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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

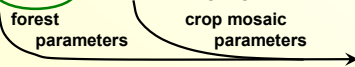
Why surveys in forests and edges ?



- ✓ 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.

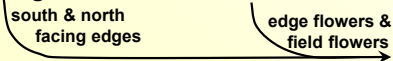
Thus, we take as hypotheses :

1. Local and landscape parameters



influence *E. balteatus* distribution and abundance in forests, which vary according to the different seasons through the year

2. Edge orientation and flowers



act, in our study region, as respectively winter and summer shelters (flowers being prerequisite)

3. Pre-imaginal overwintering stage

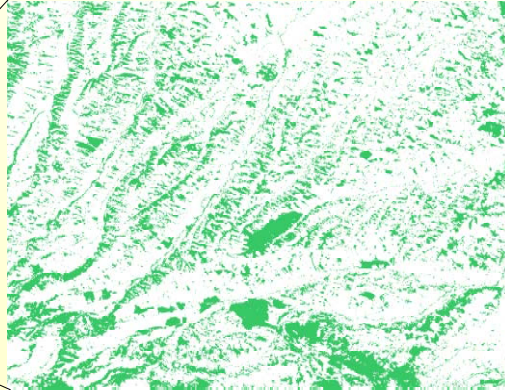
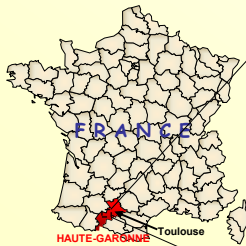
Adult females are not the single overwintering stage, so larvae or pupae also overwinter

- Study sites and methods – (5/24)



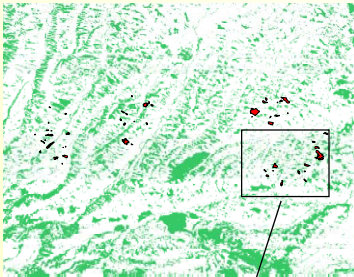
Coteaux de Gascogne area

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



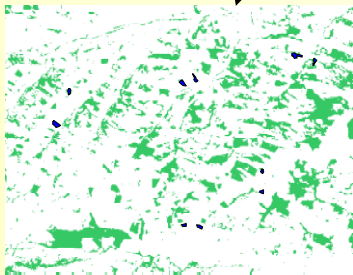
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- Study sites and methods-



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

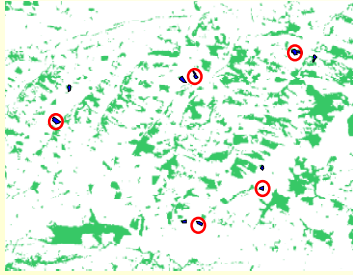


Hypothesis 2 study site

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)

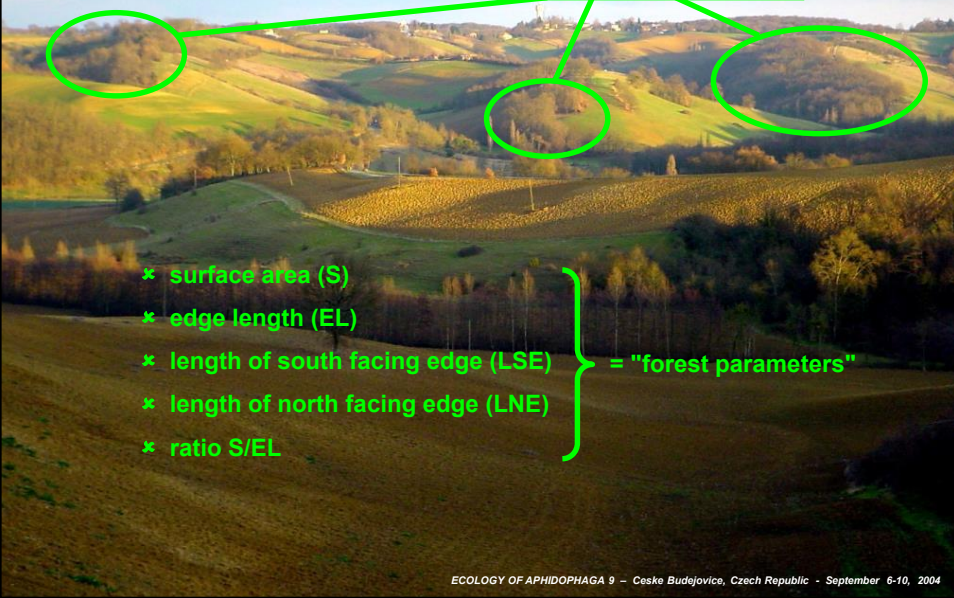


Hypothesis 2 (Edge orientation and flowers)



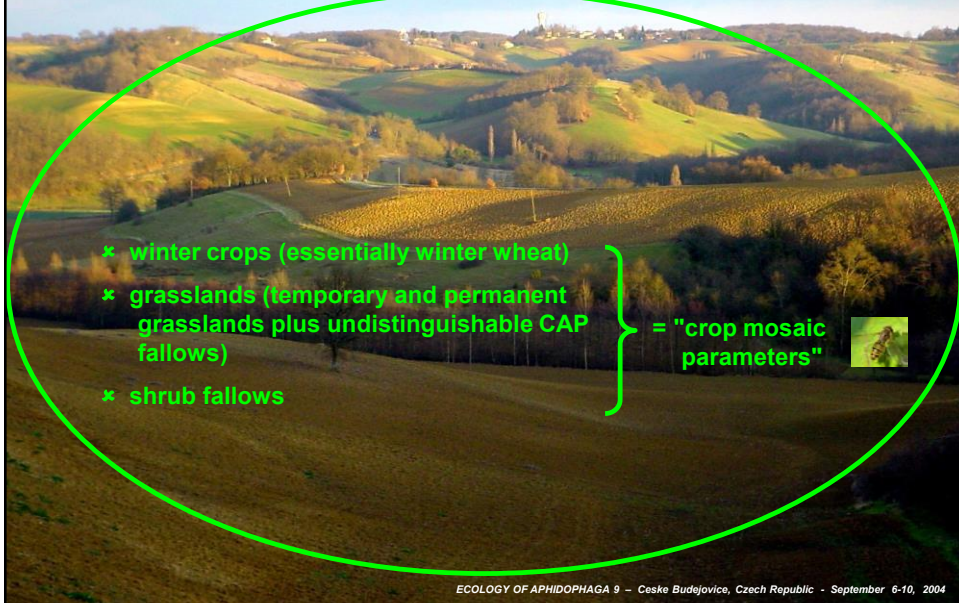
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Local parameters : 5 measures of forest fragment geometry



- * surface area (S)
 - * edge length (EL)
 - * length of south facing edge (LSE)
 - * length of north facing edge (LNE)
 - * ratio S/EL
- } = "forest parameters"

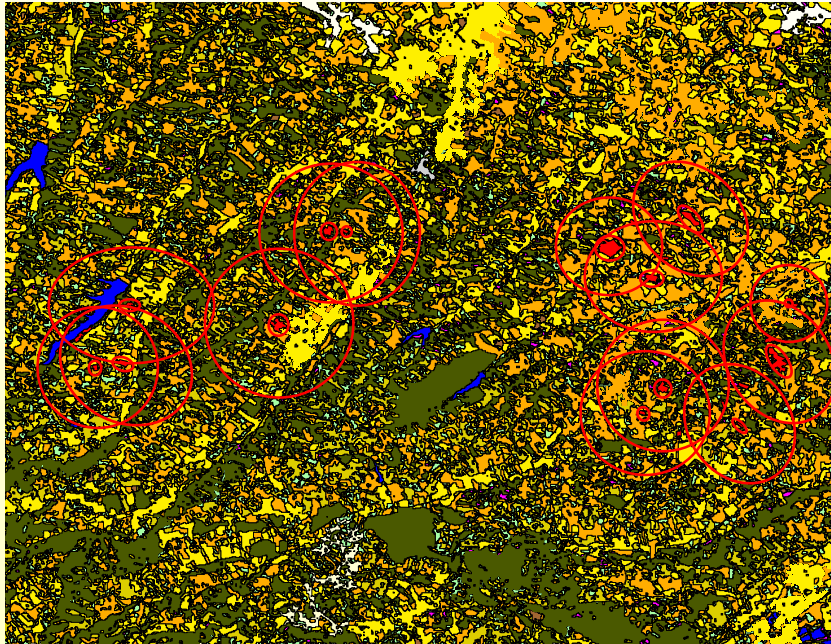
Landscape parameters : % of 3 land cover types within 100m and 2000m around each forest



- * winter crops (essentially winter wheat)
 - * grasslands (temporary and permanent grasslands plus undistinguishable CAP fallows)
 - * shrub fallows
- } = "crop mosaic parameters"



- 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 ($\mathbf{\hat{\beta}}$ multivariate analyses):

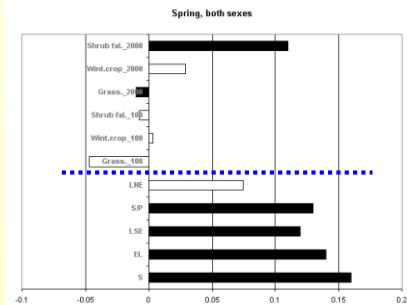
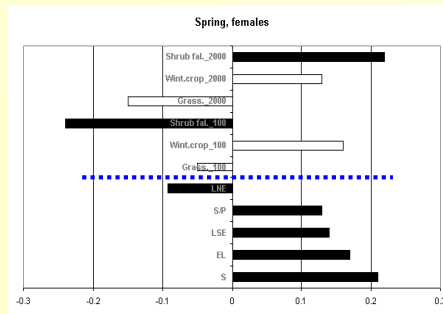
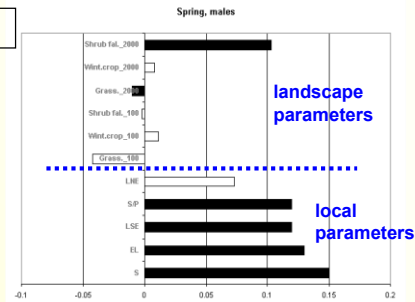
useful calibration technique when explanatory variables are correlated and when there are more than one response variable

Hypothesis 2 (Edge orientation & flowers)

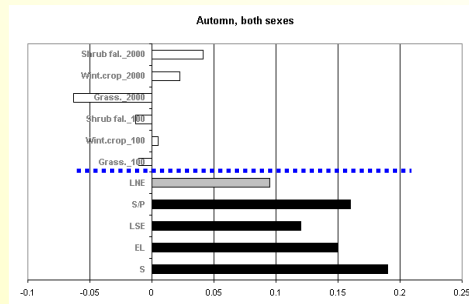
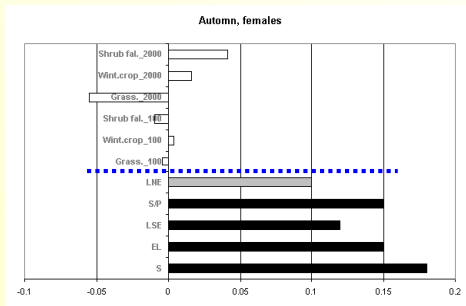
Usual non parametric tests

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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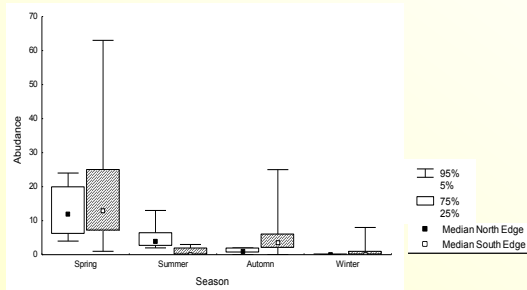
- Results -

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

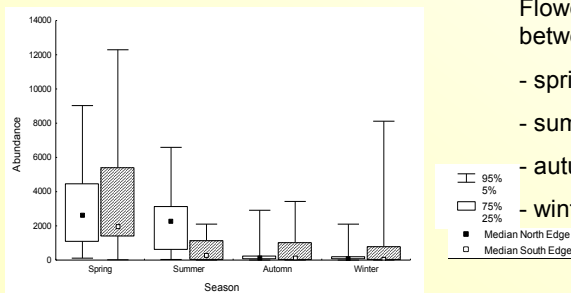
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- Results -



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° 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)

