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**Local and landscape parameters explaining distribution and abundance of *Episyrphus balteatus* (De Geer, 1776) (Diptera, Syrphidae) in forests and edges of rural landscape**

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ECOLOGY OF APHIDOPHAGA 9  
 Ceske Budejovice, Czech Republic  
 September 6-10, 2004



- Introduction – (2/24)

**Why such a study ?**



- ✓ *E. balteatus* larva : one of **the most efficient** predator of aphids ( → crops)
- ✓ *E. balteatus* adult : - ubiquitous "flower fly" → **nectar and pollen feeding**  
 - active females overwinter in southern Europe
- ✓ the sooner aphidophagous insects set up in crops → the greater the chance to keep the aphids below damage level



**in southern Europe, it is worth to try to help *Episyrphus balteatus* going through winter & summer, the two main critical seasons**

## Why surveys in forests and edges ?



- ✓ they are some of the most stable structures in rural landscapes
- ✓ edges can be supposed to be "used" differently through the four seasons according to their proper characteristics
- ✓ in spring and autumn, forests inside (which are not optimal habitats) can be supposed to act as filter and be visited by a sample of foraging individuals of this open ground and ubiquitous species.

## Thus, we take as hypotheses :

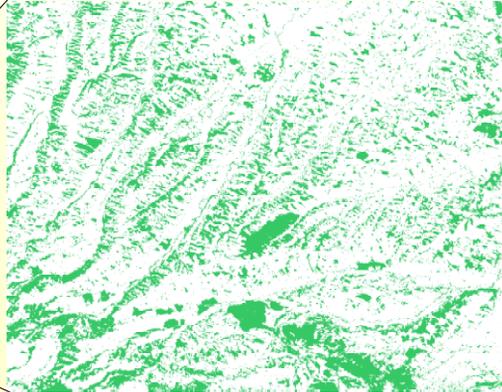
1. **Local and landscape parameters**
  - forest parameters → crop mosaic parameters
  - influence *E. balteatus* distribution and abundance in forests, which vary according to the different seasons through the year
2. **Edge orientation and flowers**
  - south & north facing edges → edge flowers & field flowers
  - act, in our study region, as respectively winter and summer shelters (flowers being prerequisite)
3. **Pre-imaginal overwintering stage**
  - Adult females are not the single overwintering stage, so larvae or pupae also overwinter

- Study sites and methods – (5/24)



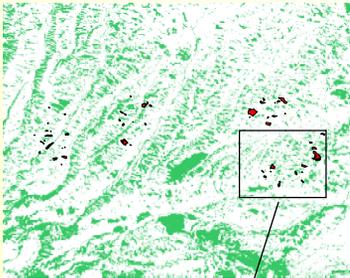
**Coteaux de Gascogne area**

Hilly region with fragmented forests, 200 to 400m alt., within sub-Atlantic climate subject to both Mediterranean & montane influences



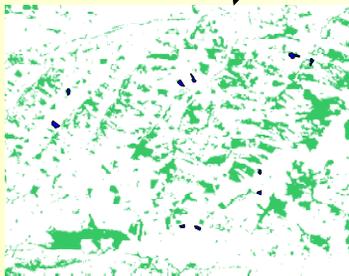
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- Study sites and methods-



**Hypothesis 1 study site**

54 forests,  
ranging from 0.5 to 171ha,  
with low to high degree of isolation,  
fitted out with Malaise traps in well-lit places,  
during 35 days in spring, plus 36 days in autumn,  
trap number adjusted to for. fragment surface area

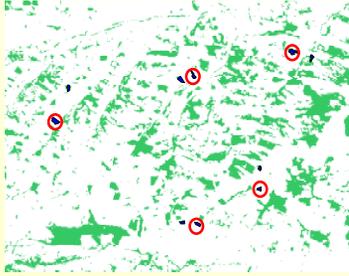


**Hypothesis 2 study site**

10 forests,  
ranging from 1.5 to 4ha,  
with an equal degree of isolation,  
fitted out with one Malaise trap in S facing  
edge, one in centre (bad-lit place) and one in N one,  
from March 2003 to March 2004.

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- Study sites and methods -



### Hypothesis 3 study site

5 forests, among the 10 previous ones, fitted out with emergence traps (modified Malaise traps with closed entrances, enclosing  $\pm 4\text{m}^2$ ), one on S facing edge and one in N one, from February to June 2004.

**Malaise trap, Marris House Nets model**



**Emergence trap (based on Malaise trap model)**



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- Study sites and methods -

## Environmental parameter recording

Hypothesis 1 (Local & landscape parameters)



Hypothesis 2 (Edge orientation and flowers)

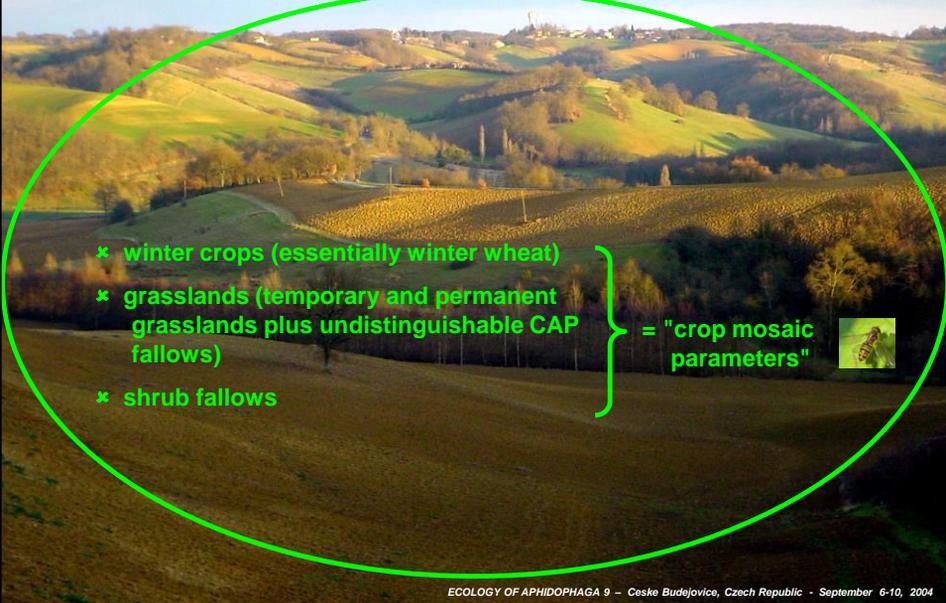


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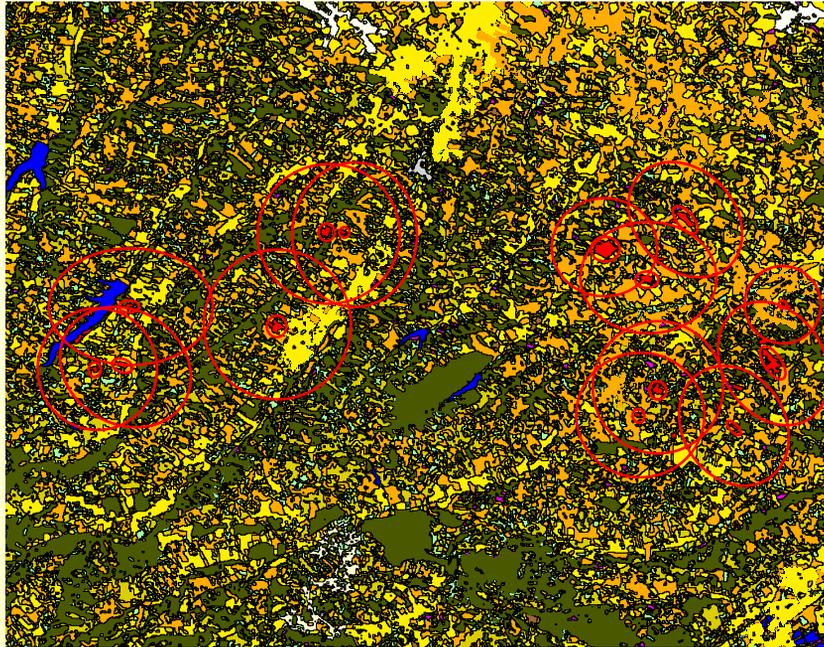
Local parameters : 5 measures of forest fragment geometry



Landscape parameters : % of 3 land cover types within 100m and 2000m around each forest



- Study sites and methods



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- Study sites and methods -



In the vicinity of each trap, flower diversity surveyed every fortnight:

- traps in centre:

. within circle 50m Ø



- traps along edges (S & N):

. 25 m on both sides of traps

. within semicircle 25m radius

Just close to 4 traps (2 S, 2 N), temperature recorded every 2 hours

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## Statistical analysis

### Hypothesis 1 (Local & landscape parameters)

Partial Least Squares (PLS) regression ( $\mathbf{\hat{E}}$  multivariate analyses):

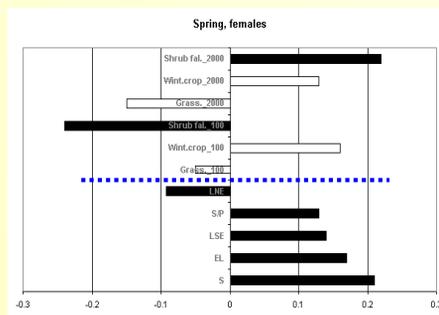
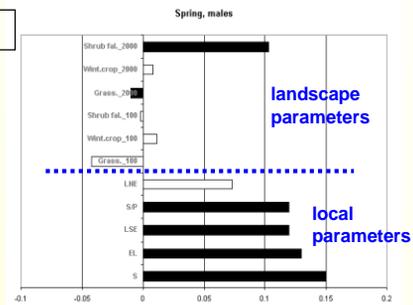
useful calibration technique when explanatory variables are correlated and when there are more than one response variable

### Hypothesis 2 (Edge orientation & flowers)

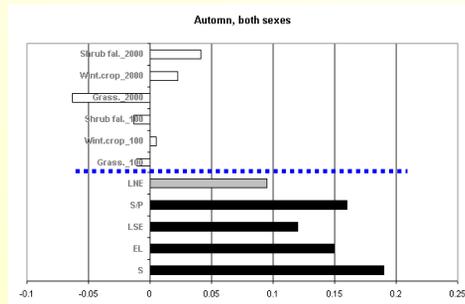
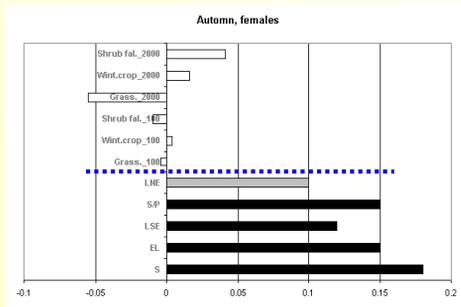
Usual non parametric tests

### Global results for Local & landscape param.

- 881 individuals trapped = 20% of all syrphids (>4900 ind. in > 120 spp)
- model for males in autumn non significant
- significant parameters (VIP>1):
- sub-significant param. ( $0.9 \leq \text{VIP} < 1$ ):
- non significant param. ( $\text{VIP} < 0.9$ ):



- Results -



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- Results -

Spring:

- S, EL, LSE and S/EL: + + + → ♂♀, ♂♂, ♀♀

- Shrub fallow 2000m: + + + + → ♀♀

- Shrub fallow 100m: - - - - → ♀♀

- LNE: - - - → ♀♀

Autumn:

- S: + + + + → ♂♀, ♀♀

- EL, LSE and S/EL: + + + → ♂♀, ♀♀

- LNE: → + + + ♂♀, ♀♀

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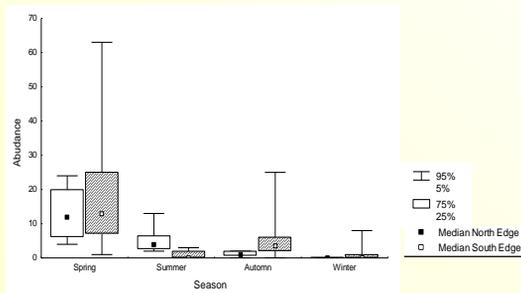
- Results -

Global results for Edge orientation & flowers param.

- 658 individuals trapped (575 in edges, 83 in centres)
- 128 366 flowers in fields semicircles
- 25 298 flowers along edges
- 5955 flowers in forest centres
- T°: high ≠ between S & N facing edges throughout year

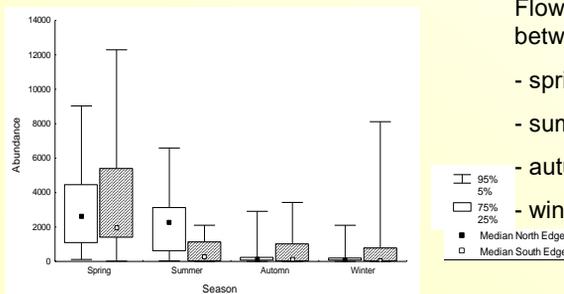
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- Results -



*E. balteatus*, between S & N:

- spring: no ≠
- summer: more in N than S
- autumn: more in S than N
- winter: more in S than N



Flowers (edges+semicircle in field), between S & N:

- spring: no ≠
- summer: more in N than S
- autumn: no ≠
- winter: no ≠

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- Results -

Correlation between *E. balteatus* and flowers:

	All flowers (edge + field)	Edge flowers	Field flowers
spring	++	--	+++
summer	++	++	NS
autumn	NS	-	NS
winter	+	NS	++

- Results -

Global results for Pre-imaginal overwintering stage

- 2 emergence traps out of 10 → *E. balteatus* adults in spring
  - 6 ♂♂, 14 ♀♀
  - 5 ind. on a S facing edge
  - 15 ind. on a N facing edge
- } both traps on tall herbs and weeds

**Winter:** "shelter from bad weather, then eat"

- *E. balteatus* sets only on S facing edges where  $T^{\circ}$  is higher
- it seems to have no relation with flowers along edges but seems to seek after flowers in the vicinity of it (in open ground)
- *E. balteatus* seems to strongly use shrub fallows, where few or even no flowers in winter → how far away can it fly to feed ?



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**Spring:**

- *E. balteatus* no longer preferentially uses S facing edges, it seeks after flowers every where, and is more attracted by flowers in open ground than along edges
- it still occurs in greater numbers in forests/landscape areas where:
  - . there are many shrub fallows in 2000m radius where females have overwintered, but no longer seems to use them (few or no flowers)
  - . there are long forest edges, where females have overwintered (along S facing edges), and where adults (females and males) have emerged.

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### Summer:

- *E. balteatus* sets mainly on N facing edges where T° is lower and flowers are more abundant
- it has then a strong relation with flowers along edges (no longer with flowers in fields, and yet very numerous in permanent grasslands and CAP fallows)

### Autumn:

- *E. balteatus* seems very few attracted by flowers, but essentially by edges because of their shelter function
- it is more abundant in forests/landscape areas where there are:
  - . large and compact forests
  - . long N facing edges, which have been much used in previous summer

### And now ?

- prove that shrub fallows are really used as winter shelters by *Episyrphus balteatus* and are quite no longer used after
- know which are the best places for pre-imaginal overwintering stages of *E. balteatus*
- look at aphids and *E. balteatus* dynamics in winter wheat fields of two very different landscapes according to their forest cover (study already started)

