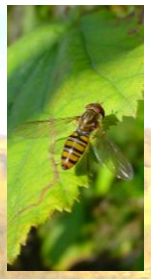
Local and landscape parameters explaining distribution and abundance of Episyrphus balteatus (De Geer, 1776) (Diptera, Syrphidae) in forests and edges of rural landscape

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

Jean-Pierre Sarthou[1]*, Annie Ouin[1], Florent Arrignon[1], Gaël Barreau[2] & Bernard Bouyjou[1]

[1] Ecole Nat. Sup. Agronomique de Toulouse, UMR Dynafor, BP 107, F-31326 Auzeville-Tolosane
[2] 12, rue Claude Bizot, F-33170 Gradignan
* e-mail address: sarthou@ensat.fr

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

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 feed**ing
  - 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)

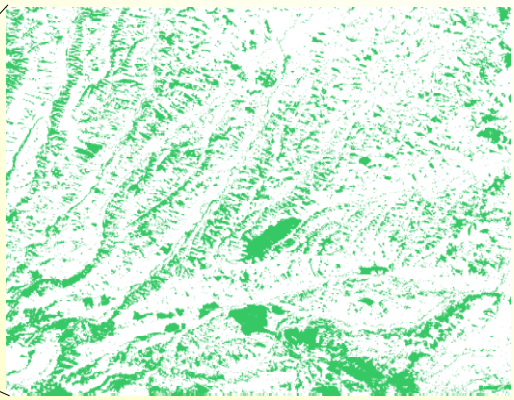
3. ***Pre-imaginal overwintering stage***

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

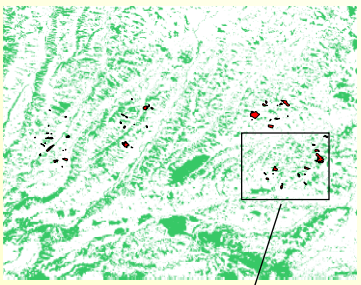
- Study sites and methods – (5/24)

Coteaux de Gascogne area

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

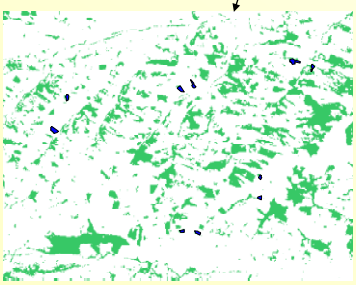


- Study sites and methods-



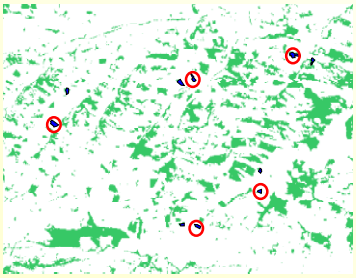
Hypothesis 1 study site

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.



Hypothesis 3 study site
5 forests,
among the 10 previous ones,
fitted out with emergence traps (modified Malaise traps with closed entrances, enclosing ± 4m²),
one on S facing edge and one in N one,
from February to June 2004.

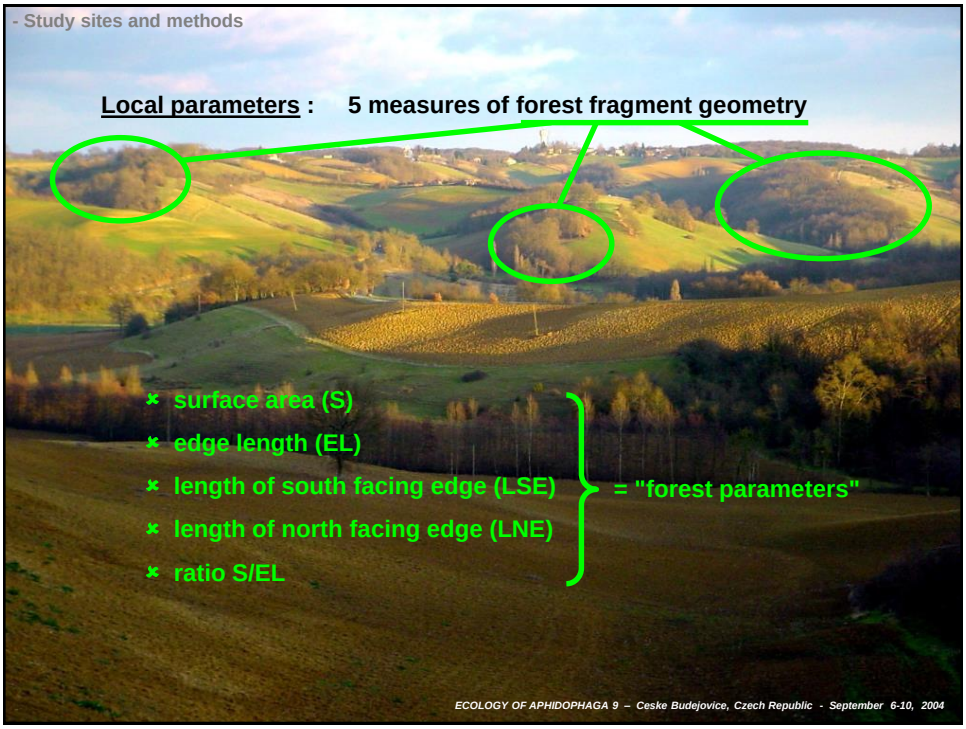
Malaise trap, Marris House Nets model

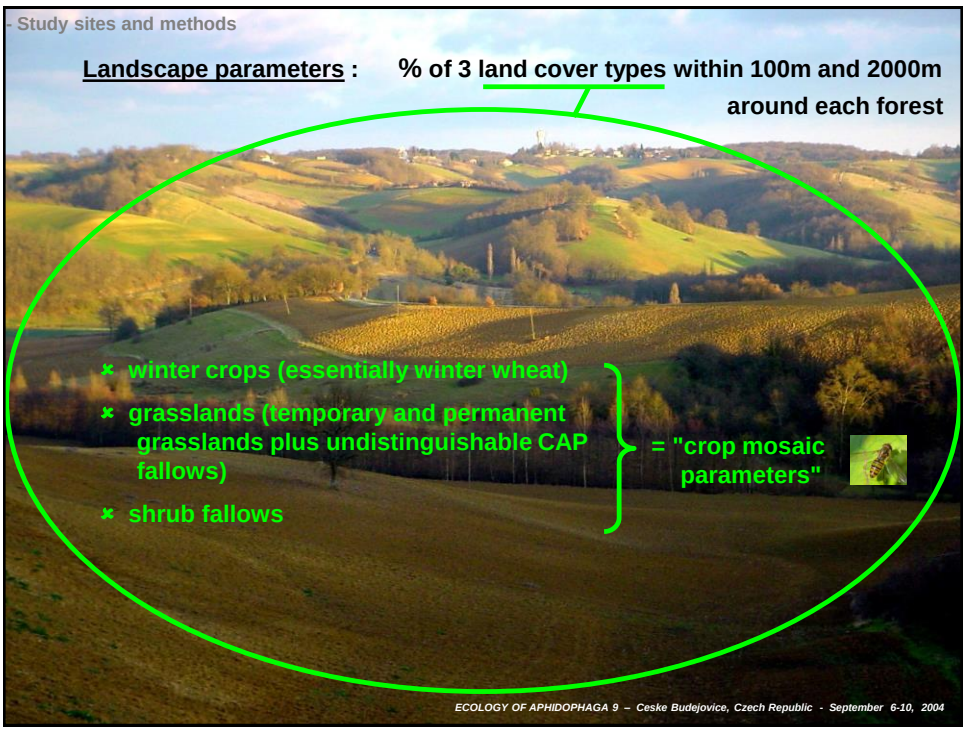
Emergence trap (based on Malaise trap model)

Environmental parameter recording

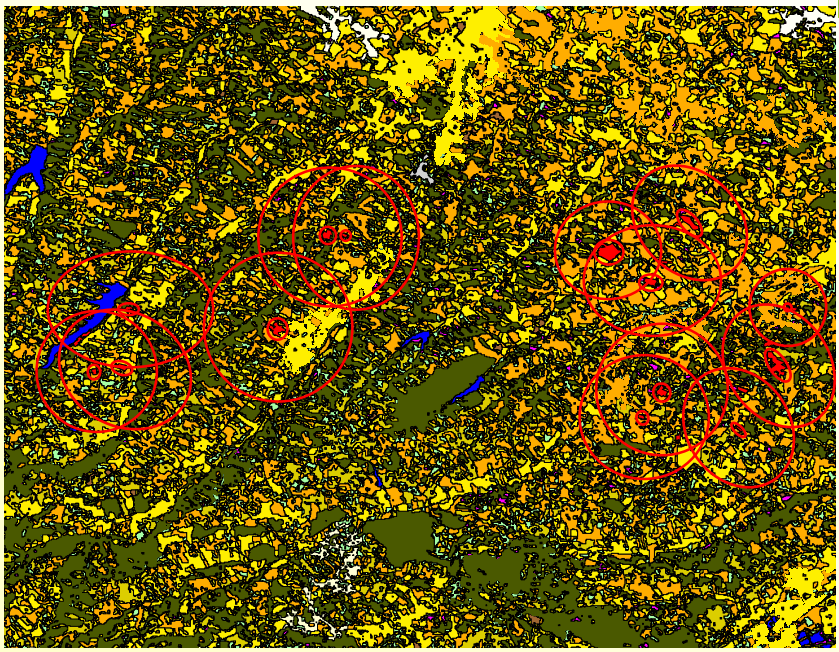
Hypothesis 1 (Local & landscape parameters)

Hypothesis 2 (Edge orientation and flowers)


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


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

- Study sites and methods



- 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

Statistical analysis

Hypothesis 1 (Local & landscape parameters)

Partial Least Squares (PLS) regression (∈ multivariate analyses):

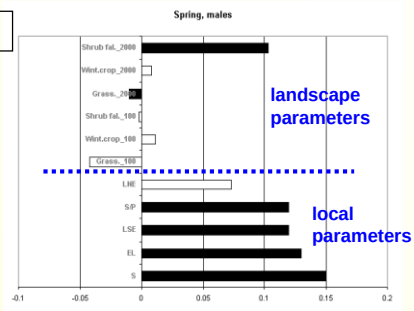
useful calibration technique when explanatory variables are correlated and when there are more than one response variable

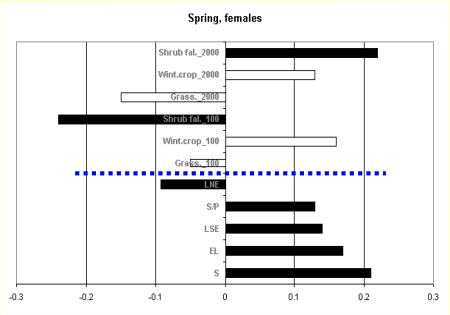
Hypothesis 2 (Edge orientation & flowers)

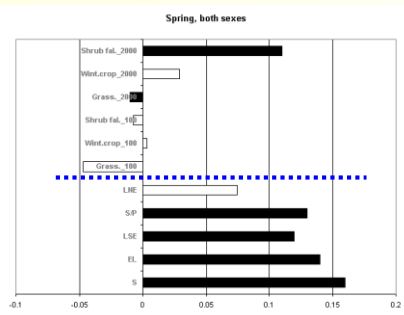
Usual non parametric tests

Global results for Local & landscape param.

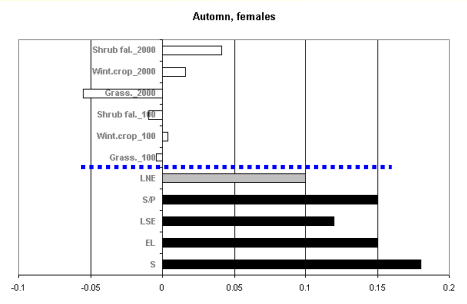
- 881 individuals trapped = 20% of all syrphids (>4900 ind. in > 120 spp)
- model for males in autumn non significant
- significant parameters (VIP>1):
- sub-significant param. (0.9≤VIP<1):
- non significant param. (VIP<0.9):

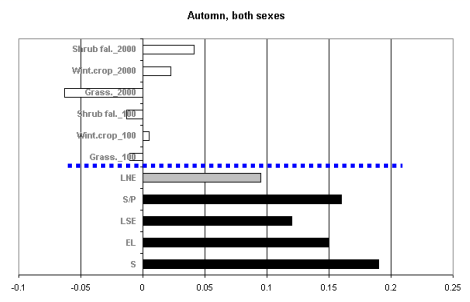






- Results -





- Results -

Spring:

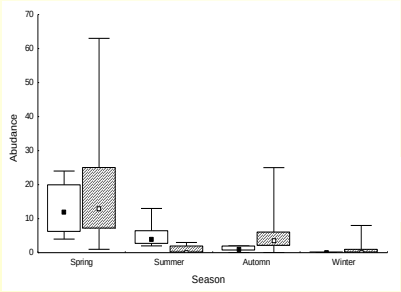
- S, EL, LSE and S/EL: + + + ⟶ ♂♀, ♂♂, ♀♀
- Shrub fallow 2000m: + + + + ⟶ ♀♀
- Shrub fallow 100m: – – – – ⟶ ♀♀
- LNE: – – – ⟶ ♀♀

Autumn:

- S: + + + + ⟶ ♂♀, ♀♀
- EL, LSE and S/EL: + + + ⟶ ♂♀, ♀♀
- LNE: ⟶ + + + ♂♀, ♀♀

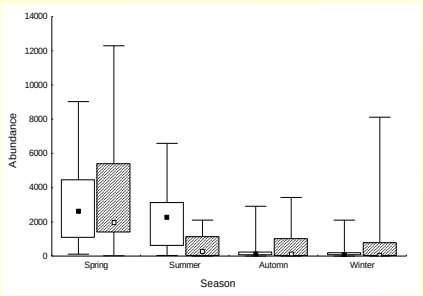
Global results for Edge orientation & flowers param.

- 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



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 ≠

Correlation between *E. balteatus and* flowers:

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

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 ?

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)