



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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Jean-Pierre Sarthou, Annie Ouin, Florent Arrignon, Gaël Barreau, Bernard Bouyjou. Local and landscape parameters explaining distribution and abundance of *Episyrphus balteatus* (De Geer, 1776) (Diptera, Syrphidae) in forests and edges of rural landscape. Ecology of aphidophaga, Sep 2004, Ceske Budejovice, Czech Republic. 12 p. hal-02832375

HAL Id: hal-02832375

<https://hal.inrae.fr/hal-02832375>

Submitted on 7 Jun 2020

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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

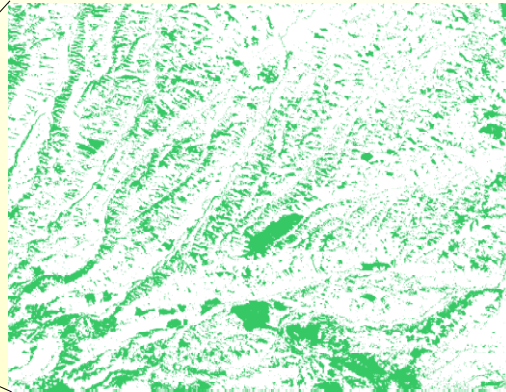
Adult females are not the single overwintering stage, so larvae or pupae also overwinter

- Study sites and methods – (5/24)



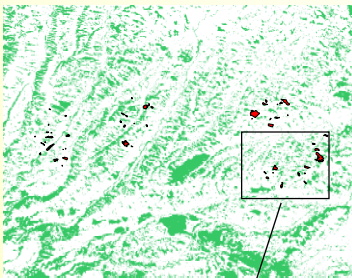
Coteaux de Gascogne area

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



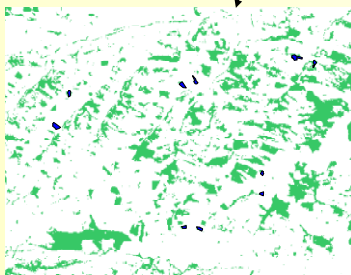
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- Study sites and methods-



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

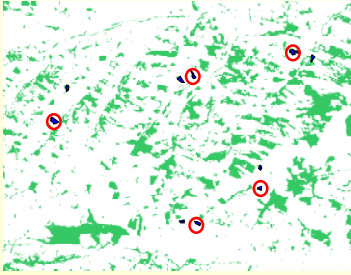


Hypothesis 2 study site

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

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

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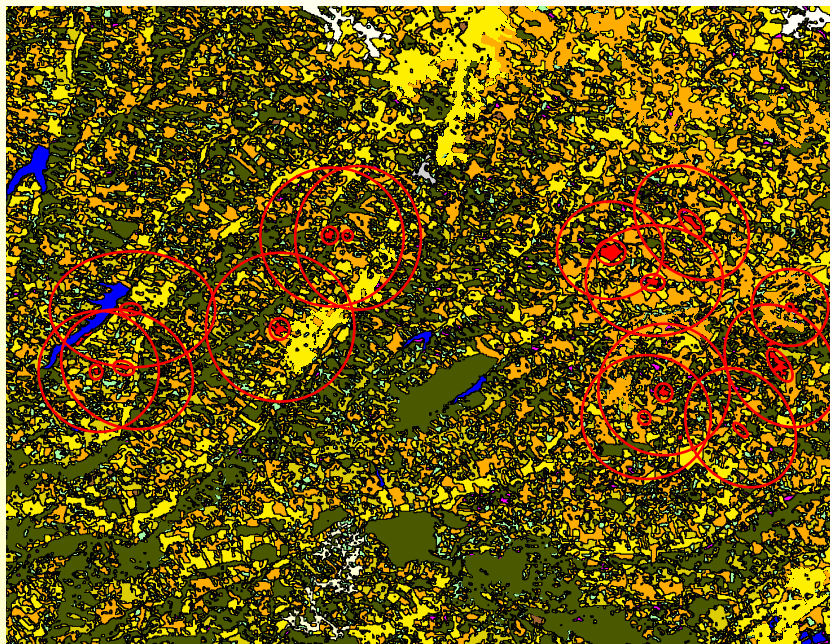
Landscape parameters : % of 3 land cover types within 100m and 2000m around each forest

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



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- 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 ($\mathbf{\Xi}$ multivariate analyses):

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

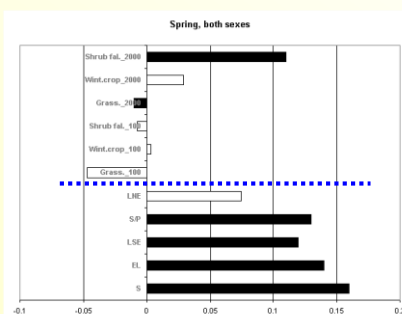
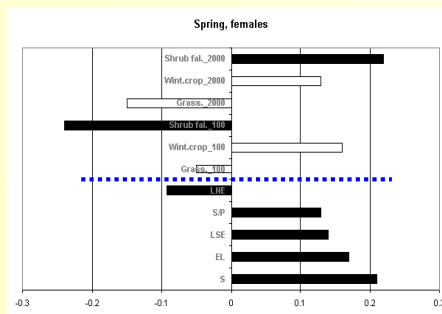
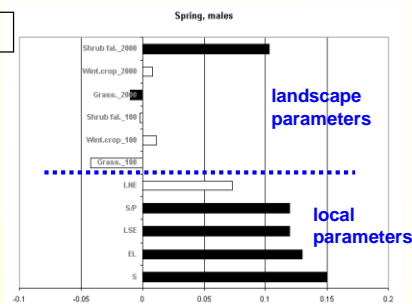
Hypothesis 2 (Edge orientation & flowers)

Usual non parametric tests

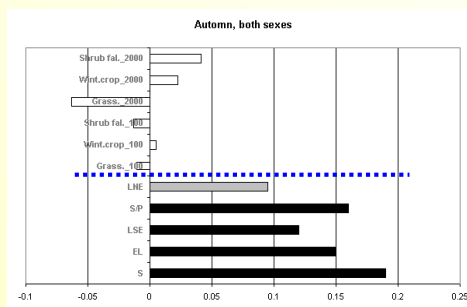
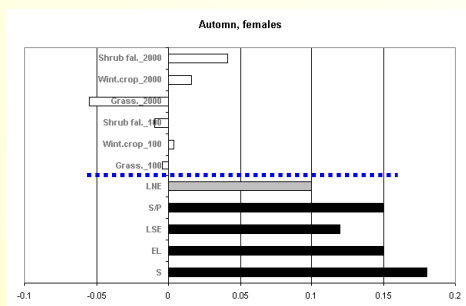
- Results – (14/24)

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. ($0.9 \leq VIP < 1$):
- non significant param. ($VIP < 0.9$):



- 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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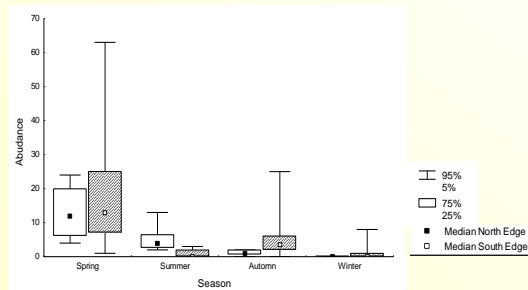
- Results -

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

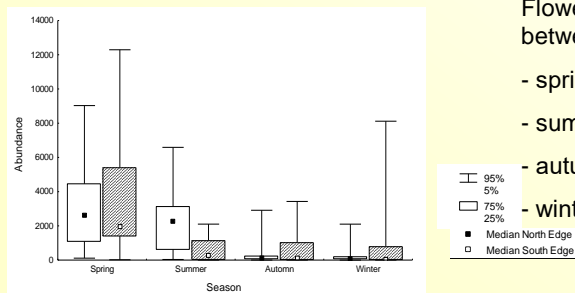
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- Results -



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	++

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- 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

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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.

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)

