



# **Influence of farming system on ground beetle communities at local and landscape scales**

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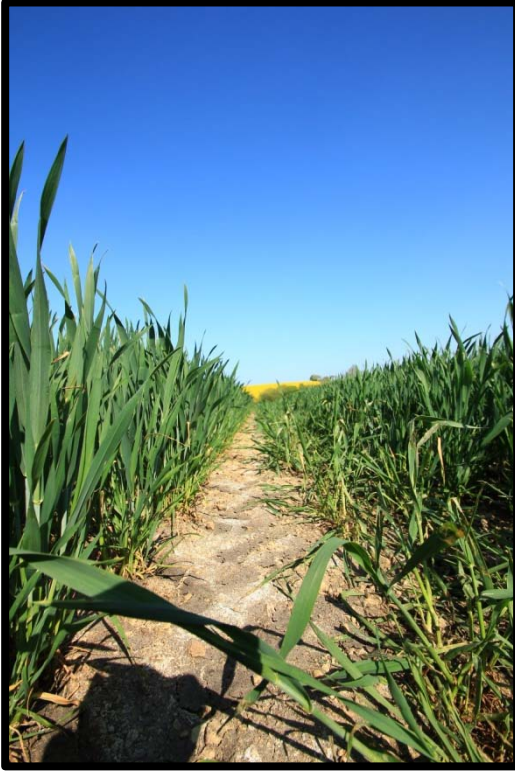
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# Influence of farming system on ground beetle communities at local and landscape scales



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Julien Pétilon and Manuel Plantegenest

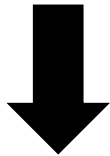
# Context

- Needs for more **sustainable** and **healthy** agricultural systems
- **Development of Organic farming**
  - based on ecological processes
  - no petrochemical fertilizers and pesticides used



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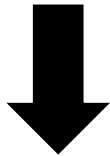


**Beneficial effect** on the  
**abundance** and **species richness**  
of **ground beetle communities**.



# Context

- Needs for more **sustainable** and **healthy** agricultural systems
- **Development of Organic farming**
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**Beneficial effect** on the  
**abundance** and **species richness**  
of **ground beetle communities**.



**How does organic farming affect ground beetle communities at local and landscape scales ?**

# Context

## ➤ Differences in abundances and species composition (richness)



Organic farming

+ Abundance  
Species richness -



Conventional farming



# Context

- Differences in abundances and species composition (richness)

↳ **local scale processes**

## Environmental characteristics



Organic farming

Resources  
Constraints

Reproduction  
Survival



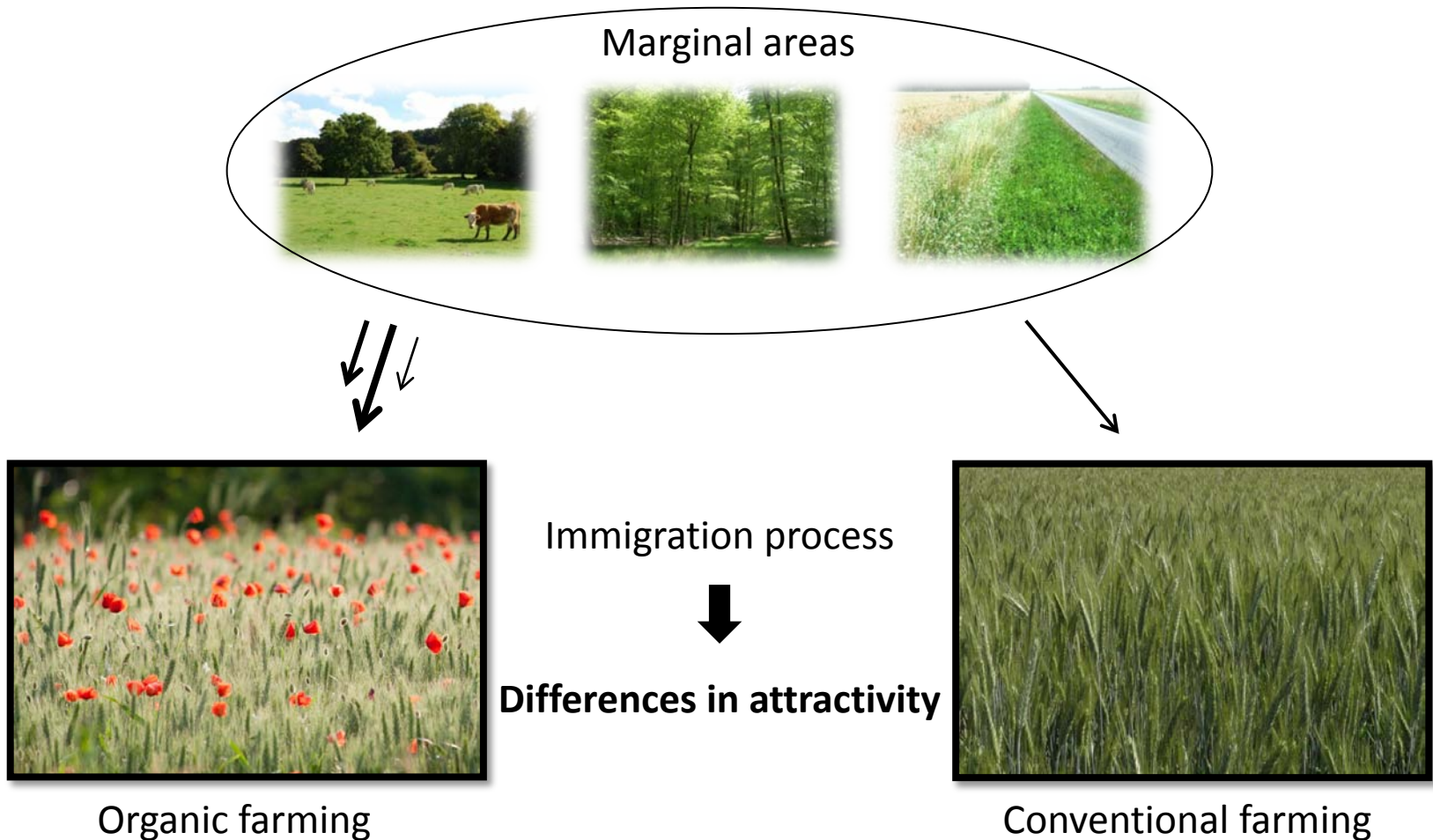
Conventional farming

**Differences in species abundances and composition**

# Context

- Differences in abundances and species composition (richness)

↳ **landscape scale processes**





# Context

- Differences in abundances and species composition (richness)
  - ↳ landscape scale processes : **coexistence of the two systems**



# Context

- Differences in abundances and species composition (richness)
  - ↳ landscape scale processes : **Source/Sink dynamics ?**



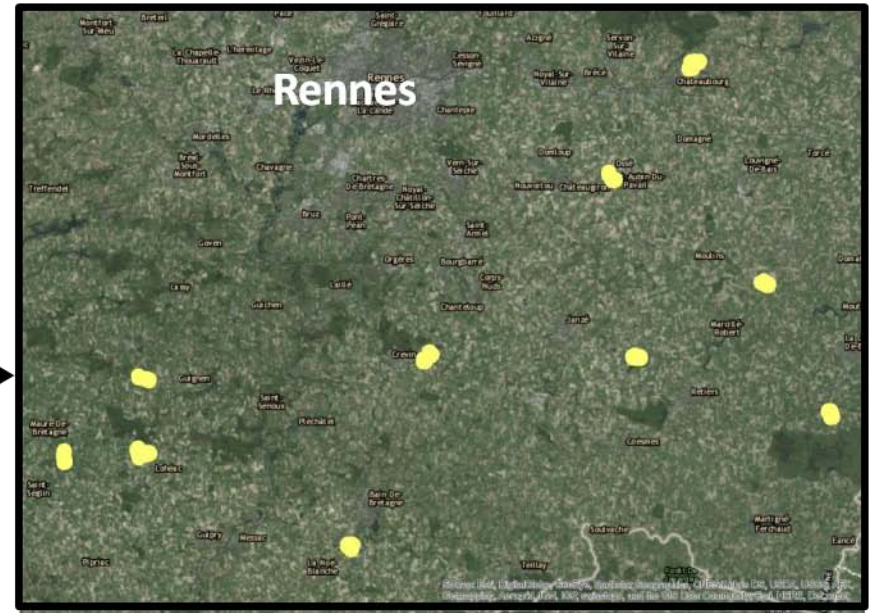
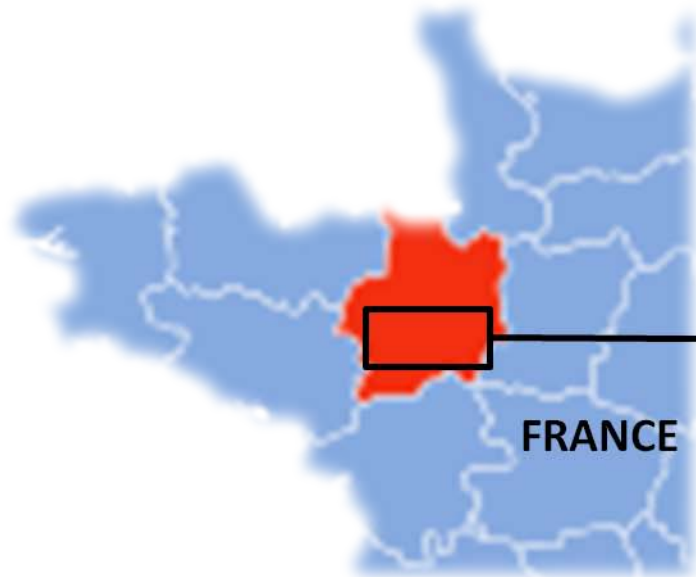
**Influence of the proportion of organic farming at landscape scale ?**

## How does organic farming affect ground beetle communities at local and landscape scales ?

- Contrasting assemblages in organic vs conventional farming
  - ↳ habitat characteristics differ between systems
- Contrasting emerging vs circulating communities
  - ↳ local vs landscape contribution
- Assessing landscape influence on local communities
  - ↳ source/sink dynamics

# Method

## ❖ Study site



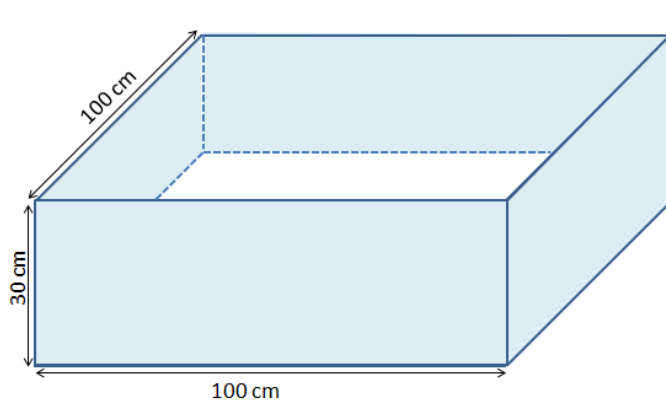
Selection of :

- 10 landscapes in Brittany
  - ↳ 20 wheat fields
    - 10 under organic farming
    - 10 under conventional farming

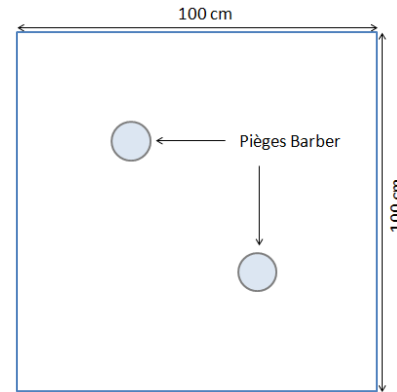


# Method

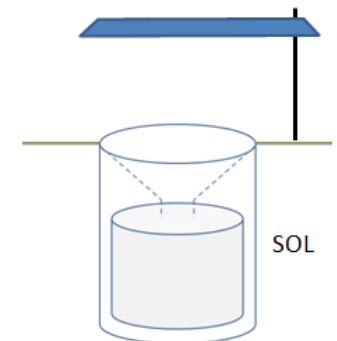
## ❖ Experimental device



Emergence arena



- In each sampled field :
  - ➔ 3 emergence arenas including two pitfall traps
  - ➔ 1 pitfall trap located in the vicinity of each emergence arena
- Samples collection every 2 weeks (april-may 2015).



Pitfall trap



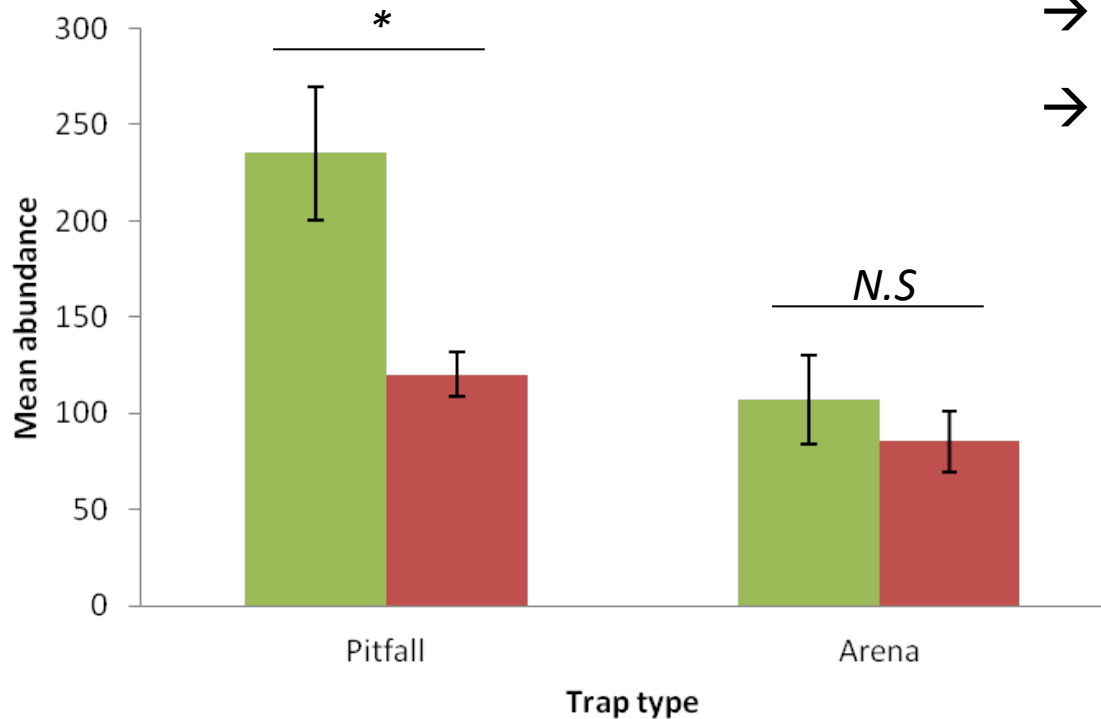
# Results : Local scale

## ❖ Abundances

**Higher abundances in OF :**

→ attractive effect ?

→ differences in mortality rates ?

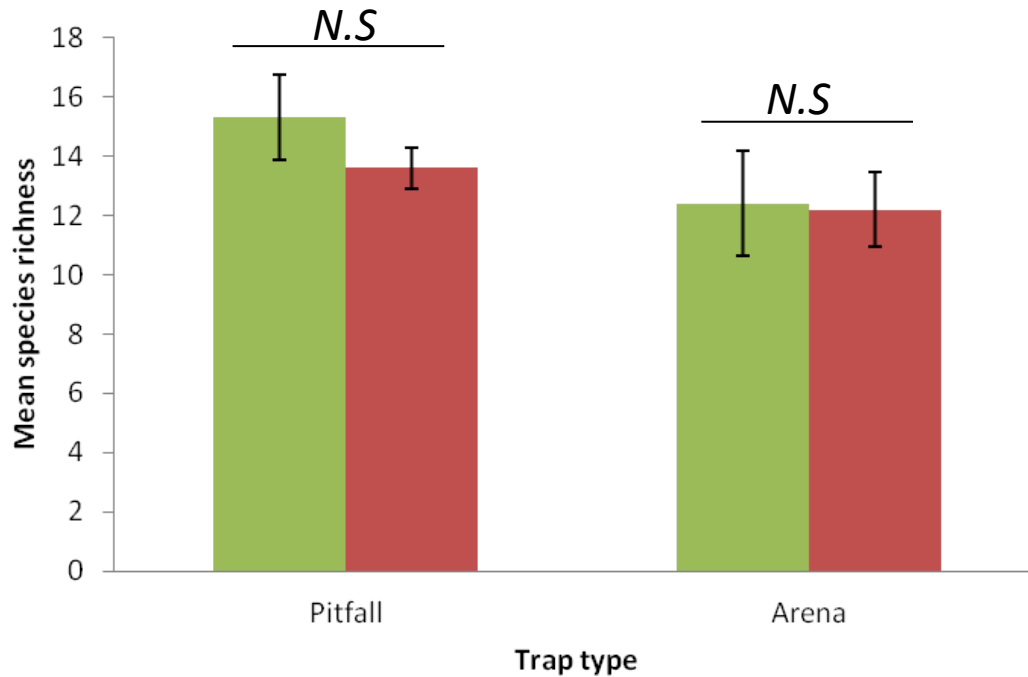


N.S : nonsignificant difference ; \* :  $P < 0.05$

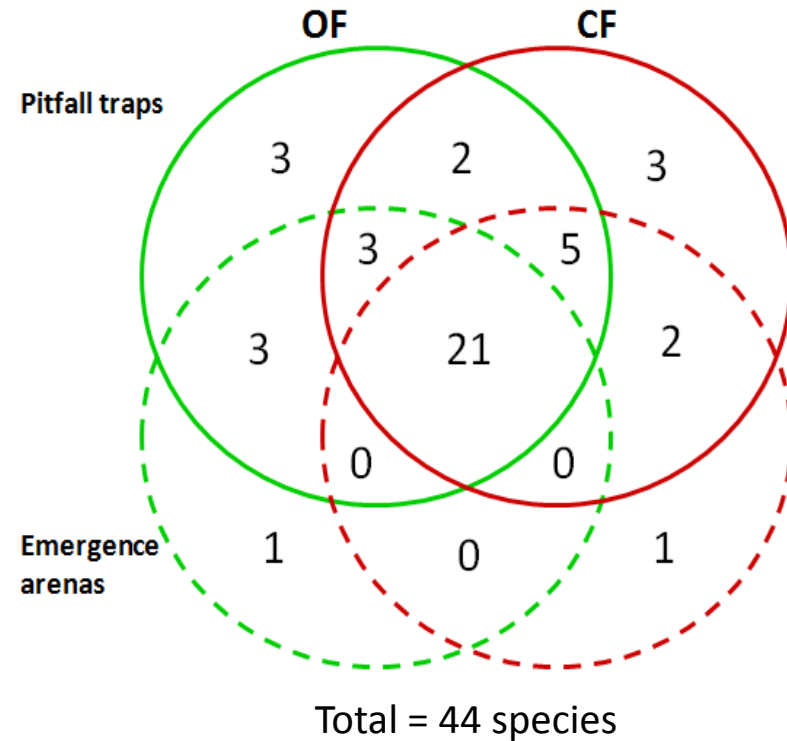
green : OF and red: CF

# Results : Local scale

## ❖ Species richness



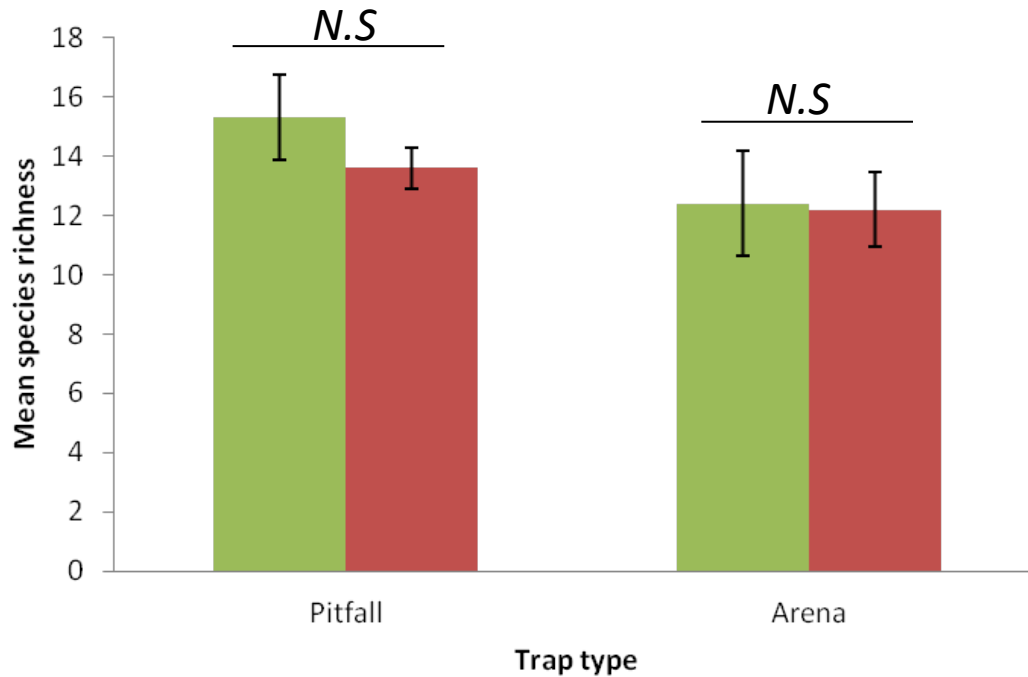
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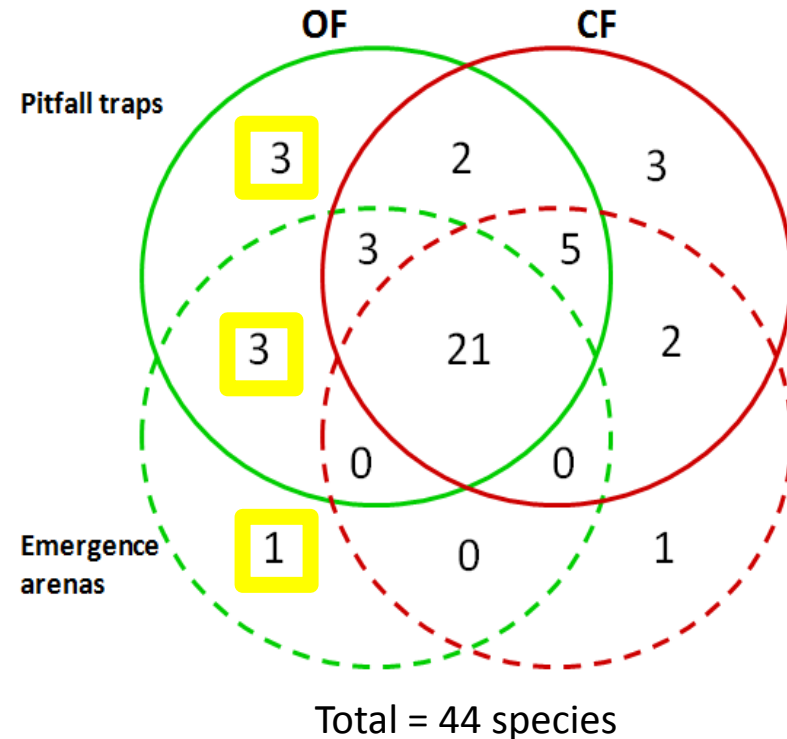
➤ Similar species richness **in** the two systems.

# Results : Local scale

## ❖ Species richness



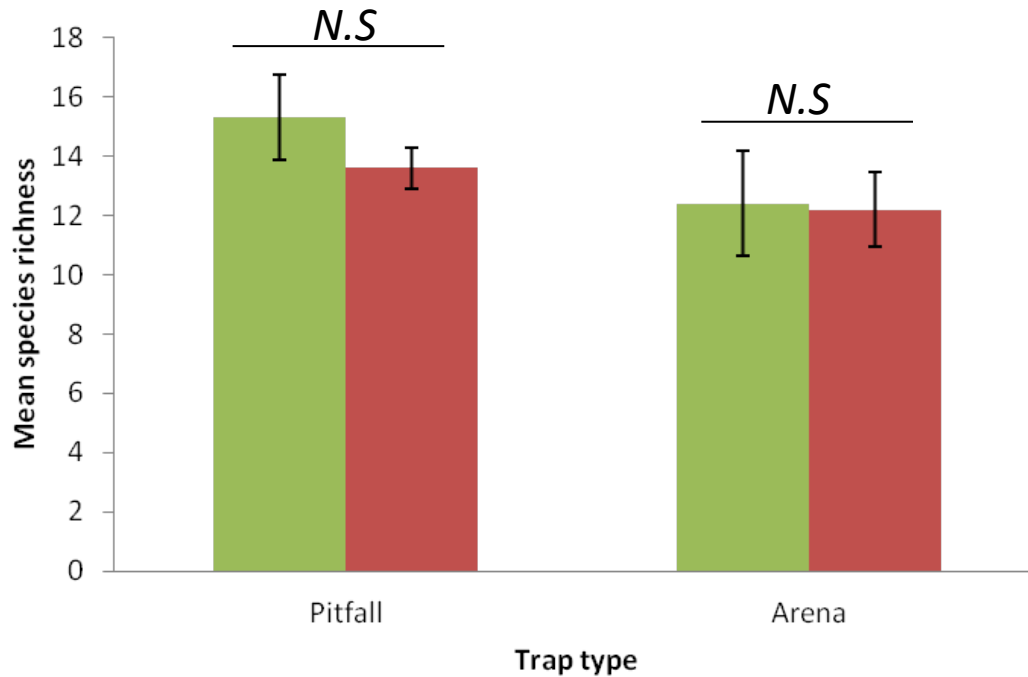
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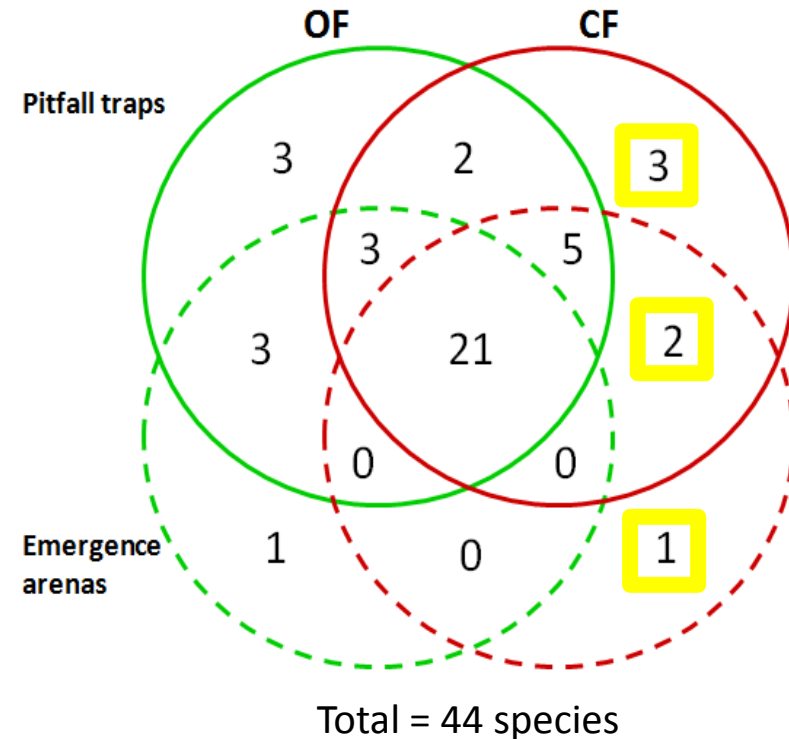
- Similar species richness between the two systems.
- Variation in communities composition.

# Results : Local scale

## ❖ Species richness



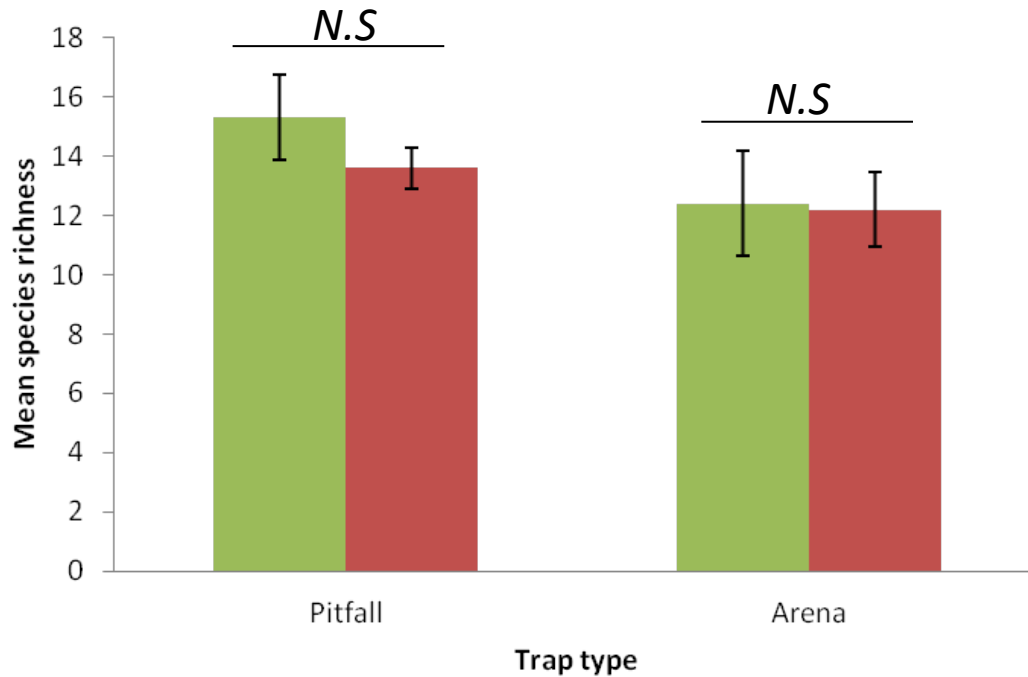
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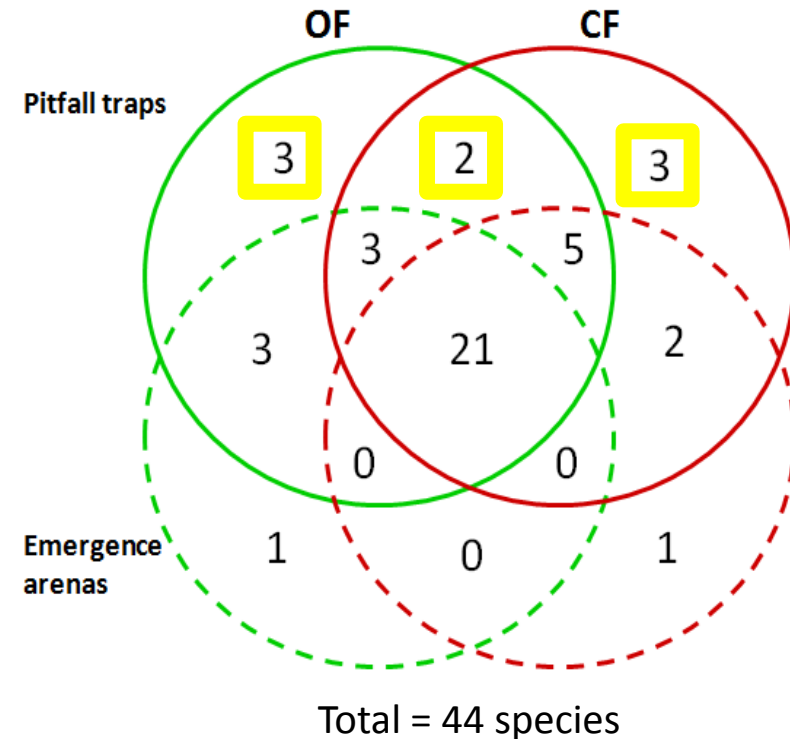
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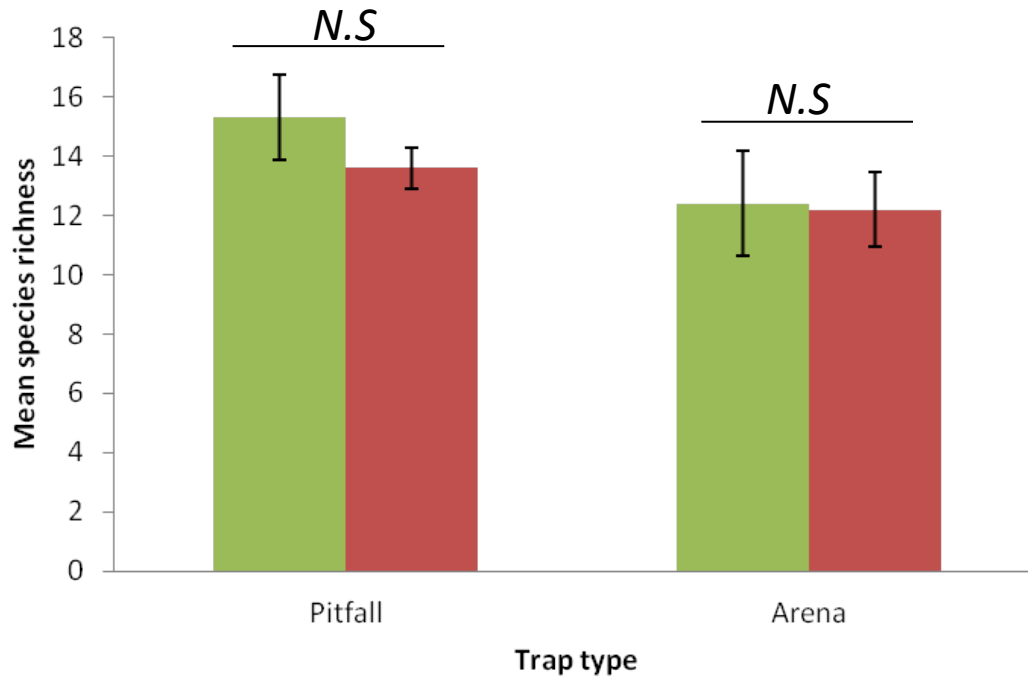


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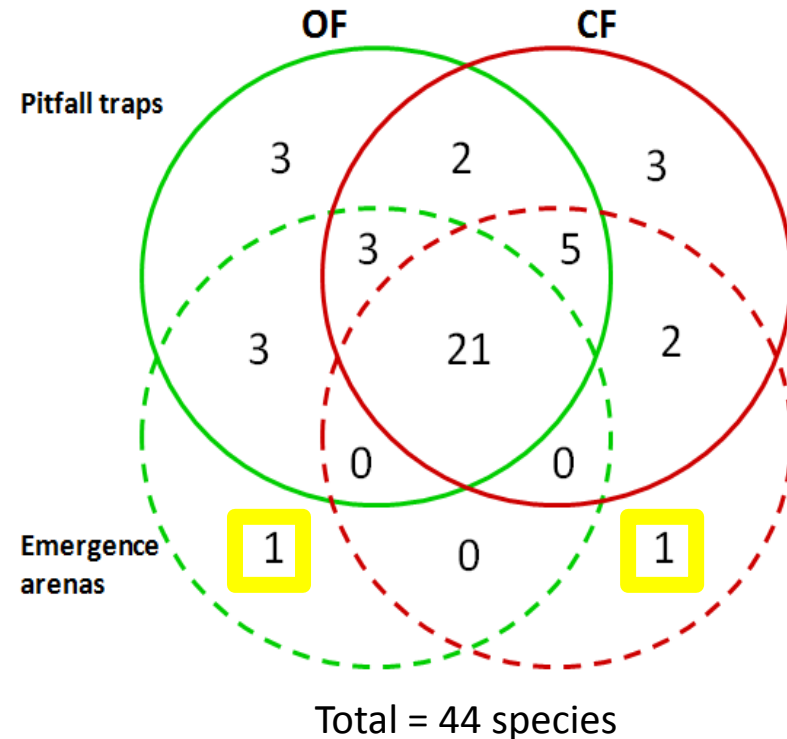


# Results : Local scale

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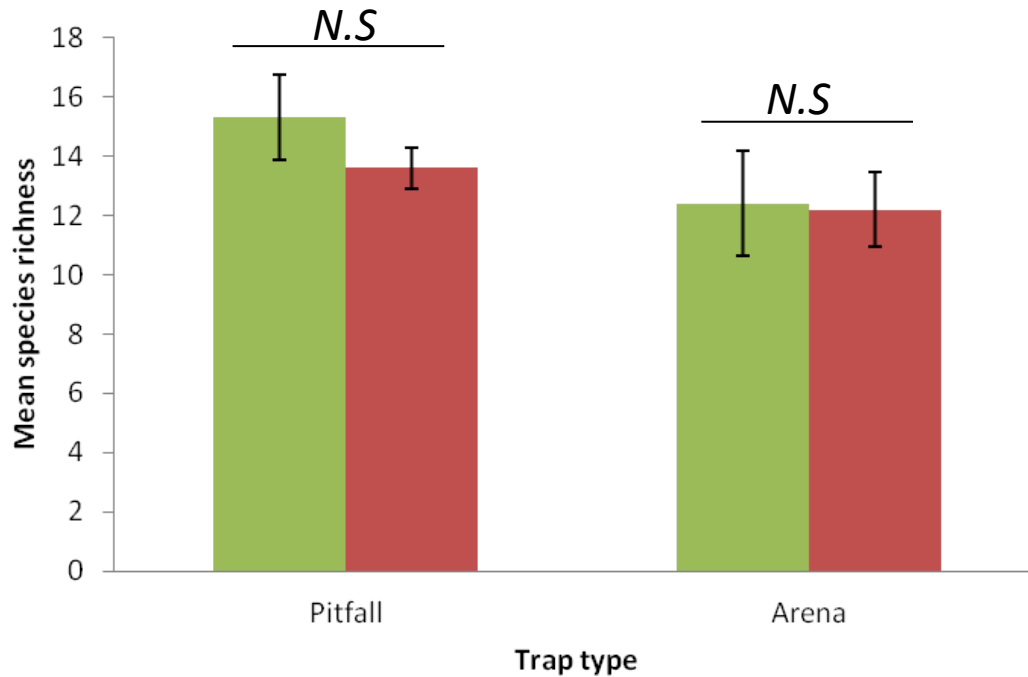
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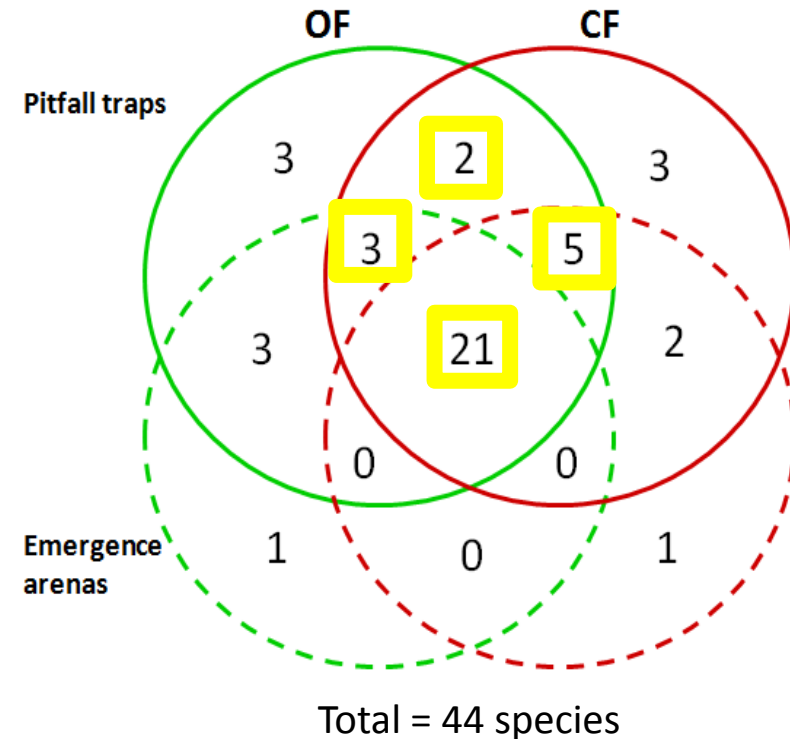
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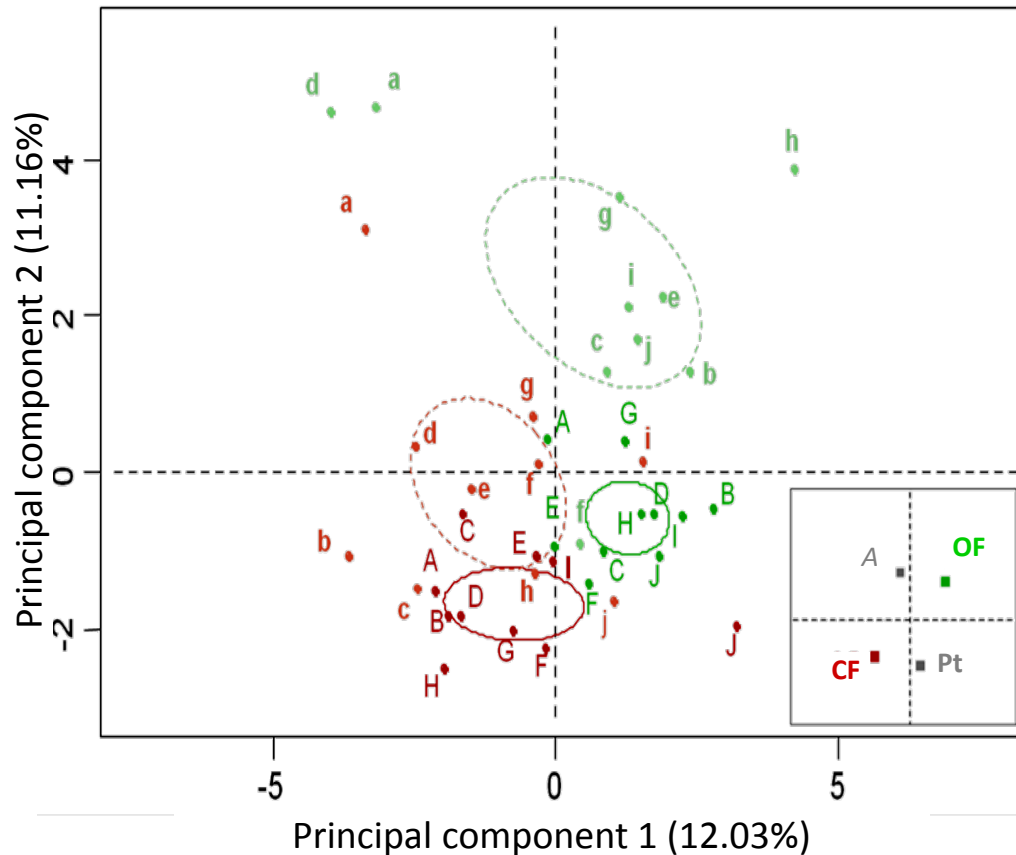
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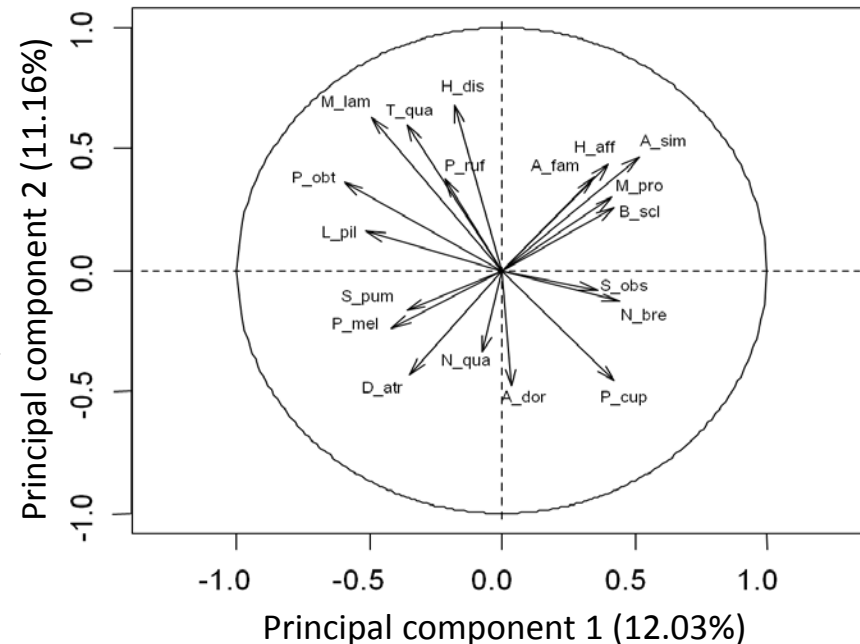
- Similar species richness between the two systems.
- Majority of species are present in the two systems.

# Results : Local scale

## ❖ Specific composition of ground beetle communities

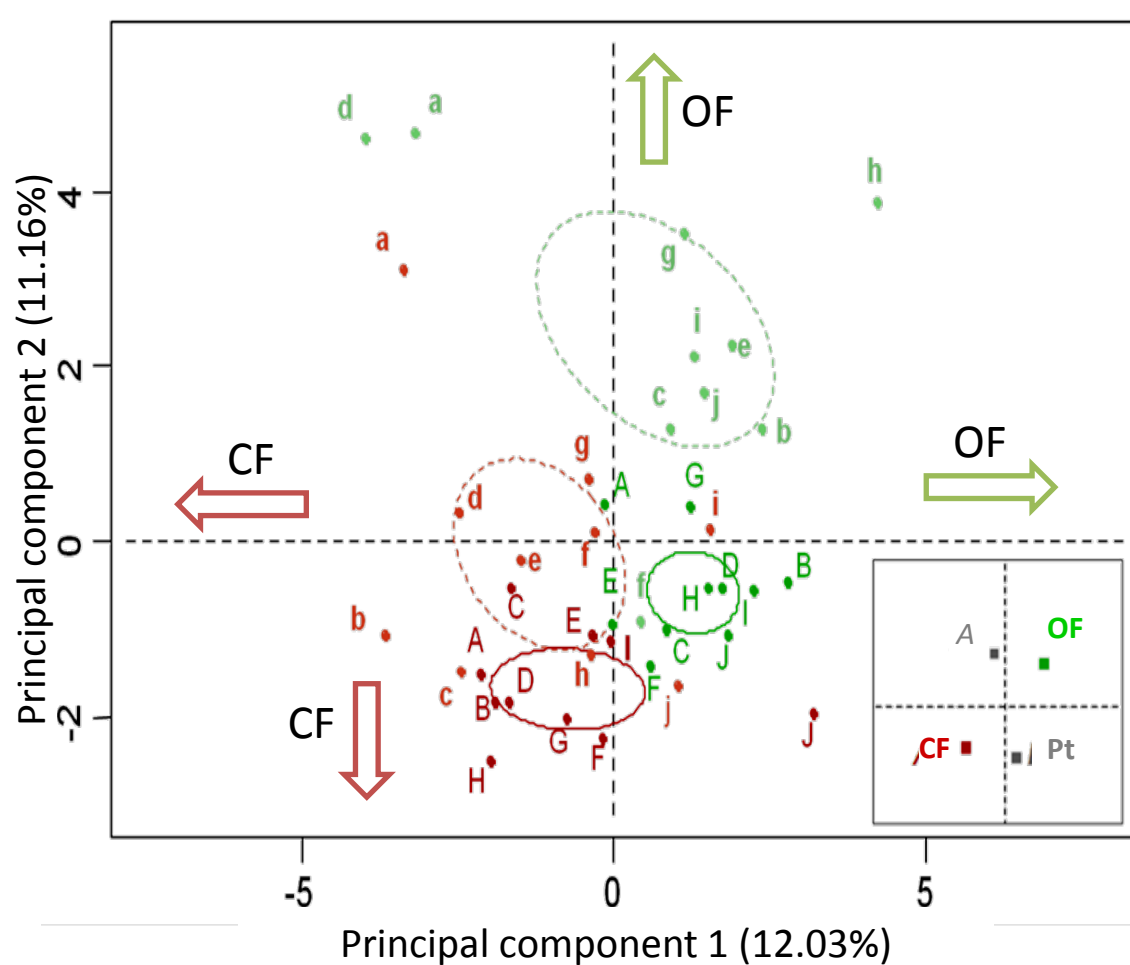


PCA : **species proportions** captured in both trap types during the entire sampling period.



# Results : Local scale

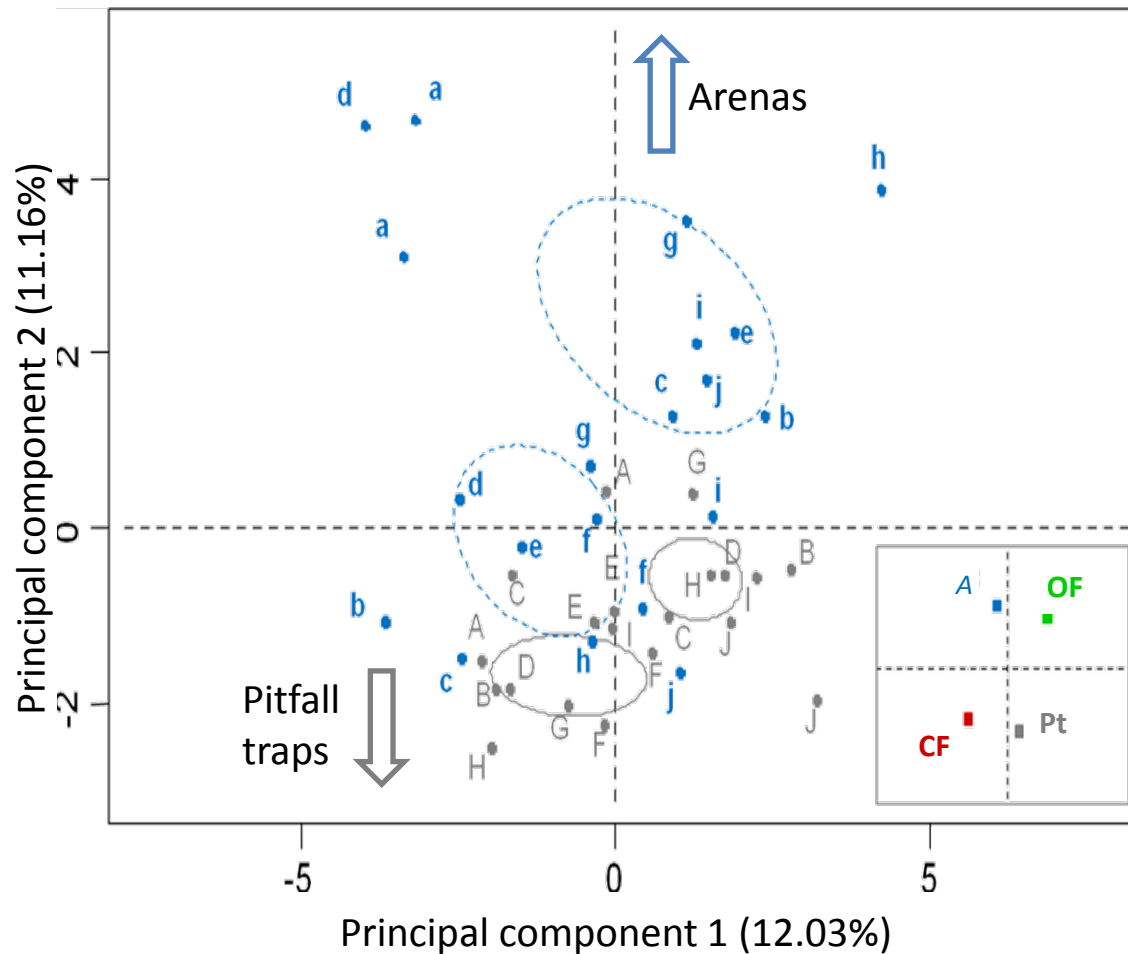
❖ Specific composition of ground beetle communities



Axe 1 & 2 :  
**organic and conventional  
communities differ**

# Results : Local scale

## ❖ Specific composition of ground beetle communities

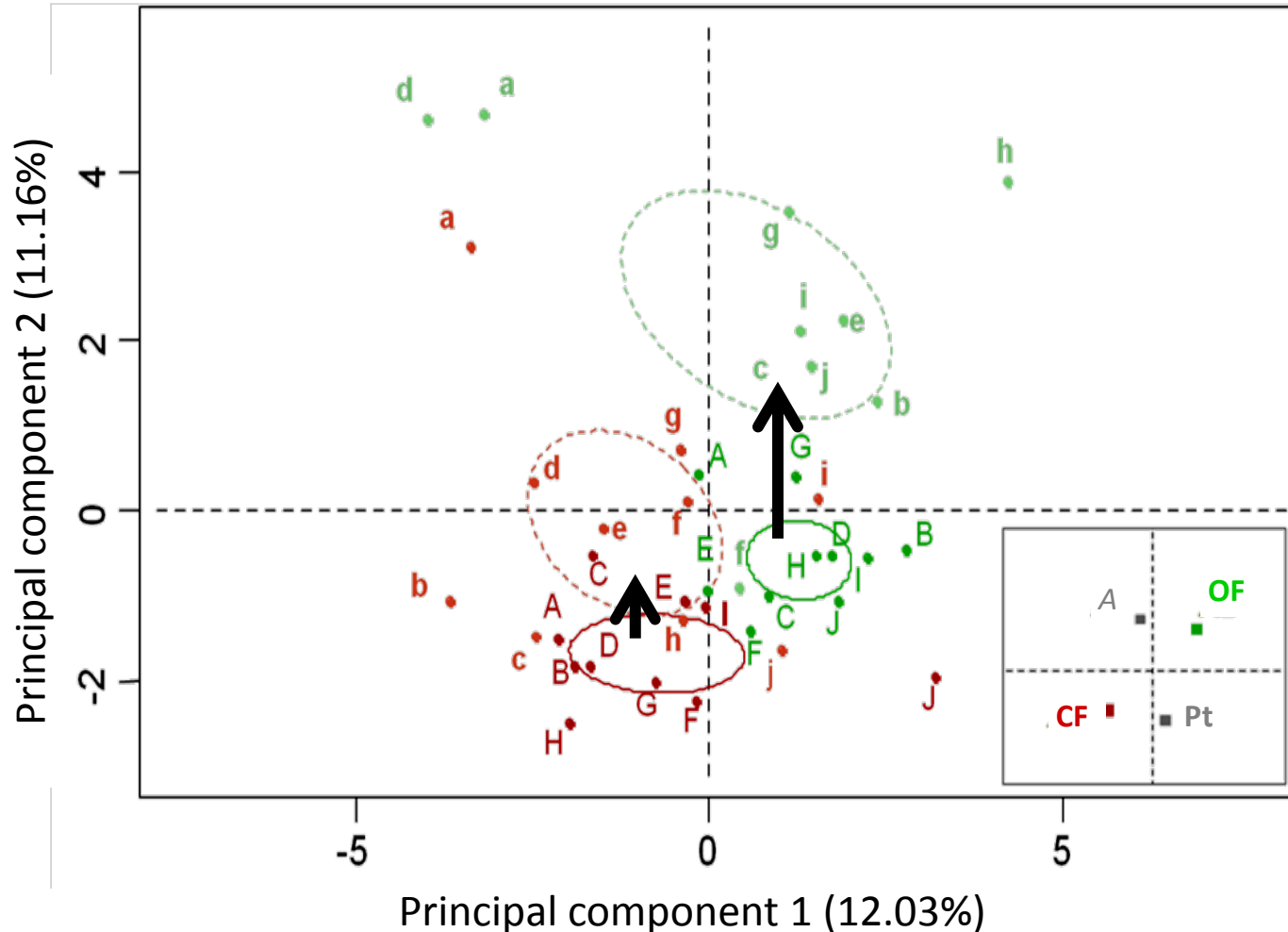


Axe 2 :  
circulating and emerging  
communities differ



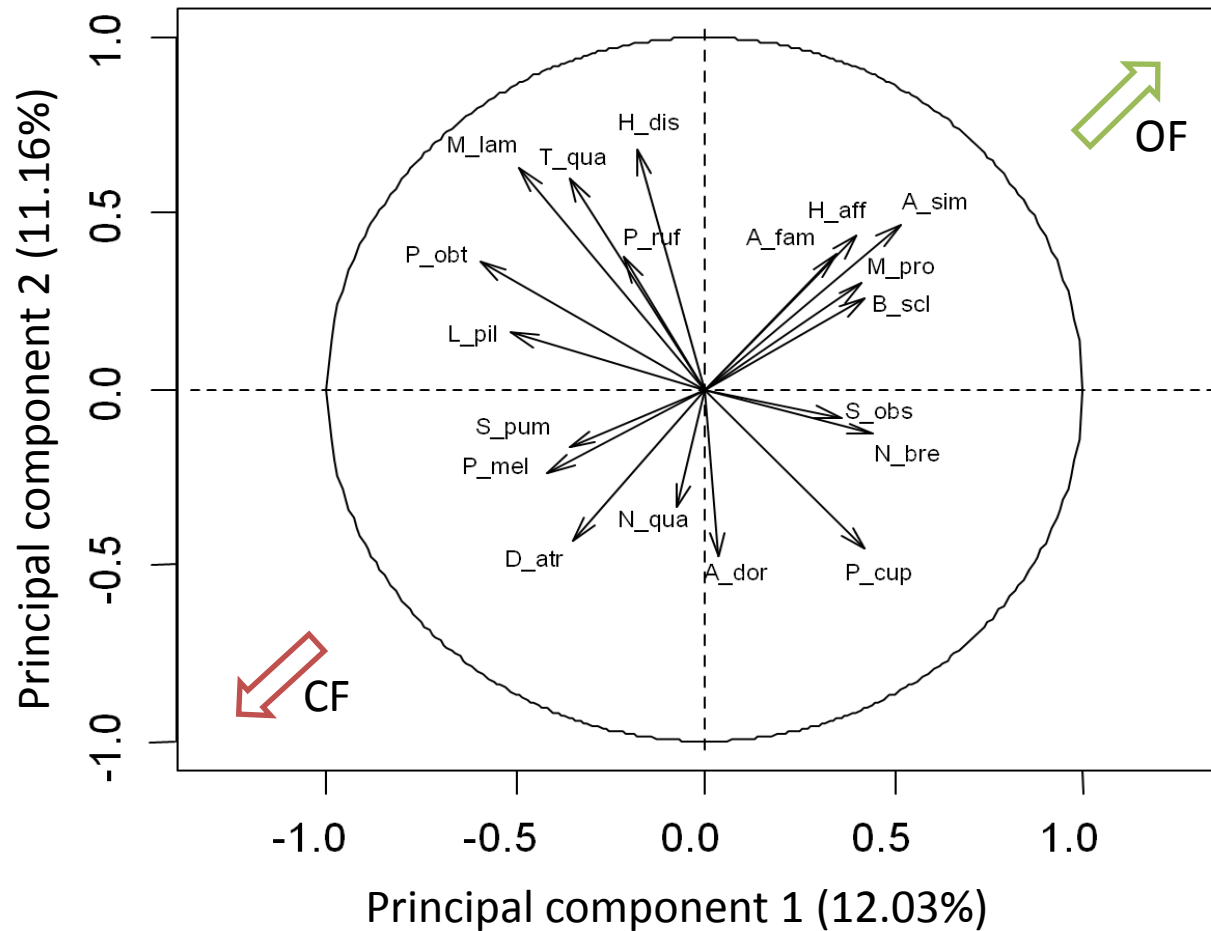
# Results : Local scale

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# Results : Local scale

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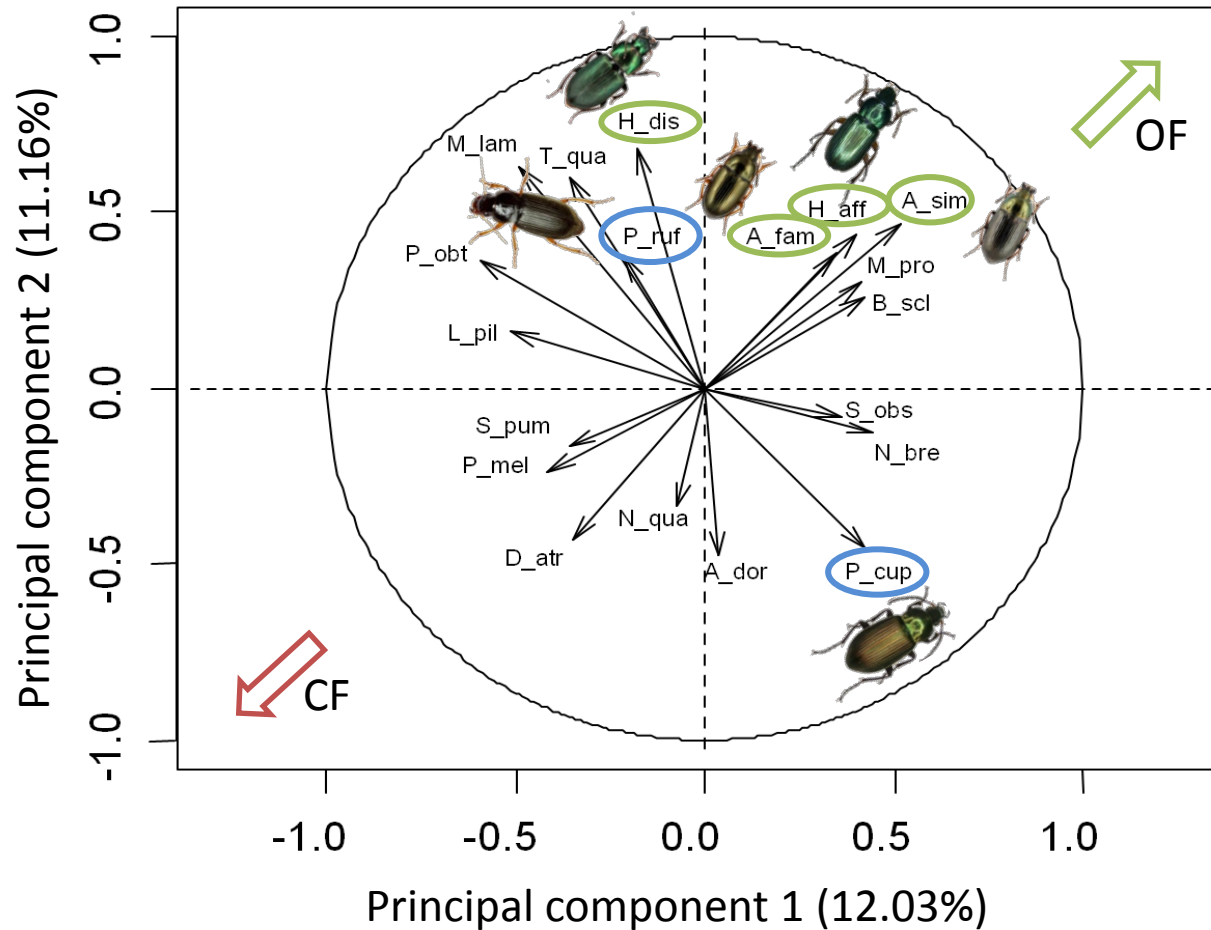


**Organic farming :**

- Rich vegetation cover

# Results : Local scale

## ❖ Specific composition of ground beetle communities



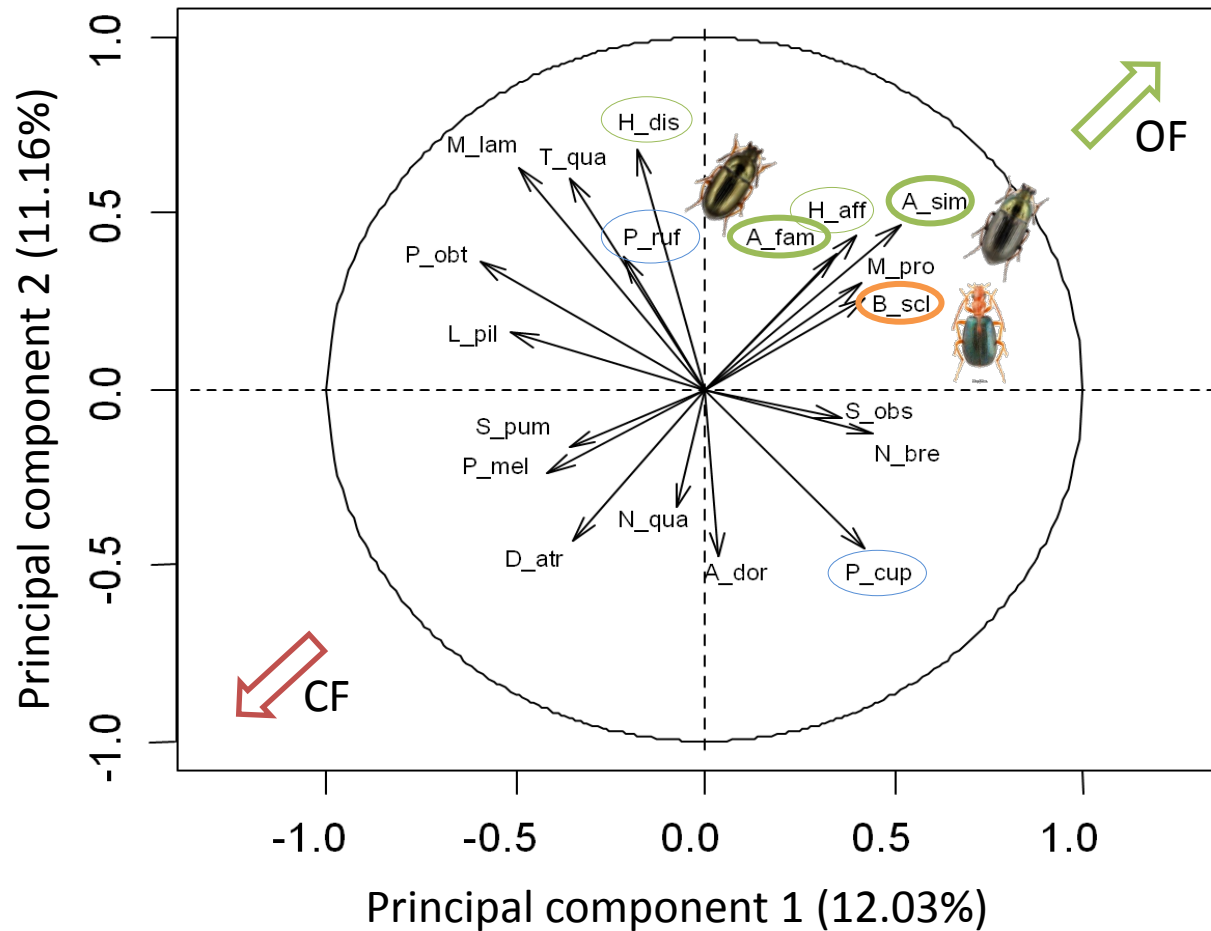
### Organic farming :

- Rich vegetation cover

↳ phytophagous

# Results : Local scale

## ❖ Specific composition of ground beetle communities



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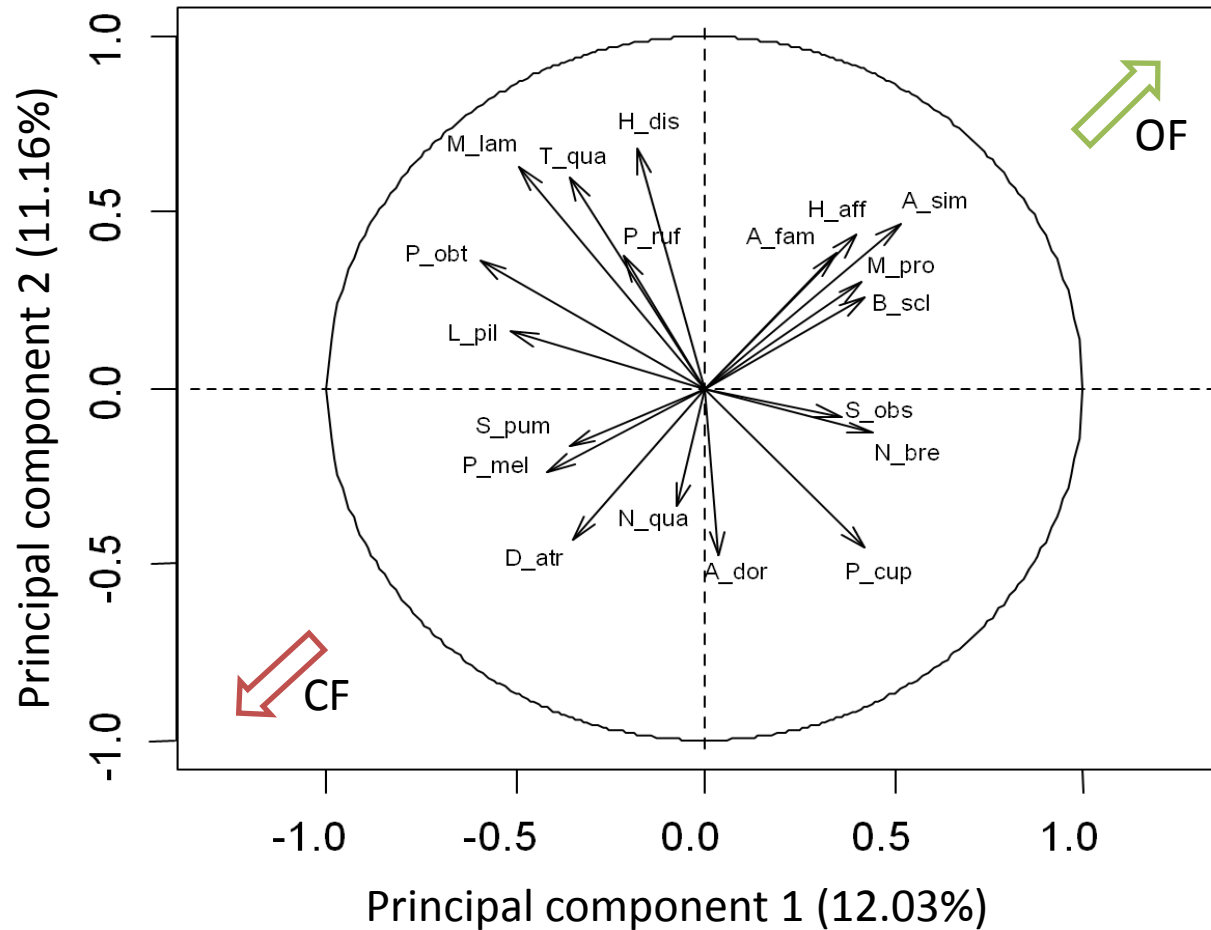
- ↳ phytophagous

- Genus *Amara*

- ↳ genus *Brachinus*

# Results : Local scale

## ❖ Specific composition of ground beetle communities

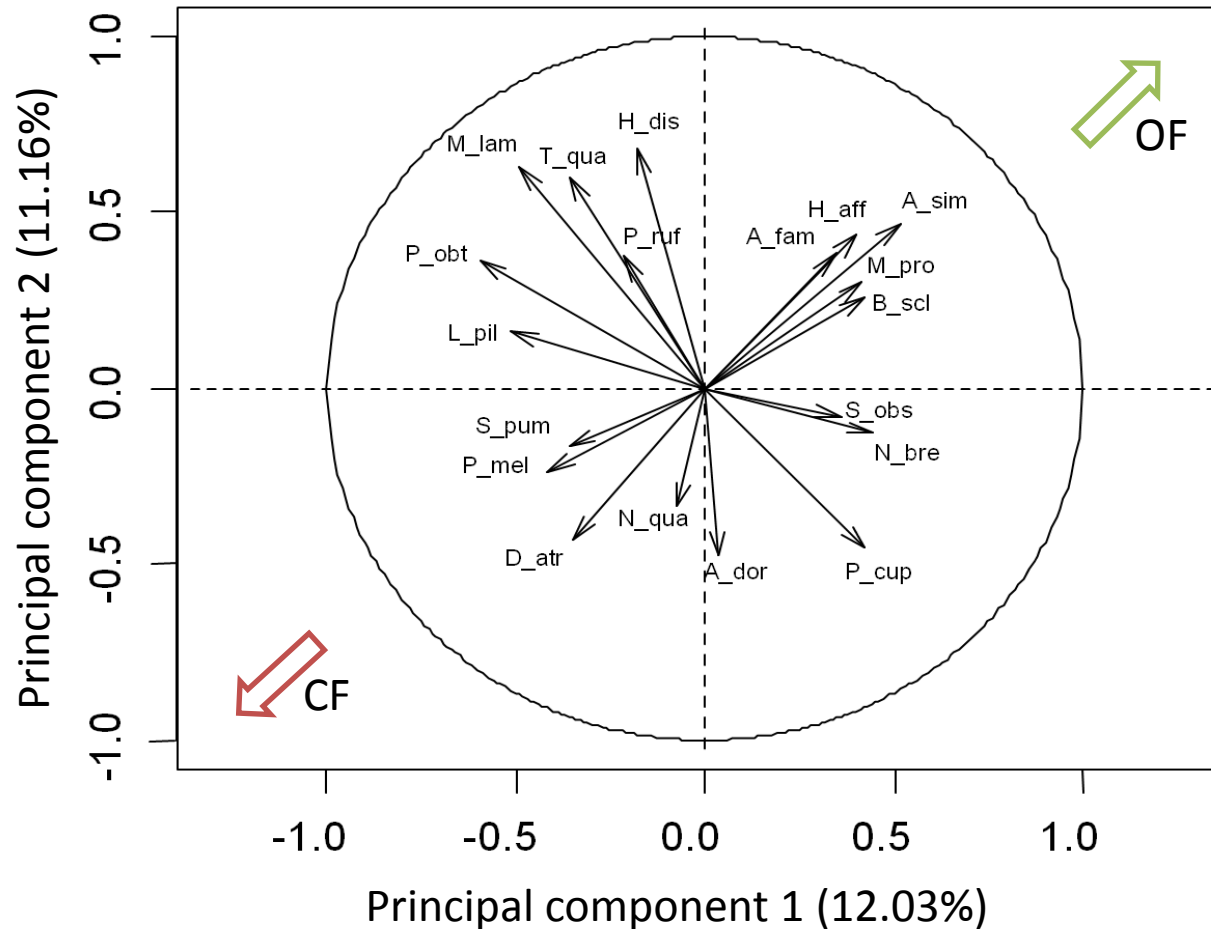


**Conventional farming :**  
- less diverse resources



# Results : Local scale

## ❖ Specific composition of ground beetle communities



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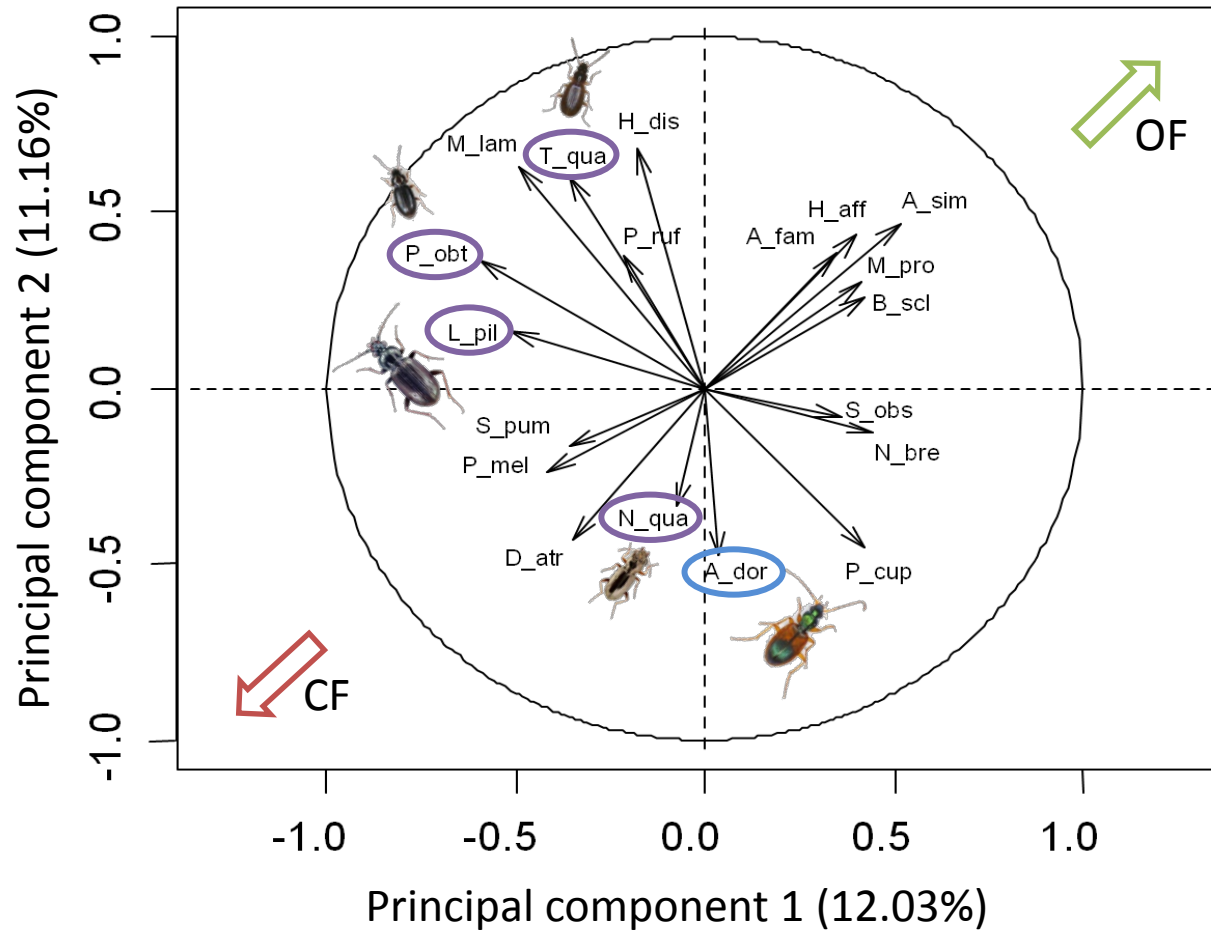
↳ collembola

↳ slugs

↳ aphids

# Results : Local scale

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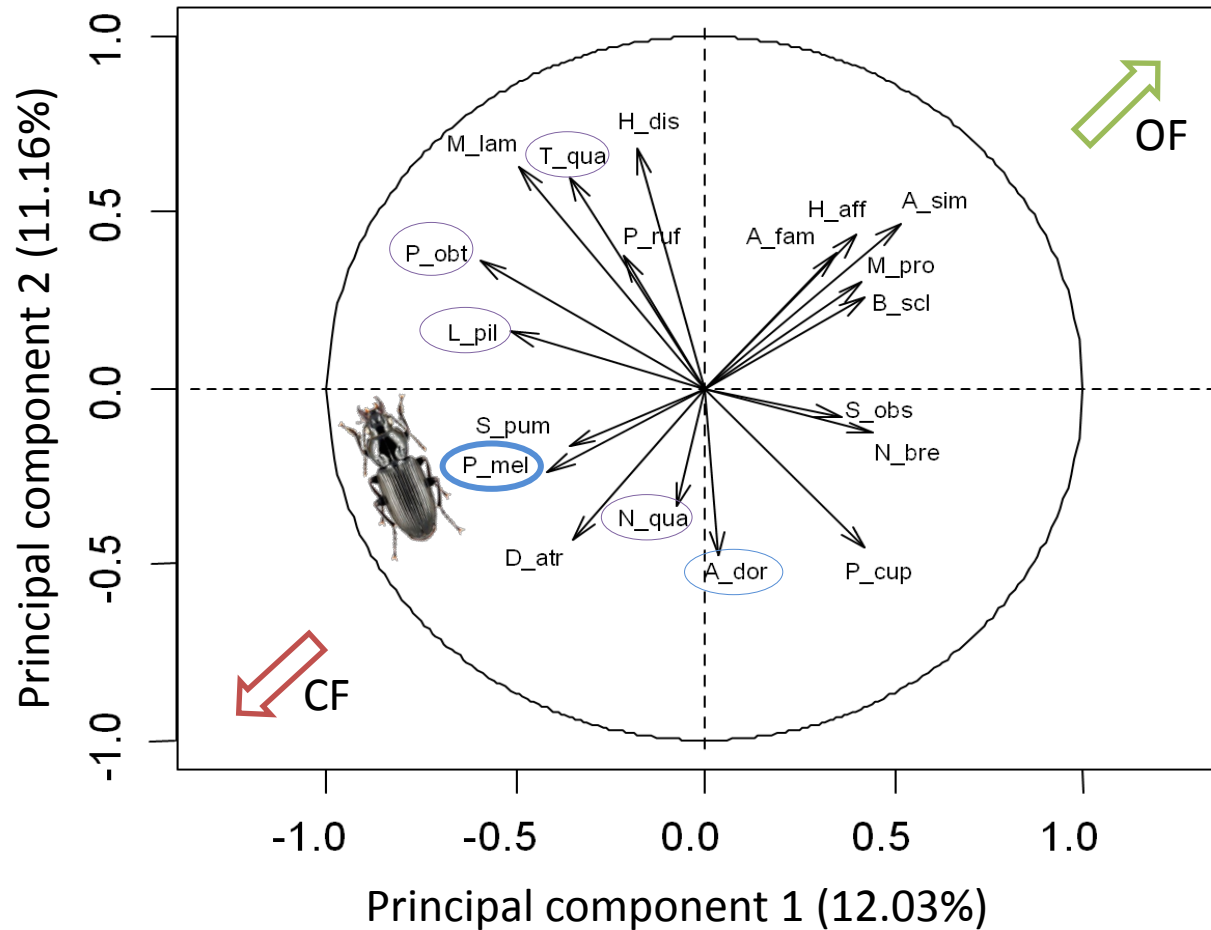
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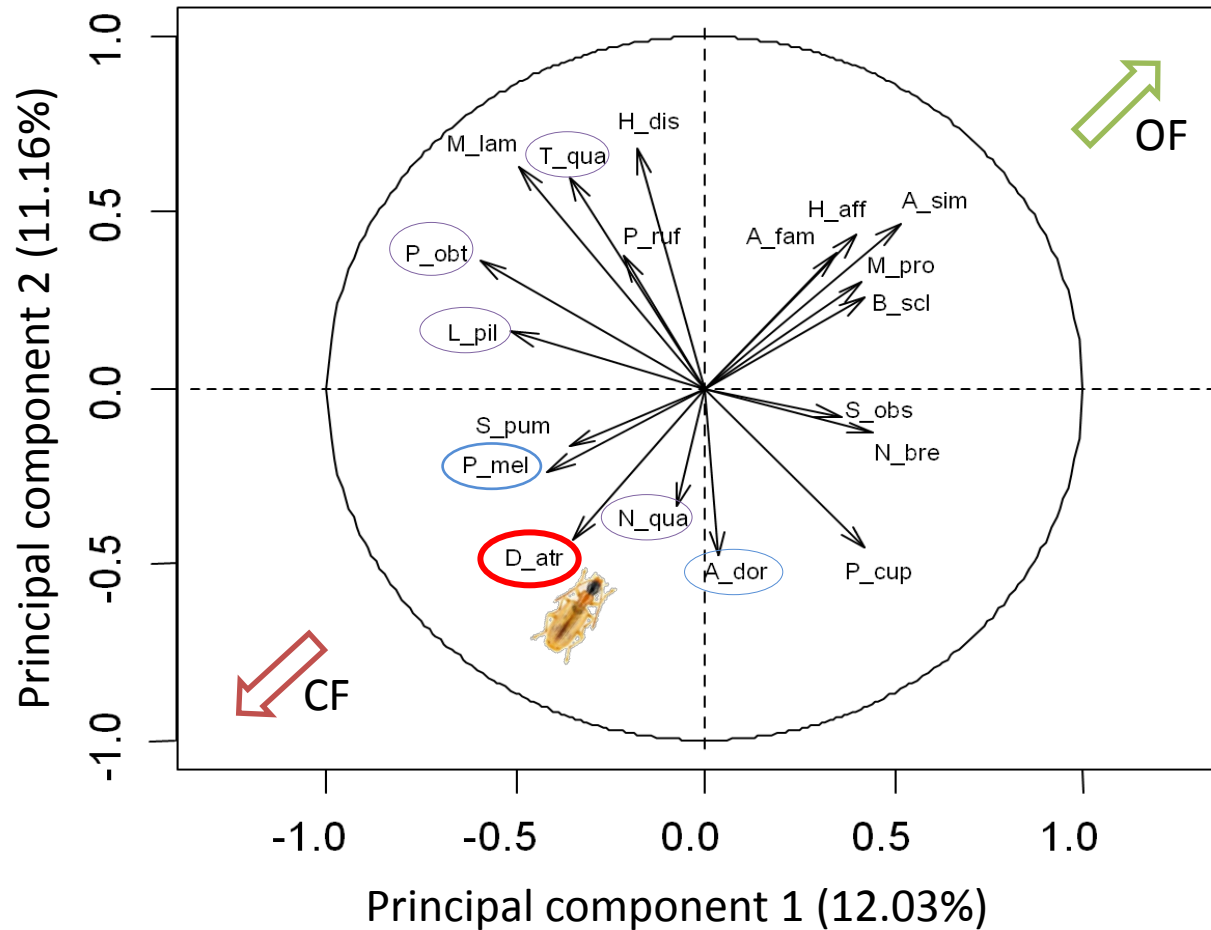
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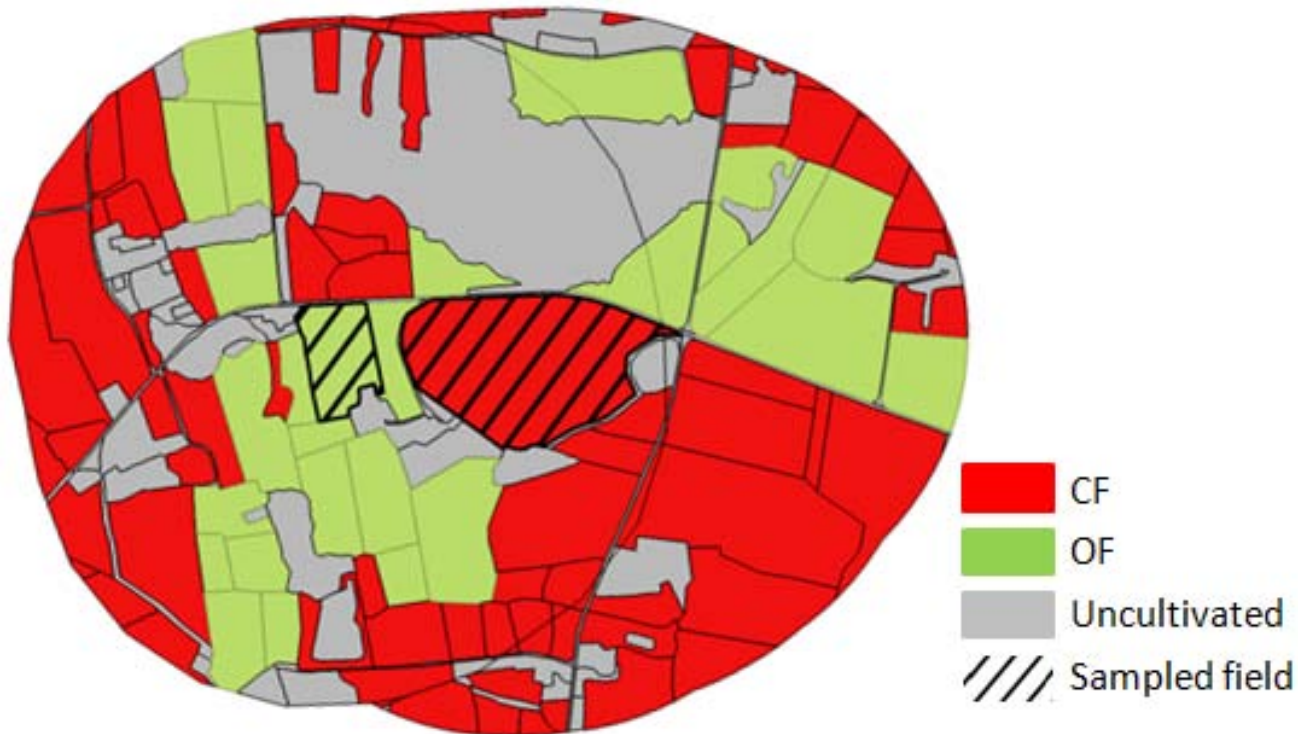
↳ aphids

# Landscape scale

## ❖ Method

Cartography :

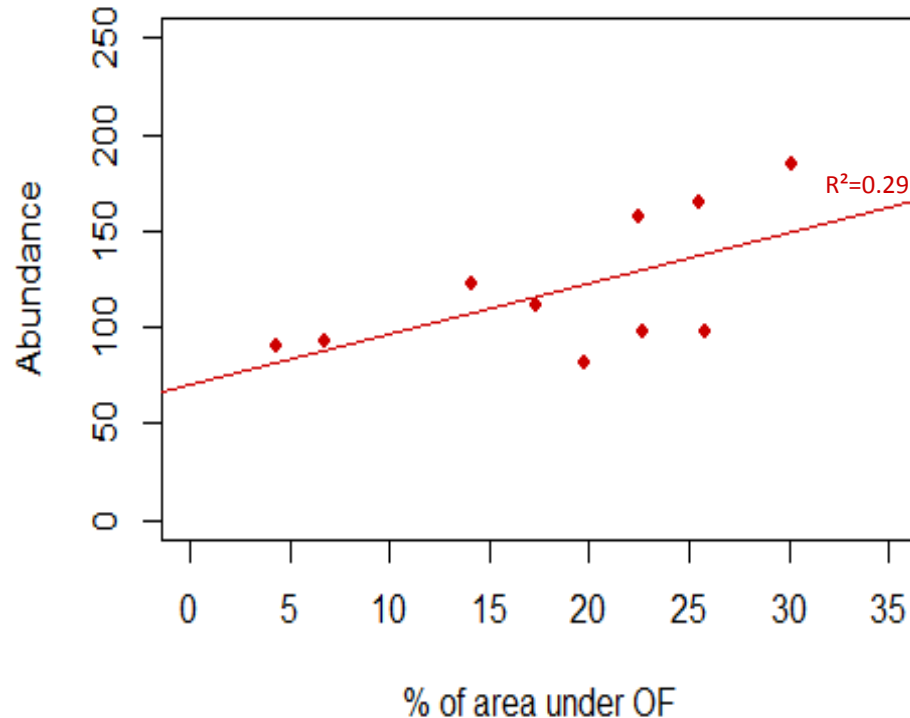
- Buffer of 500m around fields
- Information on crops management
  - ↳ OF gradient in the surroundings of sampling fields.



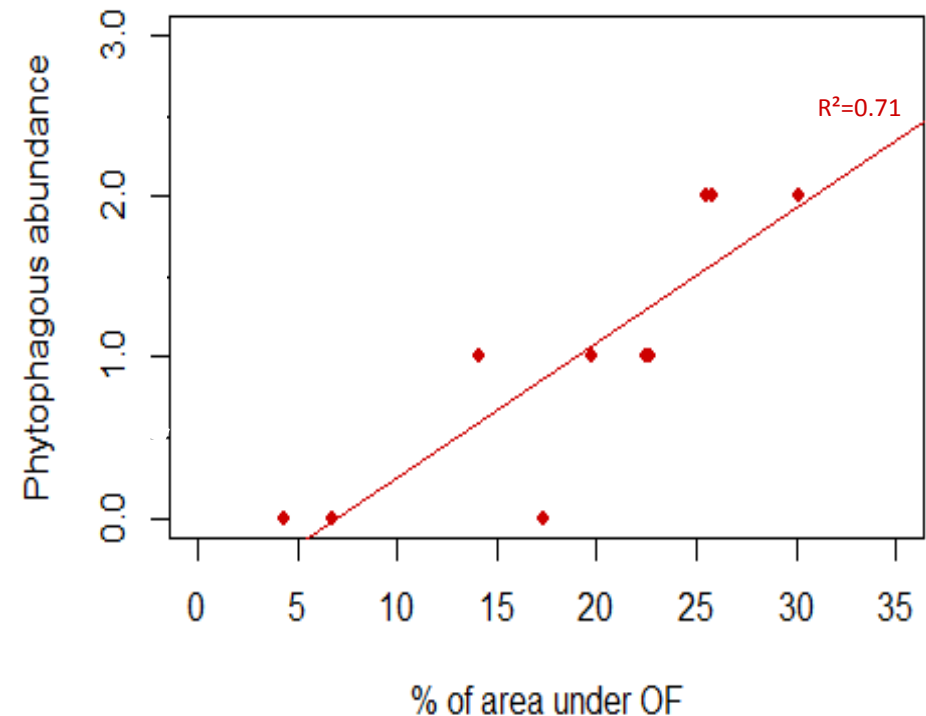
# Results : Landscape scale

## ❖ Influence of OF percentage in **the** landscape

Total abundances in CF fields



Abundances of phytophagous species in CF fields



Increasing the percentage of organic farming in **the** landscape :

- ↗ abundance **of** circulating communities in CF
- ↗ abundance **of** circulating phytophagous species in CF

# Conclusions

- Differences in species composition :
  - OF : phytophagous species
  - CF : collembola eaters
- ↳ Communities structure driven by **resources availability**.

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Organic farming



Conventional farming



# Conclusions

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Organic farming



Conventional farming

- Abundances in circulating communities > in OF.
- Slight differences in abundances in emerging communities.
- Differences between circulating & emerging communities in OF.

↳ OF act<sup>s</sup> as a **sink** → attractiveness of crops

# Conclusions

➤ Differences in species composition :

- OF : phytophagous species
- CF : collembola eaters

↳ Communities structure driven by **resources availability**.



Organic farming



Conventional farming

➤ Abundances in circulating communities > in OF.

➤ Slight differences in abundances in emerging communities.

➤ Differences between circulating & emerging communities in OF.

↳ OF acts as a **sink** → attractiveness of crops

➤ Abundances increase in circulating communities in CF in relation with the augmentation of OF percentage in **the** landscape.

↳ OF act<sup>s</sup> as a **source** → dispersion/dynamics at landscape scale

# To go further ...

Interactions between systems

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**Isotopic tool → identifying and quantifying migrant flows**

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Interactions between systems



**Isotopic tool → identifying and quantifying migrant flows**

- Changes in soil's isotopic labelling :
  - differences in fertilization methods
  - differences in organic matter origin

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Interactions between systems



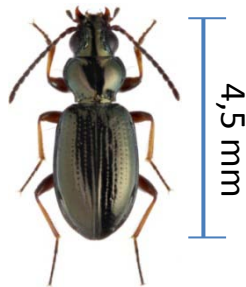
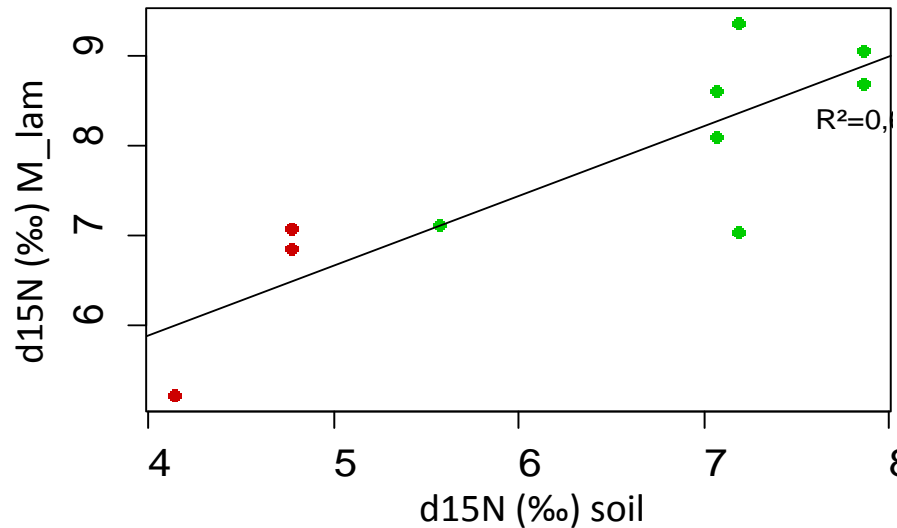
**Isotopic tool → identifying and quantifying migrant flows**

- Changes in soil's isotopic labelling :
  - differences in fertilization methods
  - differences in organic matter origin
  
- Isotopic labelling transmission from soils to ground beetle ?

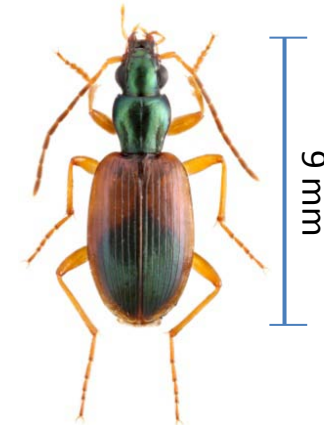
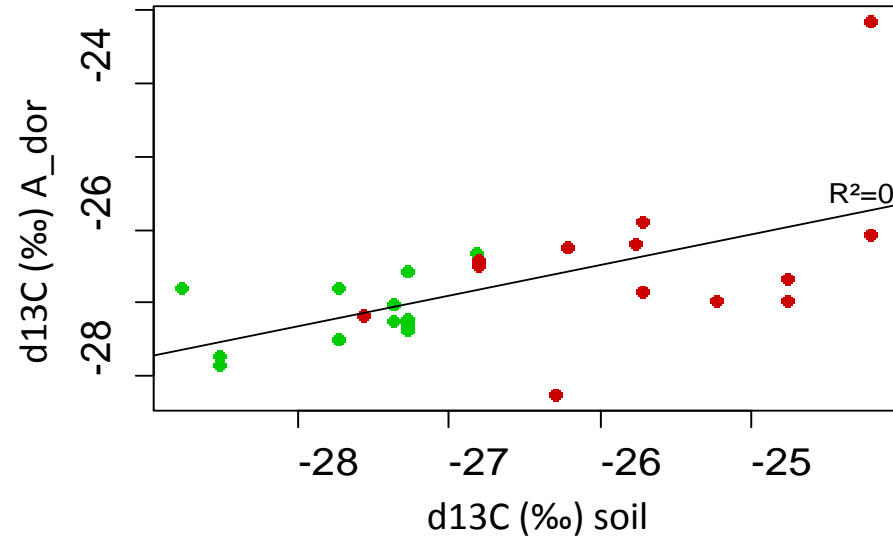
# First results : Isotopic labelling

## ❖ Isotopic labelling of emerging individuals

*Metallina lampros* pros



*Anchomenus dorsalis* alis



# Isotopic labelling

## ❖ First conclusions

- Coherence soil / ground beetle isotopic labelling
  - ↳ confirms usefulness of the method
- High intraspecific variability → no individual assignment



# Isotopic labelling

## ❖ First conclusions

➤ Coherence soil / ground beetle isotopic labelling

↳ confirms usefulness of the method

➤ High intraspecific variability → no individual assignment

➤ **The** method allows the evaluation of the contribution at populational scale.



**importance and temporality exchanges**  
between both farming systems.

➤ **Organic farming :**

- sink in spring → attractiveness of crops
- source at farm scale → management and type of marginal areas
- source at the scale of multiannual dynamics

# Prospects

## ➤ Organic farming :

- sink in spring → attractiveness of crops
- source at farm scale → management and type of marginal areas
- source at the scale of multiannual dynamics

## ➤ Take into account:

- landscape features associated with **farming** systems
- temporal variability of habitats

to **assess** :

- relative contribution of **farming** systems for auxiliary production
- exchanges of migrants between **farming** systems

and thus **quantify** their influence in terms of biological control.

# Prospects

## ➤ Organic farming :

- sink in spring → attractiveness of crops
- source at farm scale → management and type of marginal areas
- source at the scale of multiannual dynamics

## ➤ Take into account:

- landscape features associated with farming systems
- temporal variability of habitats

to **assess** :

- relative contribution of farming systems for auxiliary production
- exchanges of migrants between farming systems

and thus **quantify** their influence in terms of biological control.

## ➤ Utilization of **isotopic tool** to characterize the **migrant flows** between farming systems.

**Thank you for your attention.**

