



Intra-annual heterogeneity of the cultivated mosaic: impact on carabid beetle populations

Stéphanie Aviron, Chloé Vasseur, Sophie Puyo, Stéphanie Saussure, Jacques
Baudry

► To cite this version:

Stéphanie Aviron, Chloé Vasseur, Sophie Puyo, Stéphanie Saussure, Jacques Baudry. Intra-annual heterogeneity of the cultivated mosaic: impact on carabid beetle populations. Colloque IALE world “landscape ecology for sustainable environment and culture”, Aug 2011, Pekin, China. pp.14. hal-01458577

HAL Id: hal-01458577

<https://hal.science/hal-01458577>

Submitted on 6 Jun 2020

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Intra-annual heterogeneity of the cultivated mosaic: impact on carabid beetle populations

Stéphanie Aviron, C. Vasseur, S. Puyo, S. Saussure, J. Baudry

INRA, SAD-Paysage, Rennes, France

Contact : clo.vasseur@gmail.com



Background



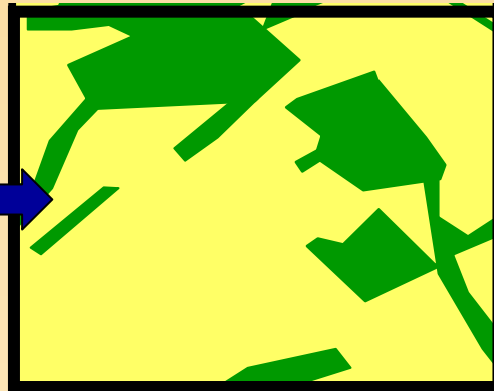
- **Conservation biological control** is proposed as an alternative to pesticide use against crop pests.



- **Enhancing biological control** requires to understand how local and landscape factors influence populations of natural enemies.

Introduction

Landscape heterogeneity for biodiversity



Amount of **semi-natural habitats** vs. cultivated matrix.

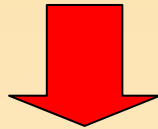


Heterogeneity of the cultivated mosaic: relevant for species which use crops during their life cycle.

Introduction

Intra-annual heterogeneity of the cultivated mosaic

Crop cover states



Mosaic of crop cover states



 Bare soil

 Dense cover

- **Changes in habitat quality** (crop growth, farming practices).
- **Asynchronous availability of resources** (timing of sowing and cultural interventions).
- **Changes in the spatial distribution of habitats** (mosaic of local dynamics induced by crop growth and practices).

Question

Impact of intra-annual heterogeneity of the cultivated mosaic on populations of natural enemies ?



Effect on the local dynamics (field and adjacent landscape elements) of carabid beetles
Model species : *Pterostichus melanarius* Ill.

- **Generalist predator**, potential role for the control of crop pests
- **Adults:**
 - Dense vegetation covers: field margins in winter, active in crops from spring to autumn (foraging, breeding)
 - Limited dispersal ability (apterous).
- **Larvae:**
 - Overwintering and development in the soil of crops
 - Sensitive to soil disturbance (timing of tillage in crops)

Hypotheses

- **Carabid activity-density (population level) in crops changes according to changes in crop covers:**

→ Increases with vegetation growth, decreases after harvest.

- **These changes are linked to carabid movements between crops:**

→ From unsuitable, reduced covers (crop newly sown or harvested) to suitable, dense crop covers.

- **These changes are also linked to carabid movements between crops and field margins:**

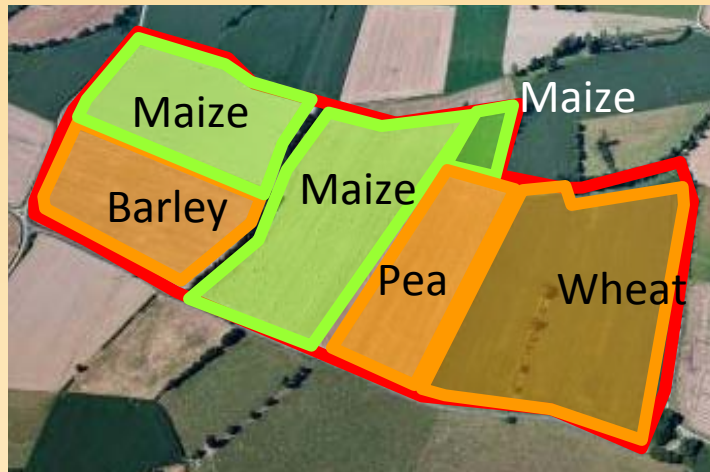
→ From field margins to suitable crop covers in spring (overwintering adults), and from unsuitable crop covers to field margins later (refuge).

Methods : Field study

Extensive survey of carabid populations in a “micro-landscape”



Brittany
(France)



Study area (30 ha):

Mosaic of crops on 6 fields and their margins.

Insect movements with surrounding fields supposed to be limited (roads, ditches)

Different crops with different cover states during carabid activity period:

- **Maize**: from bare soil in spring to dense vegetation cover in late summer, harvest in late autumn.
- **Wheat, barley and pea**: dense vegetation cover in spring, and reduced cover after harvest in mid-summer.

Methods : carabid sampling

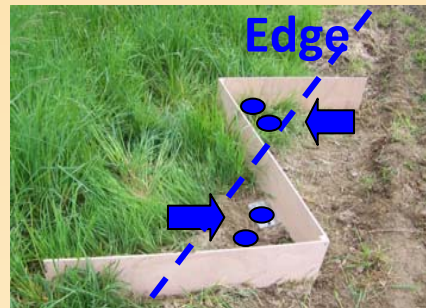
Continuous sampling from May to September



Activity-density:

Open traps (2 pitfall traps)

5 open traps / crop.



Carabid movements:

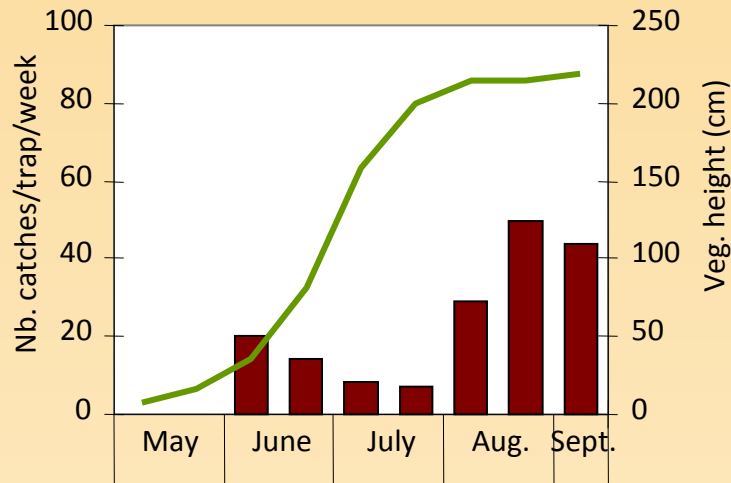
Bidirectional traps at edges between crops, and between crops and field margins.

2 bidirectional traps / edge.

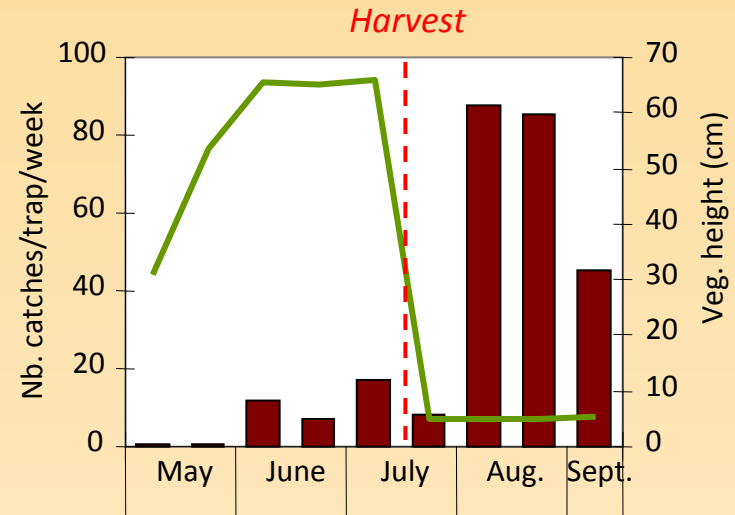
Monitoring of cover states : vegetation height, crop stage.

Results – Activity-density of carabid beetles

Activity-density and vegetation growth in maize



Activity-density and crop harvest : ex. of pea

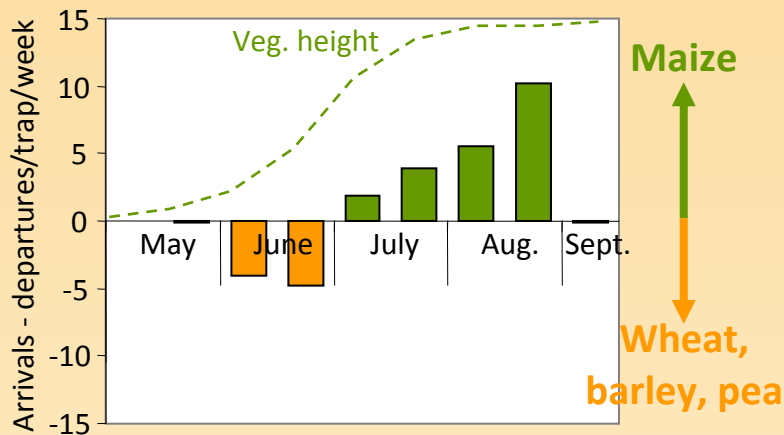


■ Activity-density — Veg. height

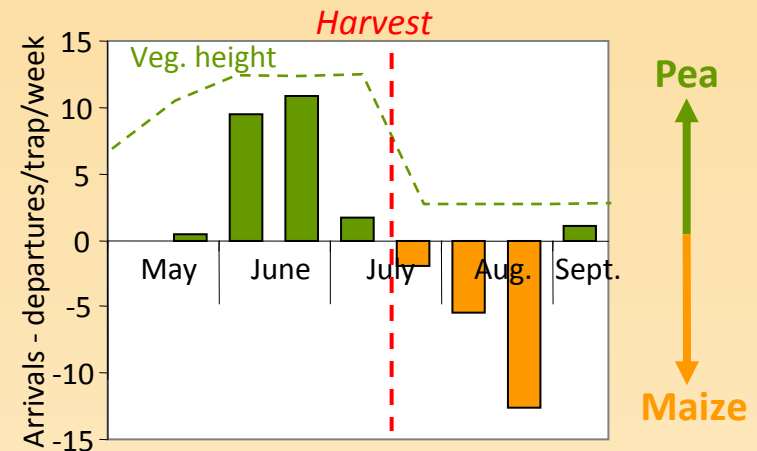
- **Vegetation growth in maize:** non negligible peak in early summer in spite of reduced cover, high activity-density when cover is developed
- **Crop harvest in pea:** low activity-density in early summer, in spite of dense cover, higher activity-density after crop harvest !

Results – Carabid movements between crops

Movement orientation at edges between maize and other crop types



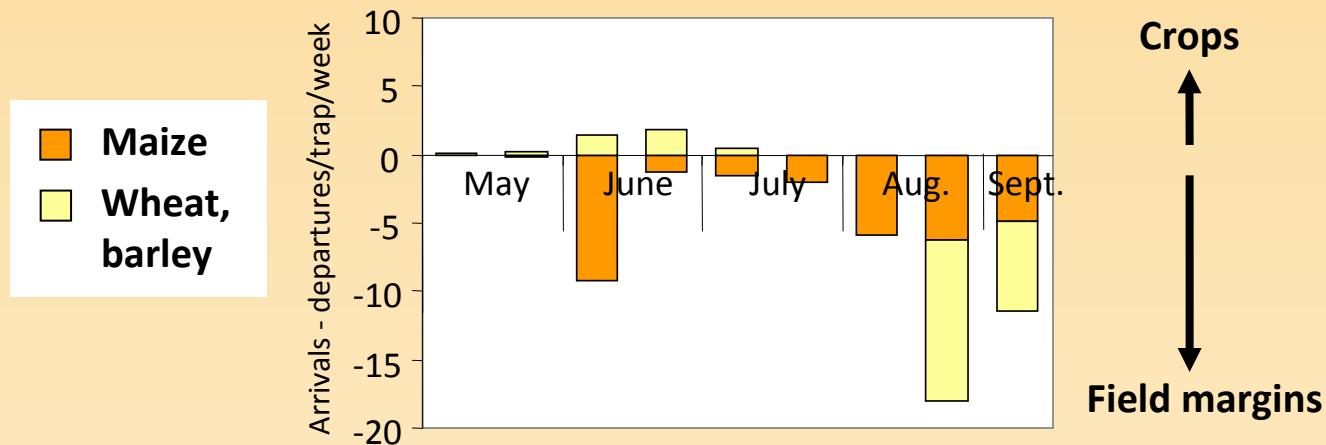
Movement orientation at edges of harvested crops : ex. of pea



- **Maize edges:** movements from maize fields to adjacent dense crop covers in early summer, in late summer colonisation of maize where vegetation is developed.
- **Pea edges:** colonisation of pea (dense cover) from adjacent maize in early summer, movements from pea to adjacent maize after pea harvest.

Results – Carabid movements between crops and field margins

Movement orientation between crops and field margins



- **Maize edges:** no colonisation from field margins, movements from maize to field margins during the whole study.
- **Edges of barley and wheat:** limited colonisation from field margins, movements from crops to field margins in the late summer.

Summary

- **No visible effect of crop cover changes (vegetation growth, harvest) on carabid activity-density in crops**
 - *High activity in unsuitable covers (starvation, exposure to predators) leading to more catches?*
- **Movements of carabid beetles from unsuitable to suitable crop covers during the whole study**
 - *Role of refuge played by suitable crop covers, habitat complementation between different crop types ?*
- **Carabid movements mostly oriented from crops to field margins**
 - *Role of refuge played by margins of unsuitable crop covers, or mass effect (high population levels in crops)?*

Conclusion

- **Within a year, the asynchronous changes in crop cover states (and resources) are likely to affect some of the local processes involved in carabid population dynamics.**
- **Semi-natural habitats are important for carabid beetles, but the effect of the spatio-temporal heterogeneity of the cultivated mosaic should be investigated.**

Thank you

Acknowledgement

Field and laboratory assistants: C. Juhel, L. Meneau, M. Mille, C. Puech, J.L. Roger

Grants: INRA, Region Bretagne, CAREN, ANR Project *Biodivagrim*.

