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## Farmland heterogeneity & complementation a case study on carabid beetles

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# Farmland heterogeneity & complementation

## A case study on carabid beetles

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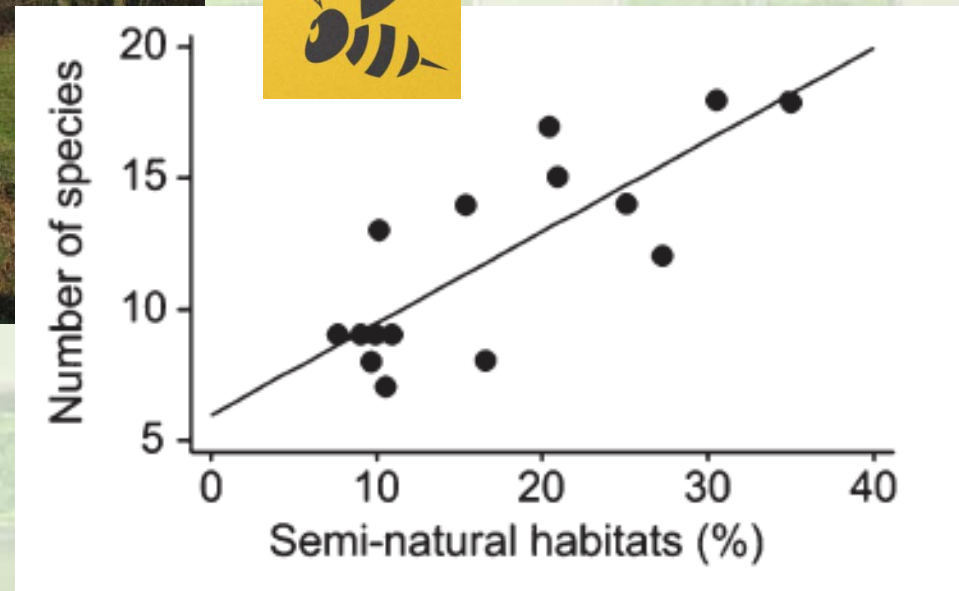
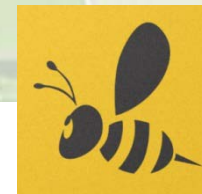
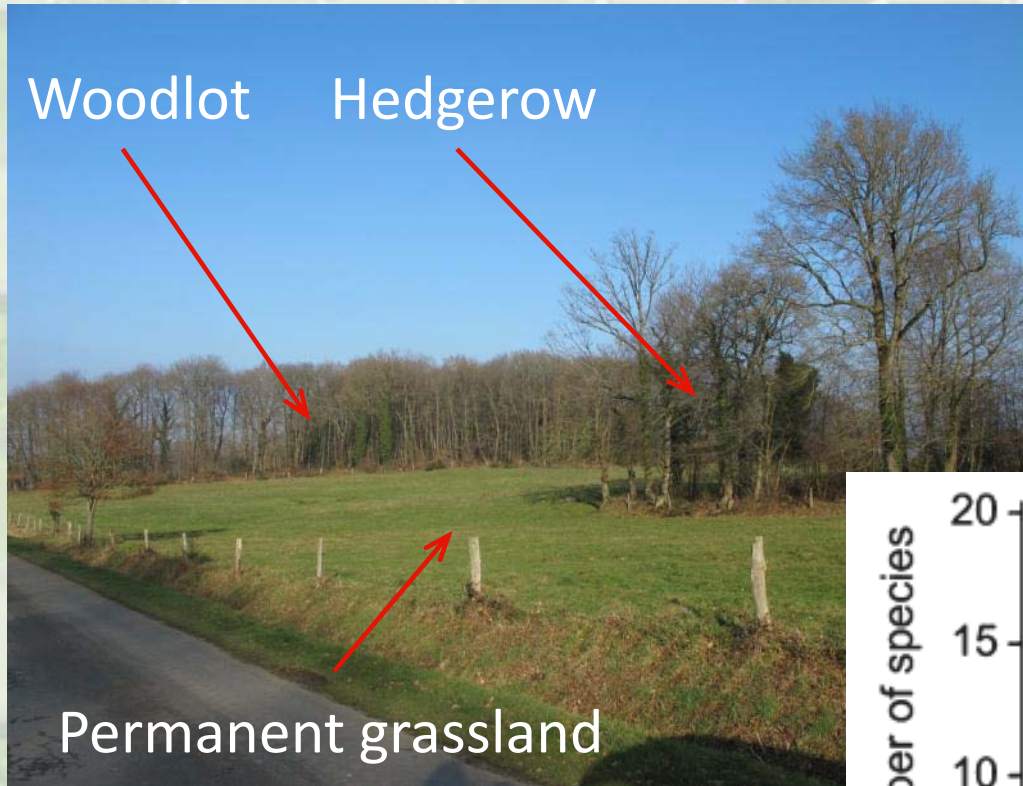
- Françoise BUREL
- Stéphanie AVIRON
- Aude ERNOULT



- **Biodiversity loss** in agricultural landscapes
- Maintaining biodiversity is a foremost social and economic issue:
  - > Role in **agro-ecosystem functioning**  
(pollination, predation...)
  - > Biodiversity conservation: **protected and ordinary species**
- **Landscape heterogeneity**
  - > major driver of biodiversity in **agricultural landscapes**
- Landscape heterogeneity: **composition / configuration**

# Semi-natural habitats

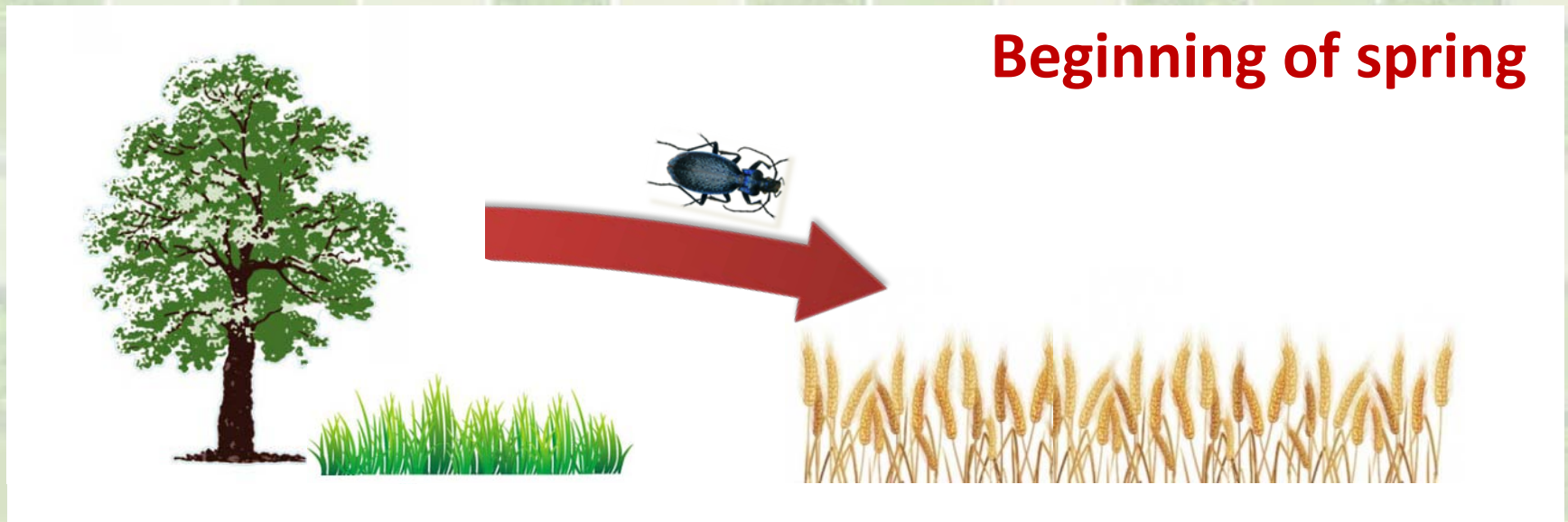
- Importance of **semi-natural habitats** (stable habitats / corridors)



# Interfaces and complementation

- Many species use **semi-natural and cultivated habitats**
- **Complementation:**

Use of resources in different habitats (Dunning et al. 1992)



- Many species overwinter in semi-natural habitats
- Colonization of cultivated lands in spring

# Interfaces and complementation

- Many species use **semi-natural and cultivated habitats**
- **Complementation** :

Use of resources in different habitats (Dunning et al. 1992)



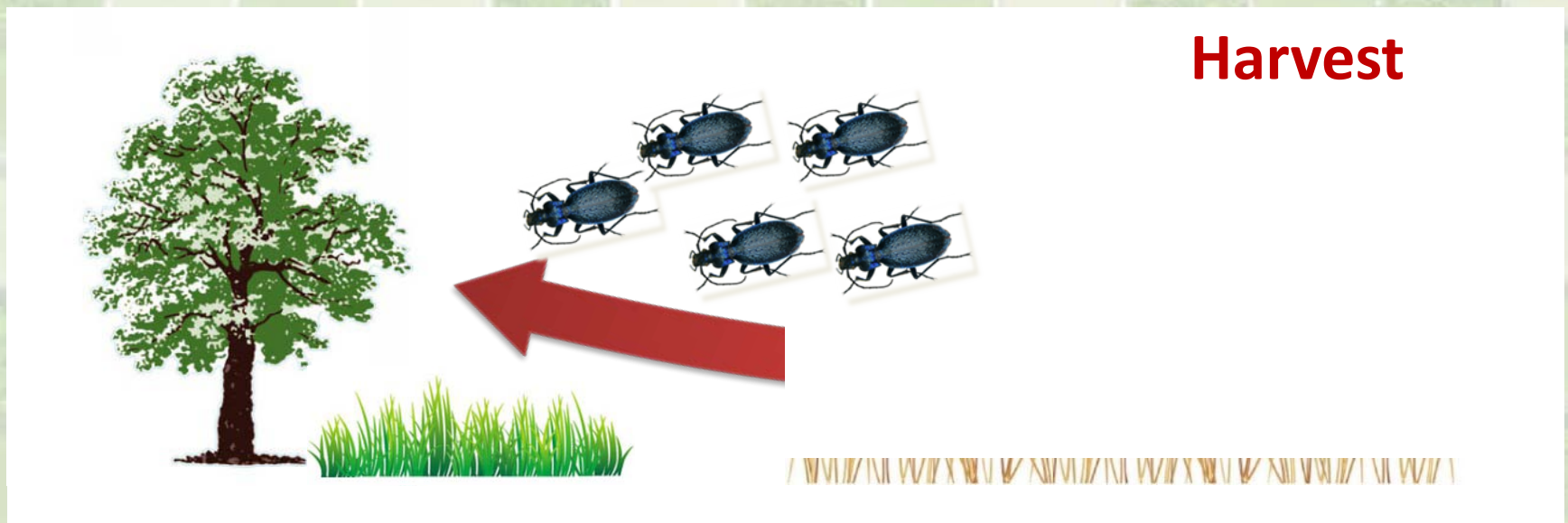
- Arthropod populations develop in crops  
--> habitat with high productivity: abundant food resources

# Interfaces and complementation

- Many species use **semi-natural and cultivated habitats**

- **Complementation** :

Use of resources in different habitats (Dunning et al. 1992)



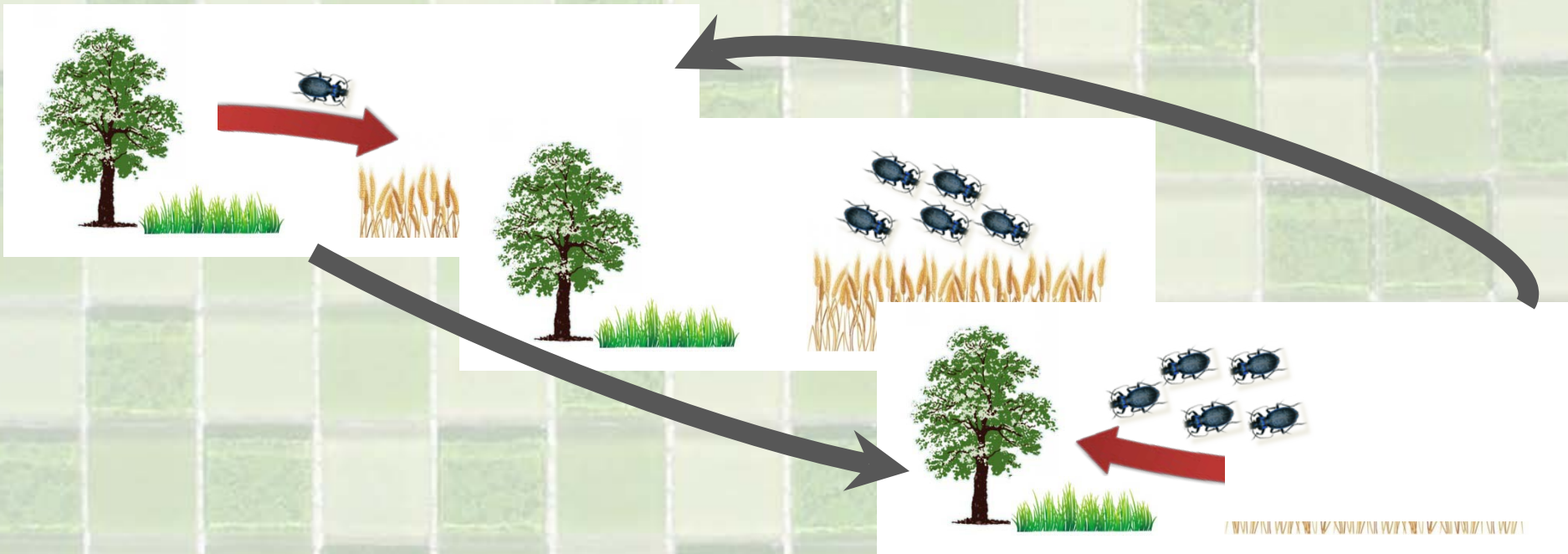
- Crop harvest --> destruction of vegetation cover  
--> opposite migration to escape disturbance (refuge)

# Interfaces and complementation

- Many species use **semi-natural and cultivated habitats**

- **Complementation** :

Use of resources in different habitats (Dunning et al. 1992)

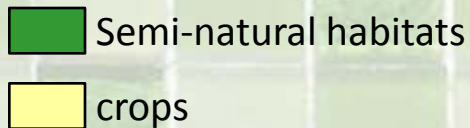
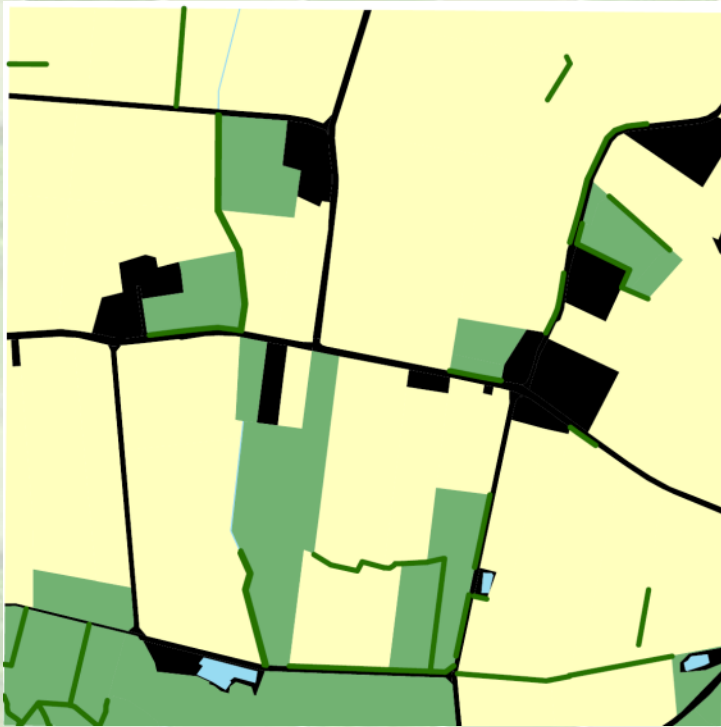


- **Cyclic migration** between crop and non-crop elements
- Role of interfaces between semi-natural and cultivated habitats



# Farmland heterogeneity

- Landscapes are more complex than this binary approach  
semi-natural habitats / crop fields
- Diversity of cover and interfaces types



# Winter crops vs. spring crops

Early June



End of June



End of July

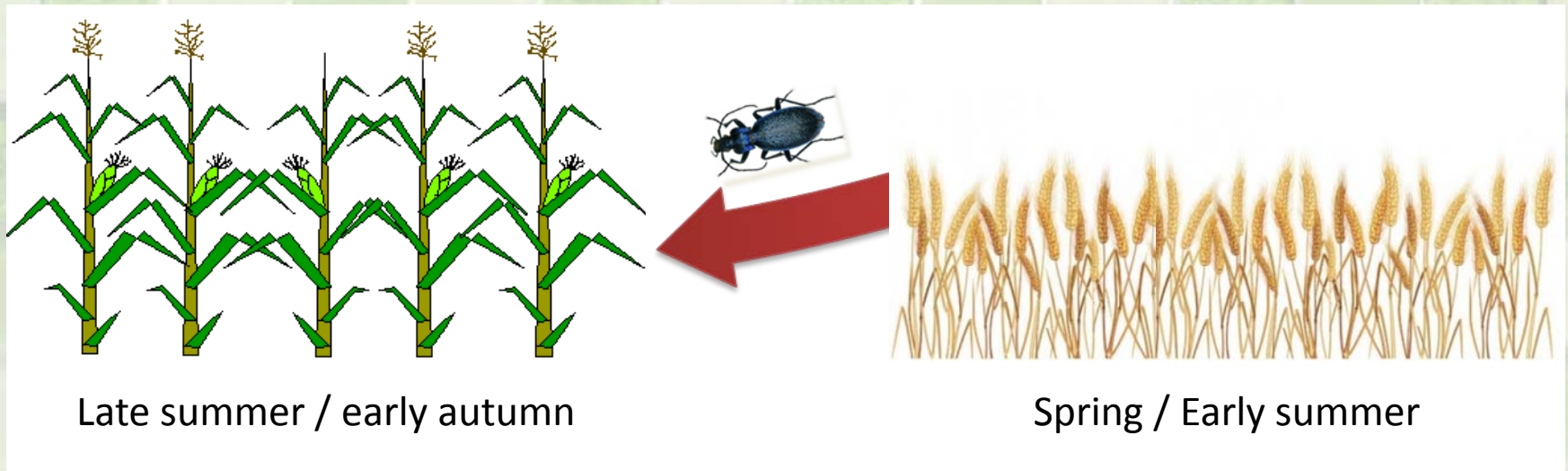


Early July

Asynchronous growing of wheat and maize fields  
--> are suitable habitats at different periods of the year

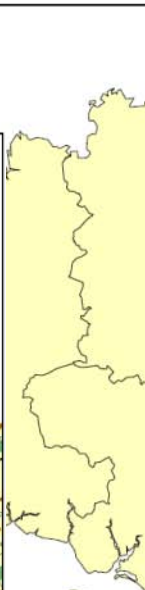
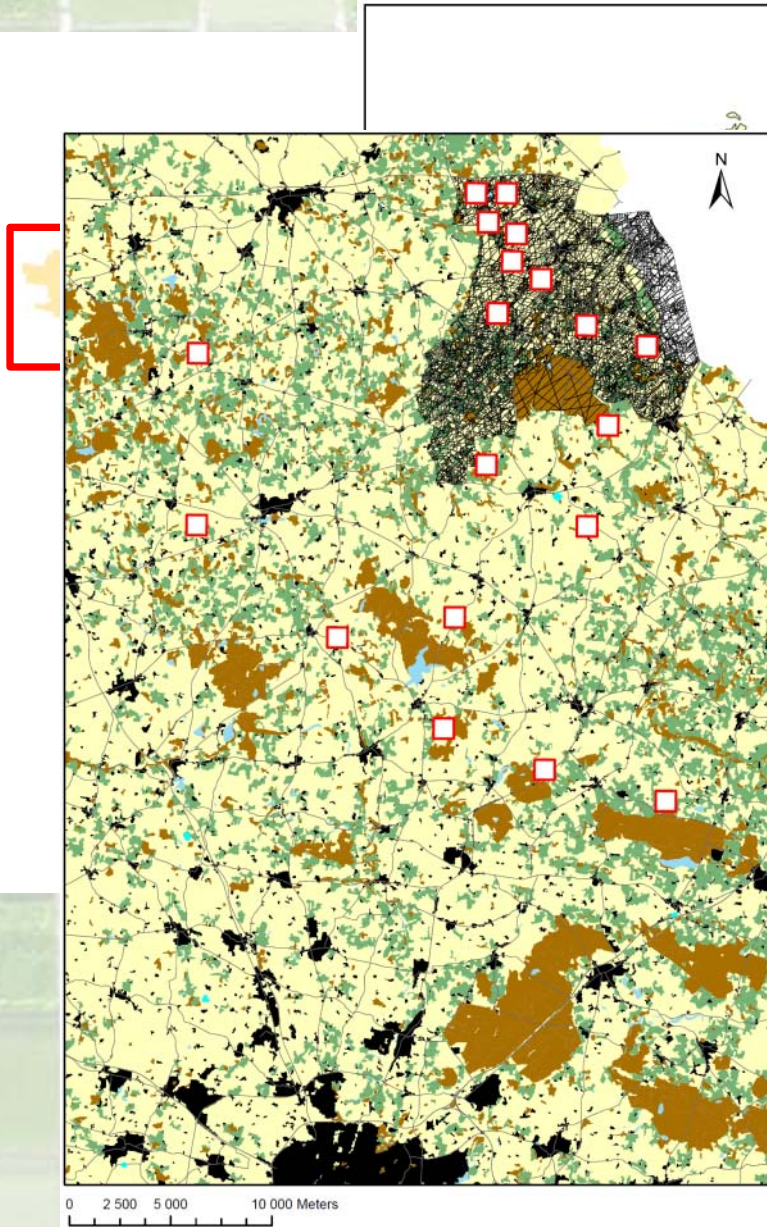
# wheat / maize complementation

- **Question** : Is there a complementarity between wheat and maize ?
- **Hypotheses**:



- Landscape scale process:
  - > relative amounts of wheat and maize
  - > length of interface between wheat and maize

# Study area: LTER site

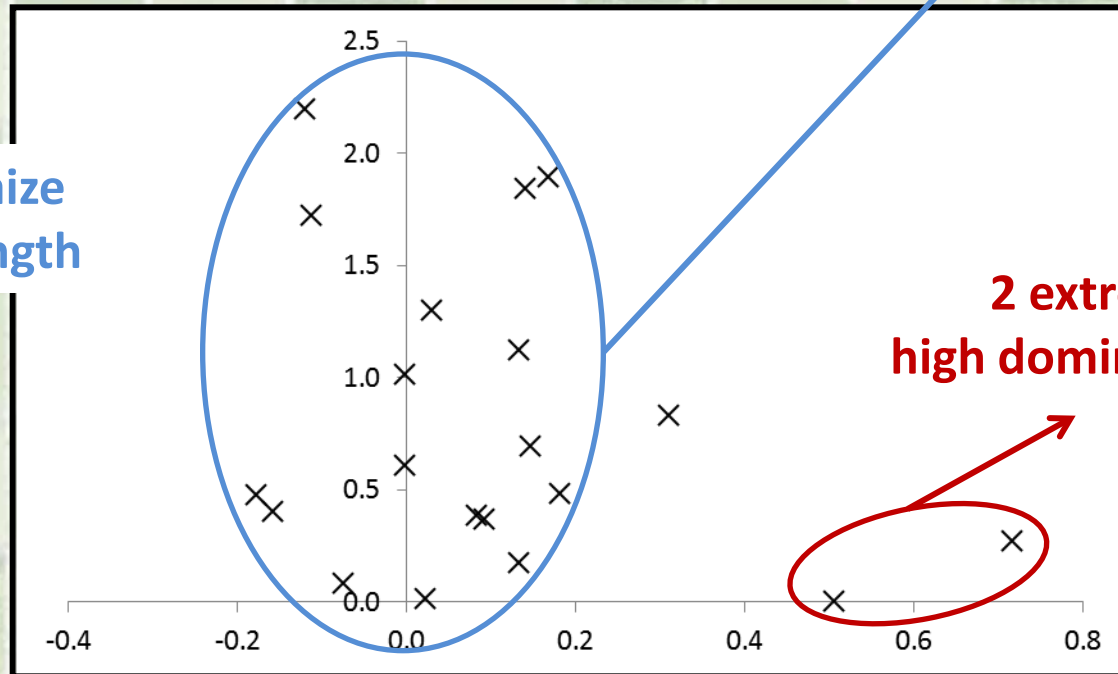


# Sites selection

**Design: gradient of cultivated land composition & organisation**  
(20 landscapes - 1km<sup>2</sup>)

variability of wheat / maize interface

wheat / maize  
interface length



2 extrem values:  
high dominance of wheat

log ratio % wheat / % maize

Maize  
dominant

Wheat  
dominant

- Survey of carabid communities in the two crops



- Compare before and after wheat harvest
  - > 2 sampling periods
  - spring: wheat and maize fields
  - late summer: maize fields

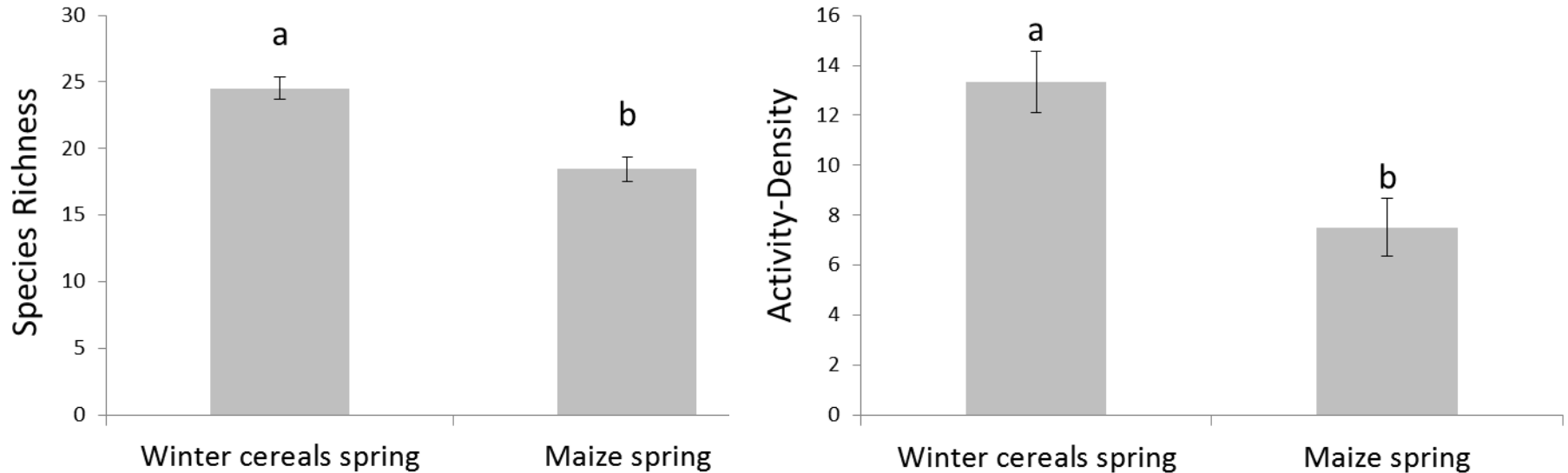


- Take into account woody and grassy habitats
  - relative surface: % woody habitats; % grasslands
  - interface length:
    - woody – crop; grassy – crop; woody – crop



# Results spring

## Species richness, activity-density and composition / 1km<sup>2</sup>

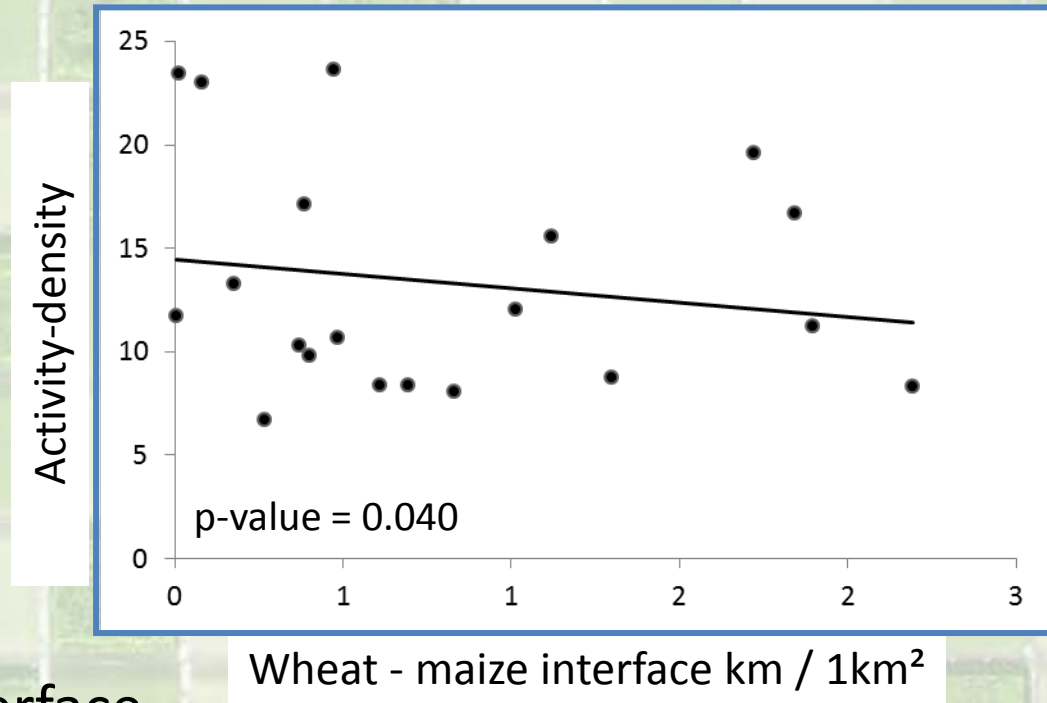


- Wheat fields are more attractive than maize at this season
- Many shared species but most of them have a preference for wheat or maize

# Results spring

--> No effects of landscape on species richness

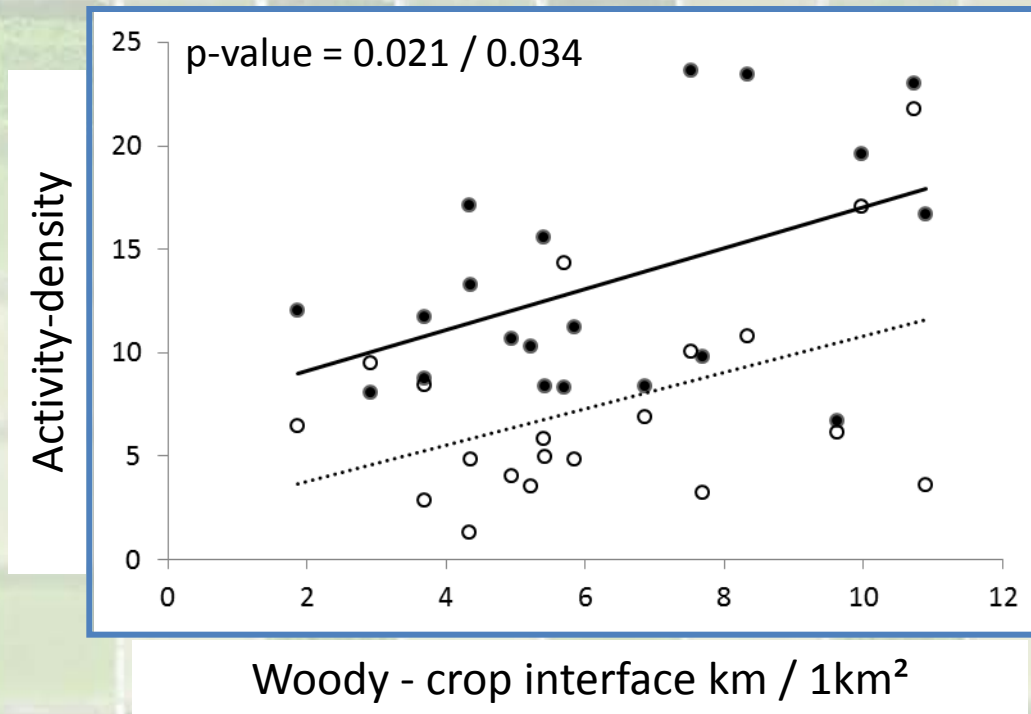
Landscape effect on activity density / 1km<sup>2</sup>



- Wheat – maize interface
  - > Negative effect on wheat field activity-density
  - > wheat / maize adjacencies -> sink effect of maize fields
- No corresponding effect: positive effect on maize field populations



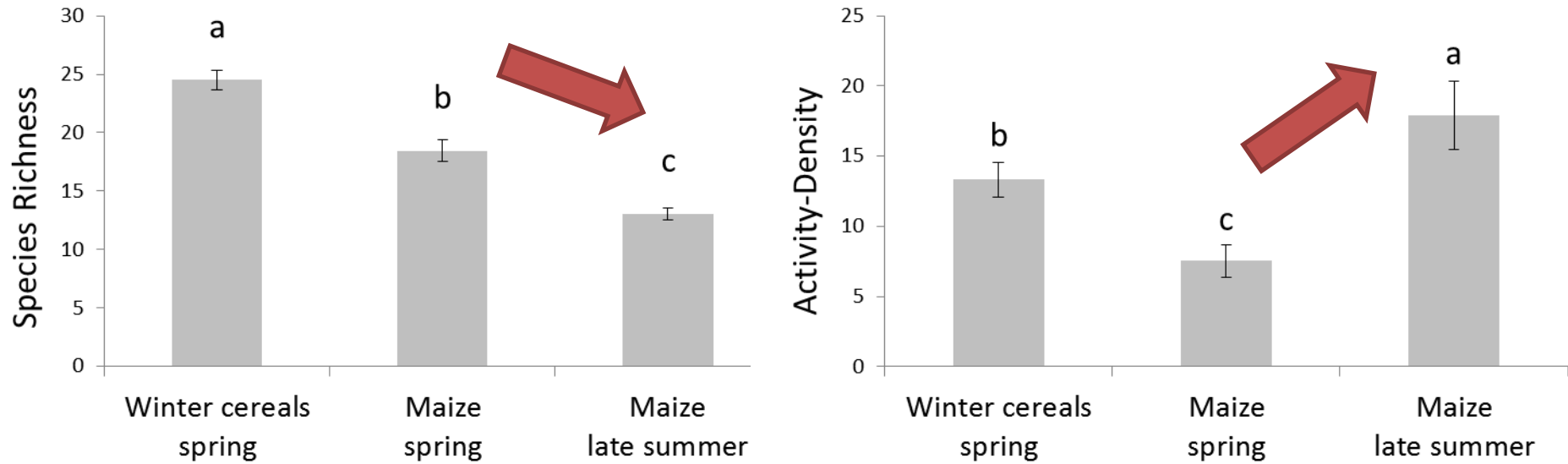
## Landscape effect on activity density / 1km<sup>2</sup>



- Woody - crop interface
  - > positive effect on activity-density of the two crop types
  - > importance of adjacencies between these elements

# Maize communities in late summer

## Species richness and activity-density / 1km<sup>2</sup>

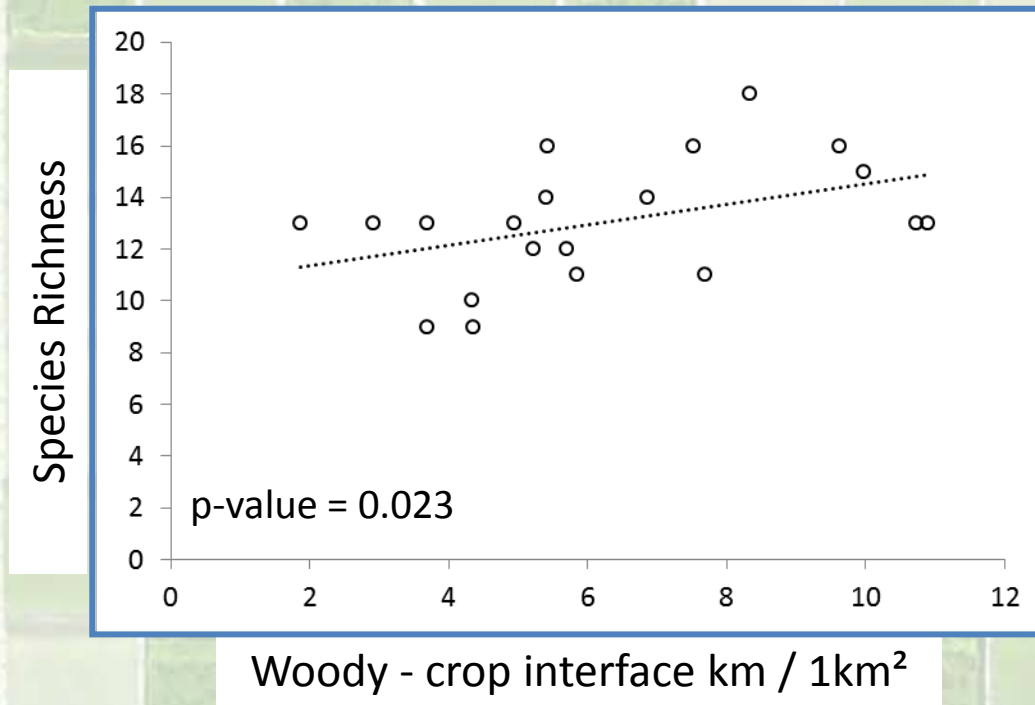


- Reduction of maize field species richness in late summer
- Great increase of activity-density, but 76% of total abundance is from two species (*P. melanarius*; *P. rufipes*)
- Most other species disappear or regress

# Maize communities in late summer

No effect of farmland landscape descriptors

--> no clear shift of carabid population



- positive effect on maize field species richness in late summer
- Presence at this period of forest and autumn breeder species  
--> maize field may be used by these species

- No evidence of spatio-temporal complementation  
--> seasonal variation mainly explained by species phenology
- But different sets of species used wheat and maize  
--> contribution to total diversity at landscape scale
- Sink effect of maize on wheat carabid population  
--> Movements at wheat – maize interface in spring
- Maize were suitable for many species in the spring season  
--> sink effect confounded with complementation?
- More direct measures, e.g. measuring between-field fluxes all over the activity period of carabid beetles

# Acknowledgement

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