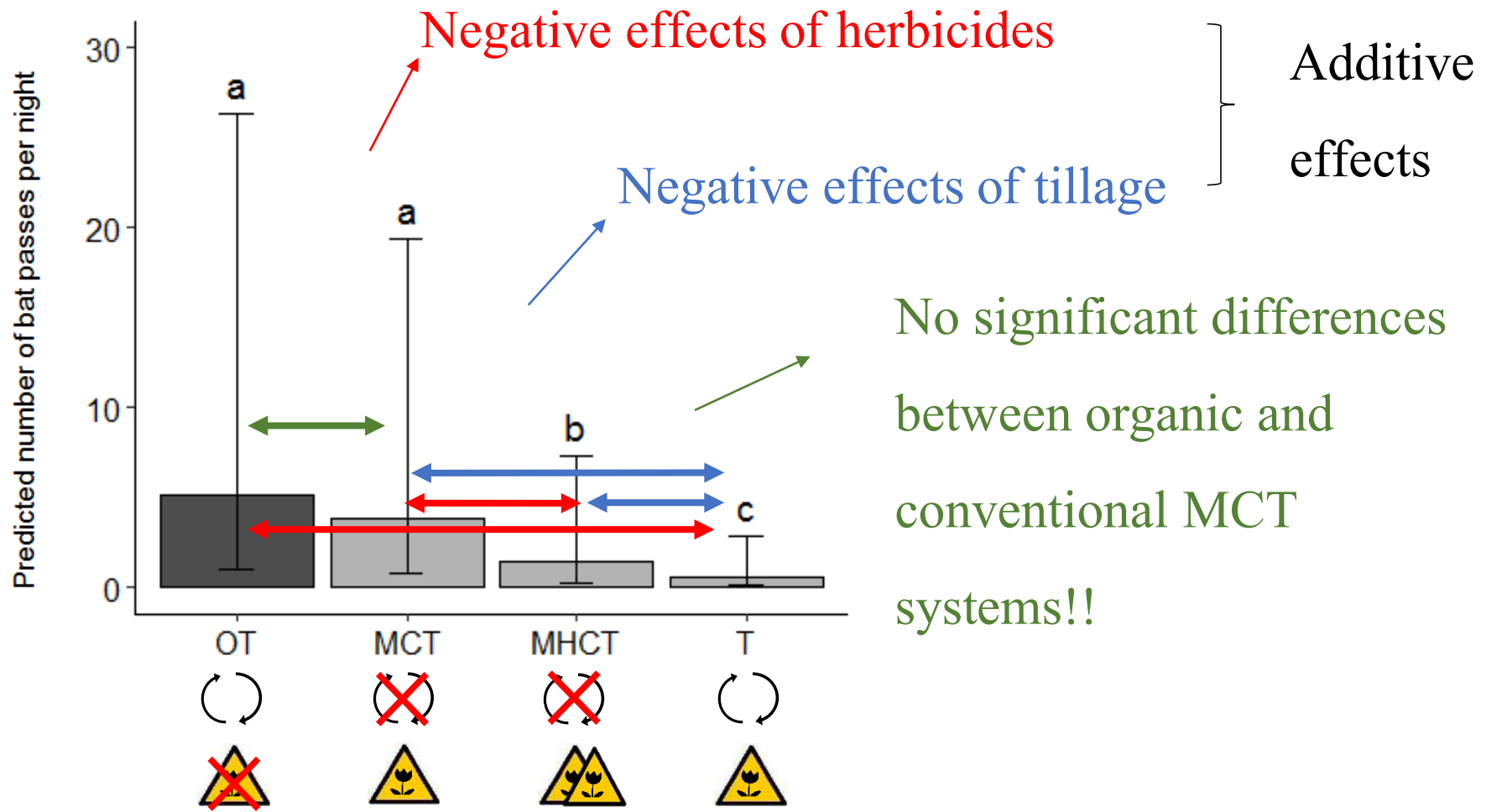
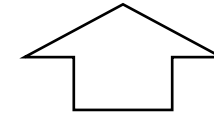
Results

All Pipistrellus ssp.

Affect development cycle of

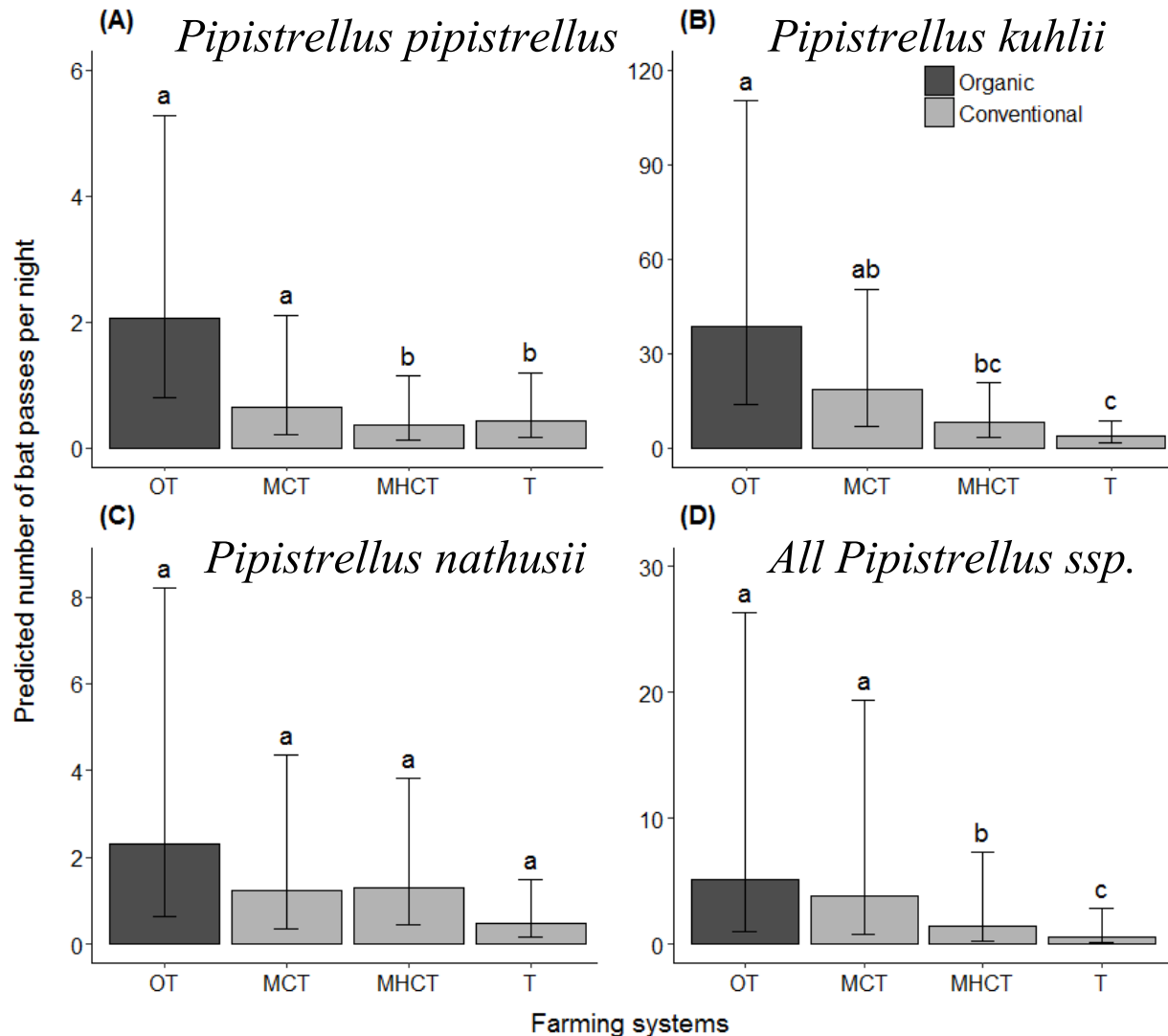
Diptera ? (70-100% of the

Pipistrellus ssp. diet)



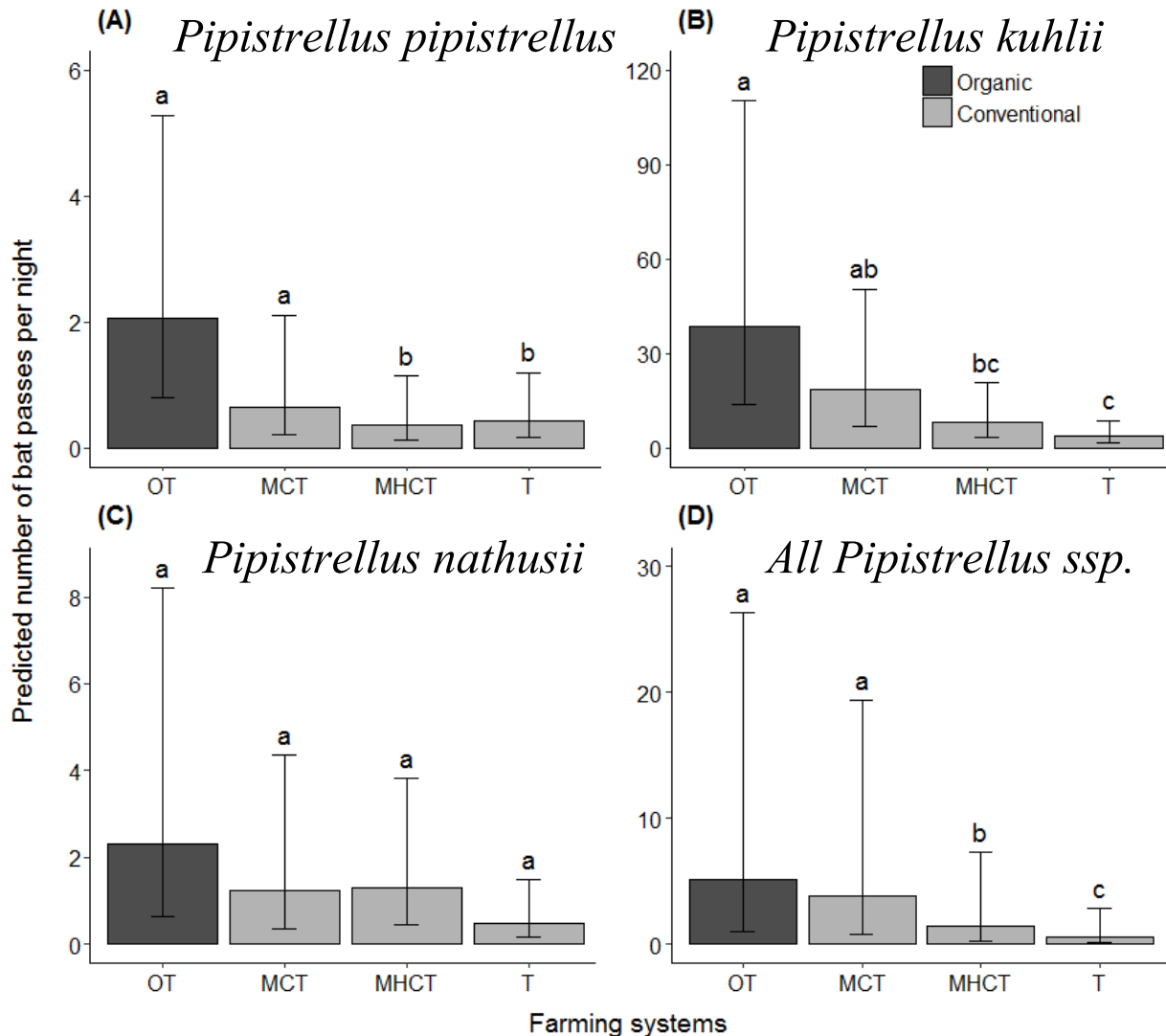
Results

Same pattern for *P. pipistrellus*, *P. kuhlii* and richness



Results

No effects for high-flying species (*P. nathusii* and *Nyctalus ssp.*)



Summary

- Bat activity in wheat far from every structuring and high-attractive habitat

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- Bat activity in wheat far from every structuring and high-attractive habitat
- Mitigation possibilities of conventional to organic gap for bats without impact yields (identical in 3 conv. systems)
- Organic farming (in arable crops) only take up 5% in France : we can easily act on the remaining area and leave productivity and profitability intact

nature
plants

LETTERS

PUBLISHED: 1 MARCH 2017 | VOLUME: 3 | ARTICLE NUMBER: 17008

Reducing pesticide use while preserving crop productivity and profitability on arable farms

Martin Lechenet^{1,2*}, Fabrice Dessaint², Guillaume Py¹, David Makowski^{3*} and Nicolas Munier-Jolain^{2†*}

SCIENTIFIC REPORTS

OPEN

Herbicides do not ensure for higher wheat yield, but eliminate rare plant species

Received: 21 March 2016
Accepted: 29 June 2016

Sabrina Gaba^{1,2}, Edith Gabriel¹, Joël Chadœuf¹, Florent Bonneau³ & Vincent Bretagnolle^{2,5}

Next step

Identification of soil arthropods sampled simultaneously (Barber trap) to study these effects on all trophic levels

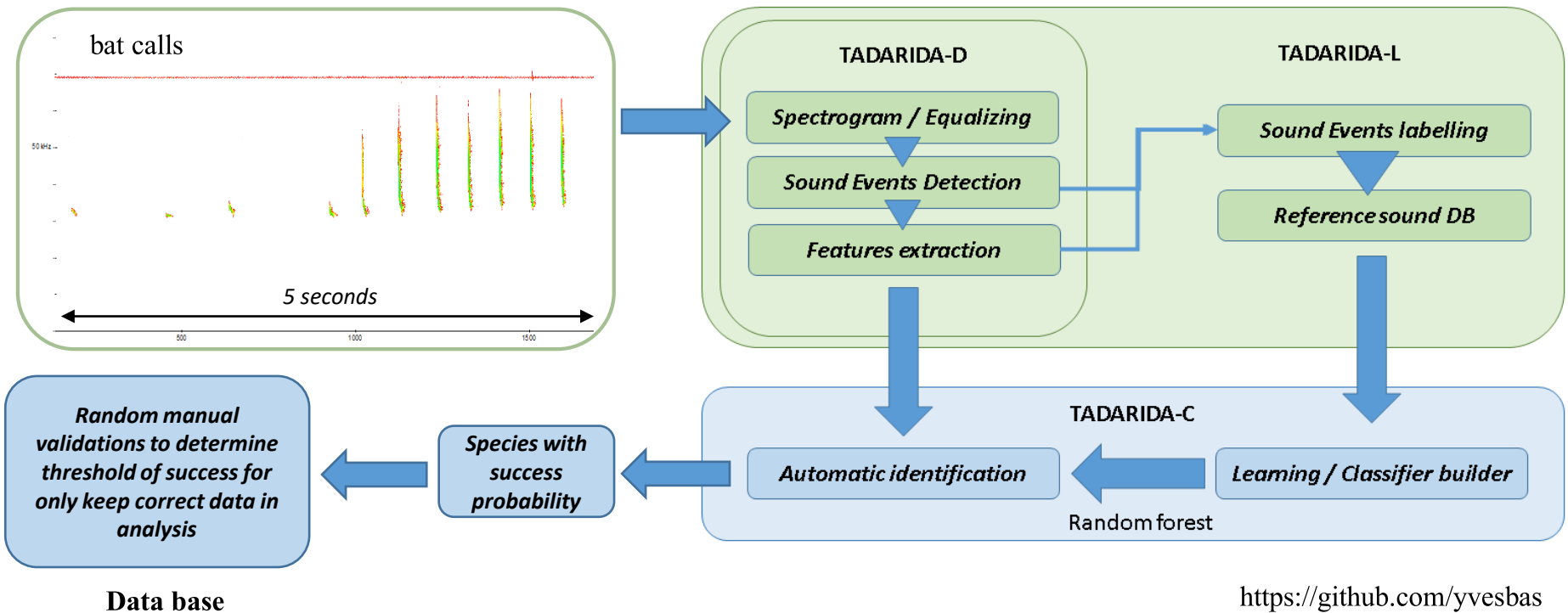


Farming systems	Chronology of interventions							
	July	August	September	October	March	April	May	June
Organic farming								
Organic tillage (OT)	Harvest	Harrowing	Tillage + smoothing	Sowing	Mechanical weed	Mechanical weed	Ø	Mechanical weed
Conventional farming								
Mechanical conservation tillage (MCT)	Harvest	Harrowing	Decompaction	Sowing + herbicide (x1)	Herbicide (x1)	Fungicide (x1)	Fungicide (x1)	Fungicide (x2)
Mechanical and herbicide conservation tillage (MHCT)	Harvest	Harrowing	Decompaction + Herbicide (x1)	Sowing + herbicide (x1)	Herbicide (x1)	Fungicide (x1)	Fungicide (x1)	Fungicide (x2)
Conventional tillage (T)	Harvest	Harrowing	Tillage + smoothing	Sowing + herbicide (x1)	Herbicide (x1)	Fungicide (x1)	Fungicide (x1)	Fungicide (x2)

II - Method

Identification of acoustic data (unit= bat passes of 5 seconds): TADARIDA open source project

Toolbox for Animal Detection on Acoustic Recordings Integrating Discriminant Analysis, developed by Yves Bas



<https://github.com/yvesbas>