



AGGREGATION IN LADYBEETLES

From chemistry to behaviour

François Verheggen

Delphine Durieux PhD Thesis

(2008-2012)

« Identifying the chemical mechanisms governing aggregation behaviour in *Harmonia axyridis* »





Harmonia axyridis

Reduction of
Biodiversity



New fruit pest

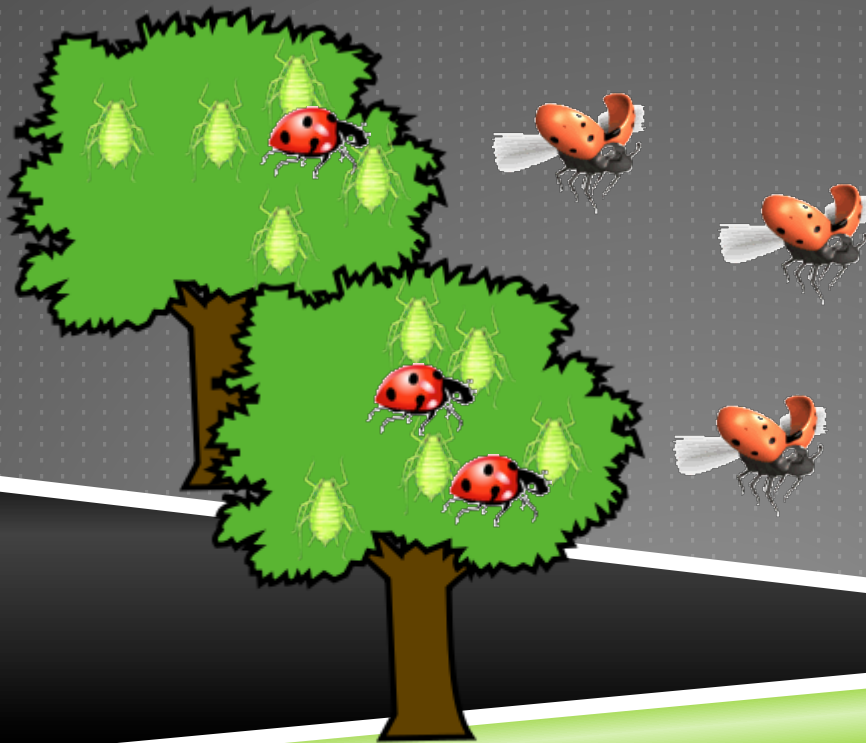


Aggregation inside
human constructions



FIVE STEPS TO SELECT AN AGGREGATION SITE

Nalepa *et al.* 2005



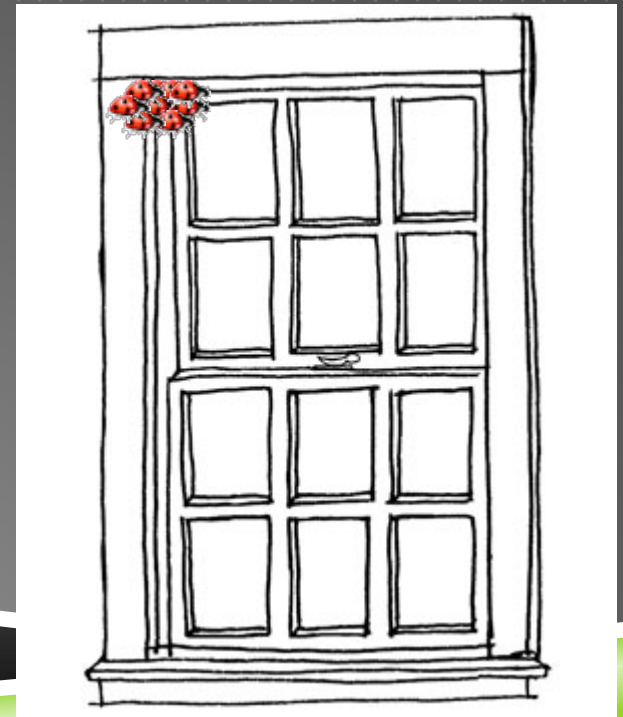
FIVE STEPS TO SELECT AN AGGREGATION SITE

Nalepa *et al.* 2005

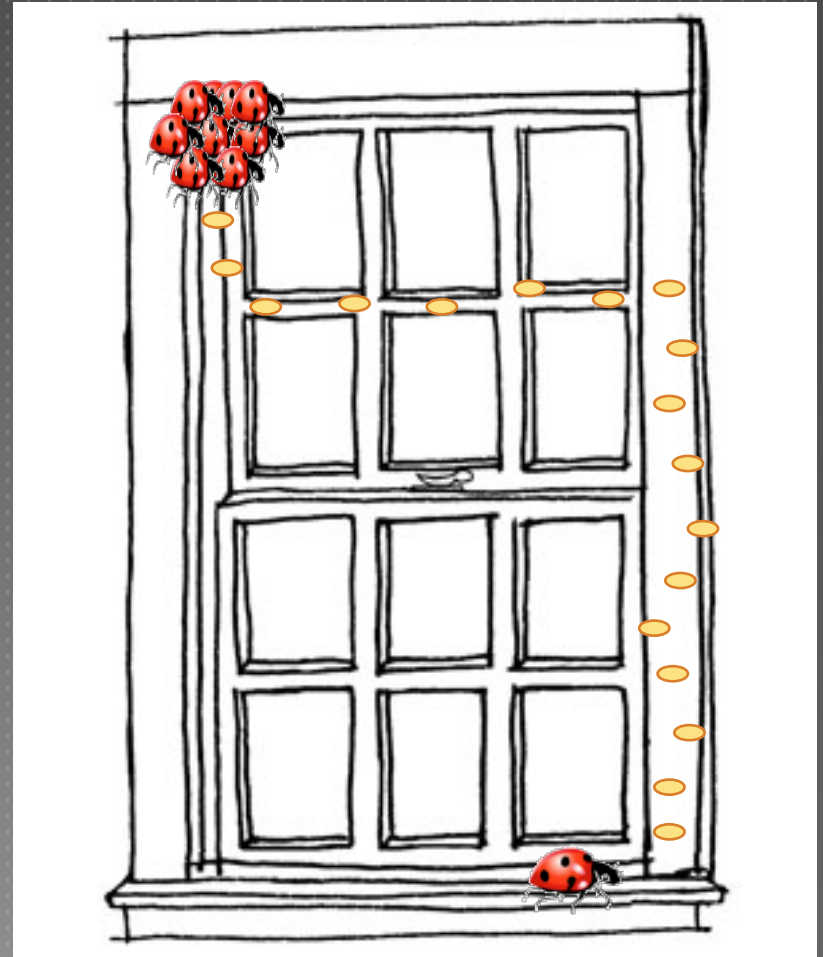


2) Searching for an aggregation site

?

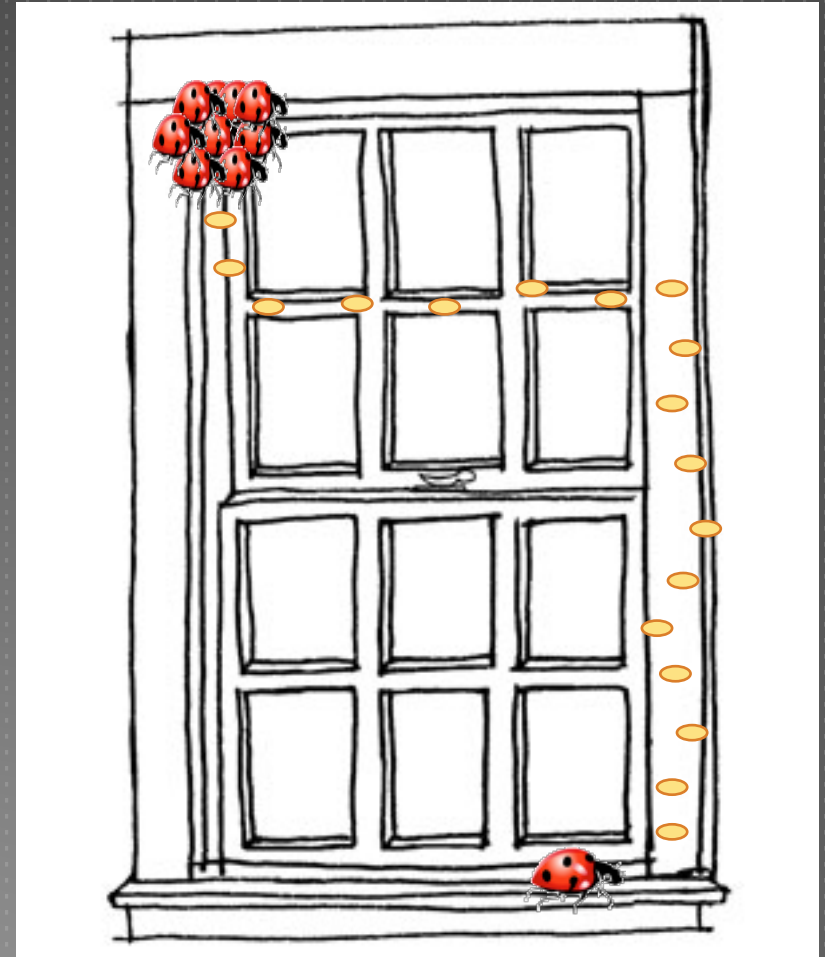


DOES A CHEMICAL MARKING OCCUR DURING THE AGGREGATION PROCESS ?



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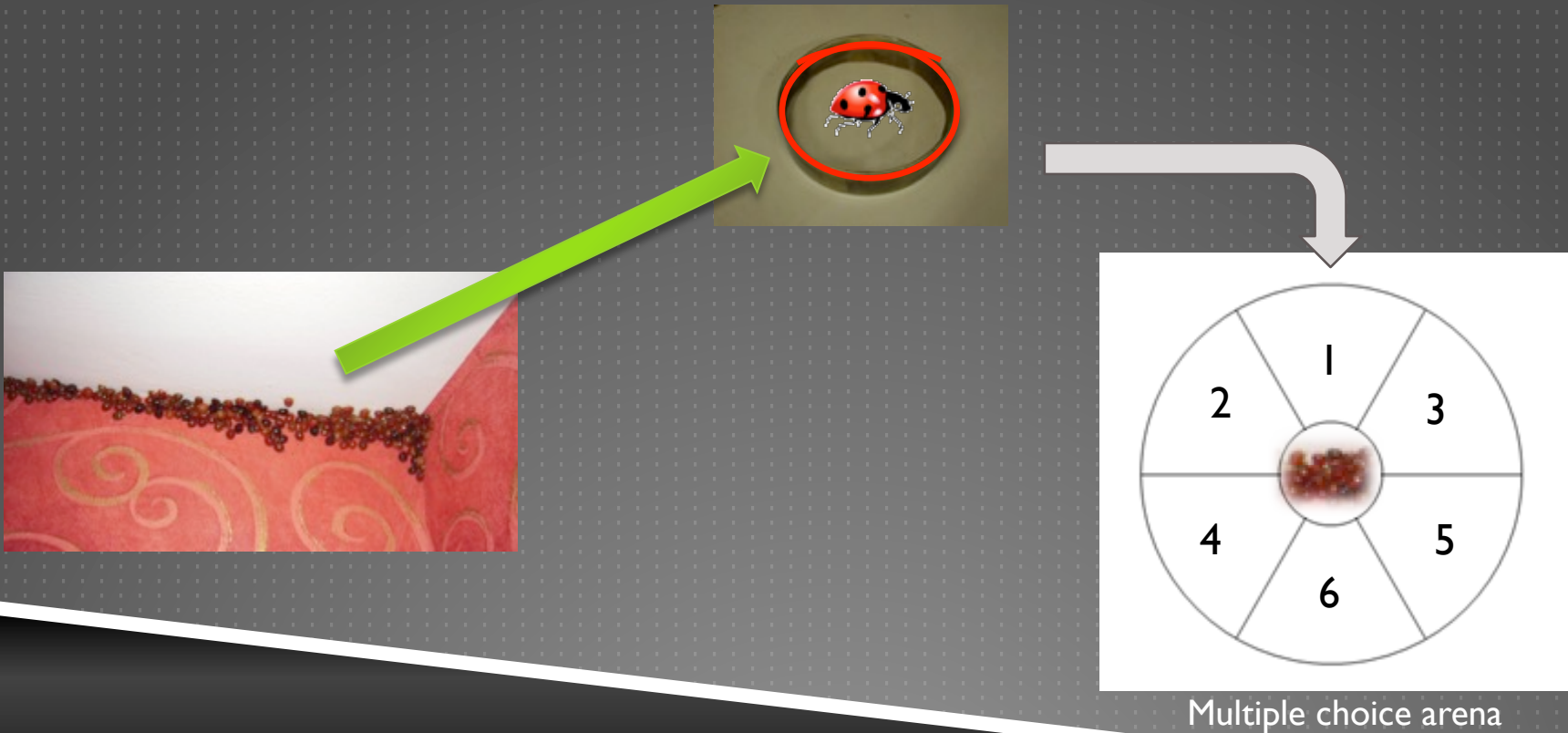
1. Do they mark the aggregation site ?
2. Do they mark the way to the aggregation site ?
3. What is the chemical composition of the marking ?
4. Is the marking used from one year to the other ?
5. Does the composition of the marking changes over time ?
6. Is the aggregative behaviour specific to winter conditions ?



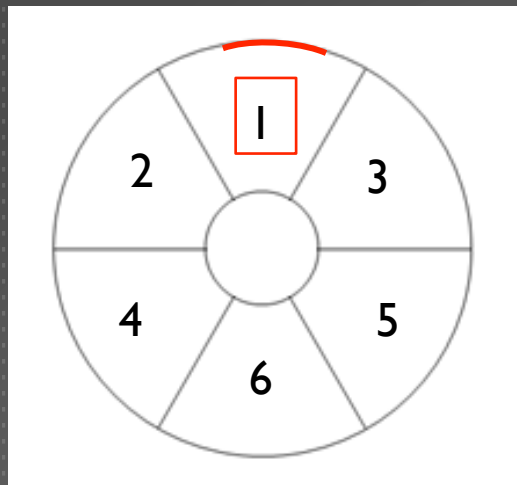
I. DO THEY MARK THE AGGREGATION SITE ?



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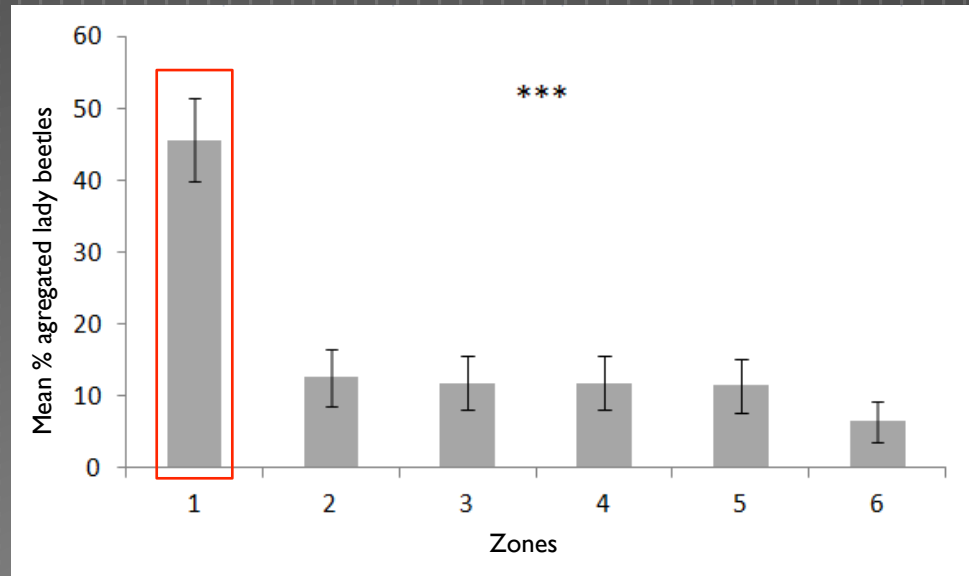


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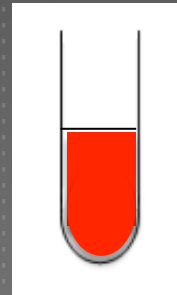
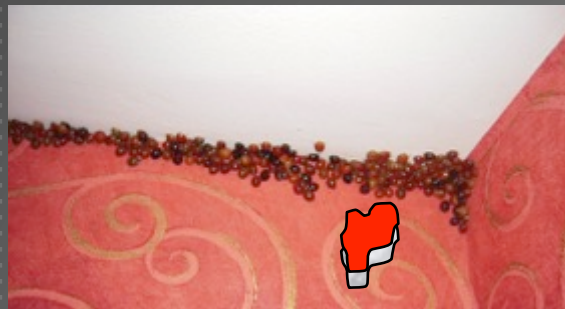
Multiple choice arena

8 hours later :

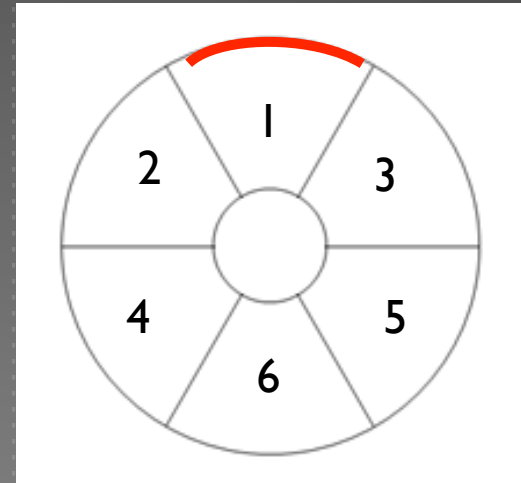


$\chi^2 : P < 0,001$

I. DO THEY MARK THE AGGREGATION SITE ?

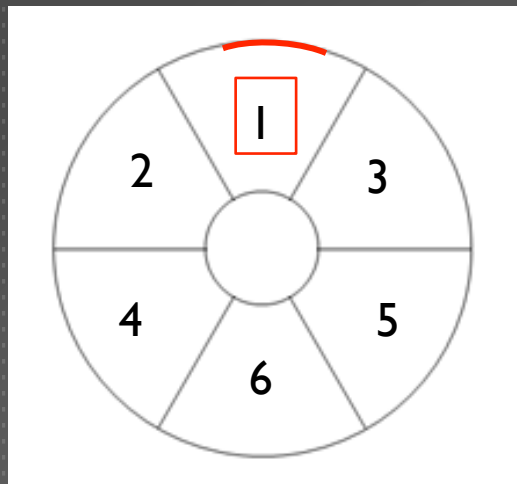


solvent



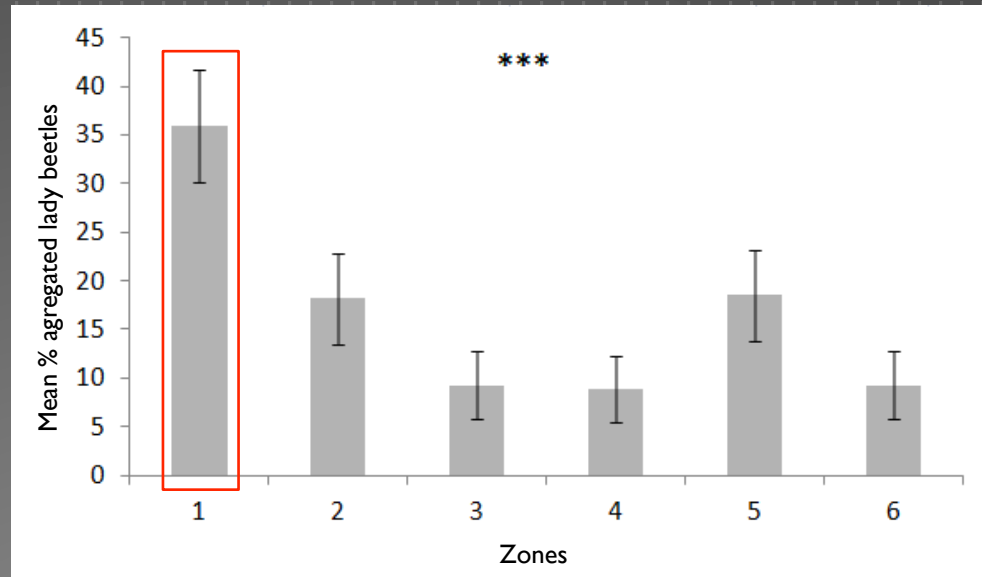
Multiple choice arena

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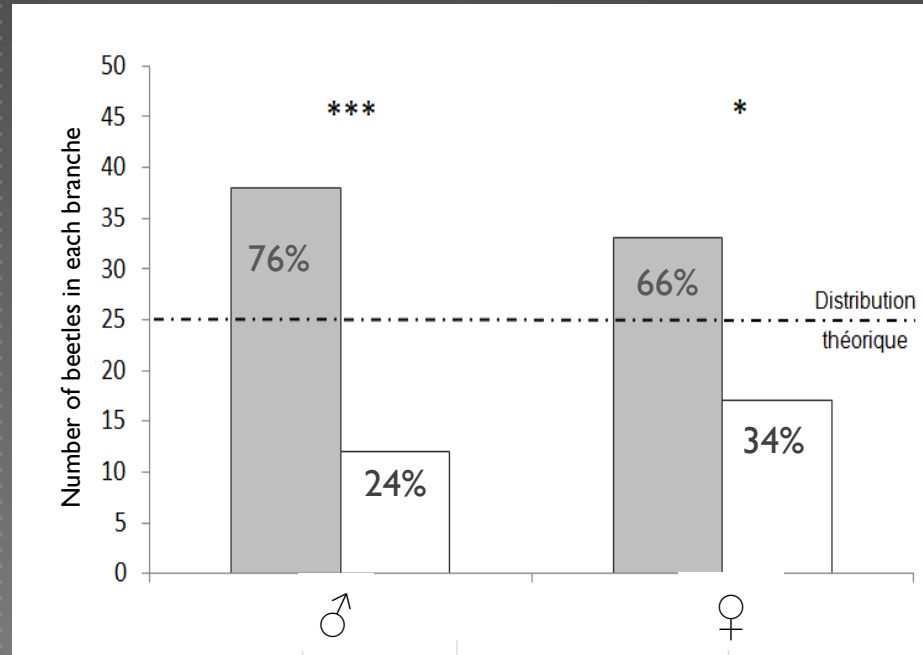
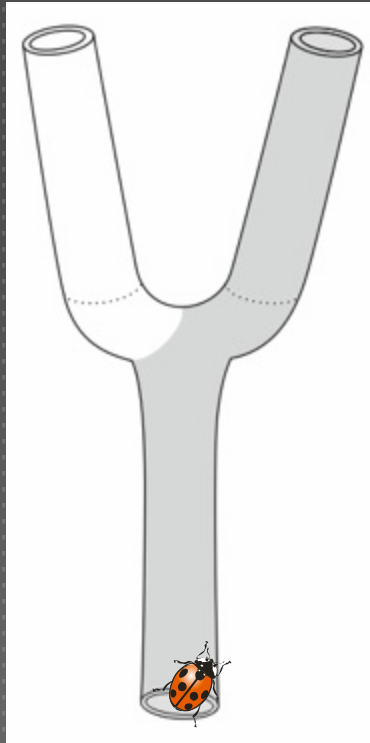
Multiple choice arena

8 hours later :



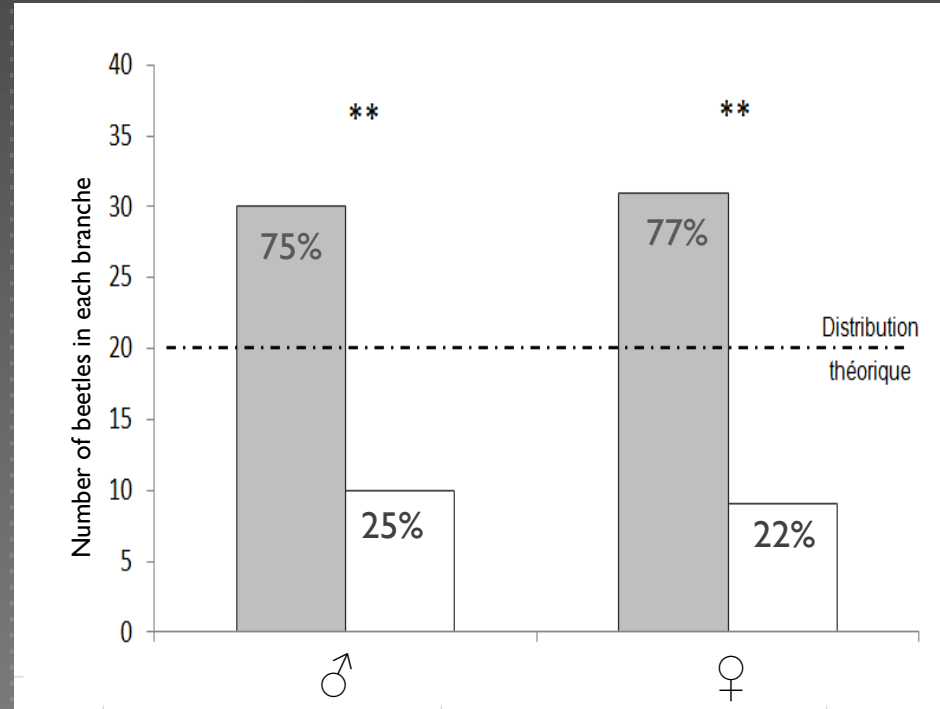
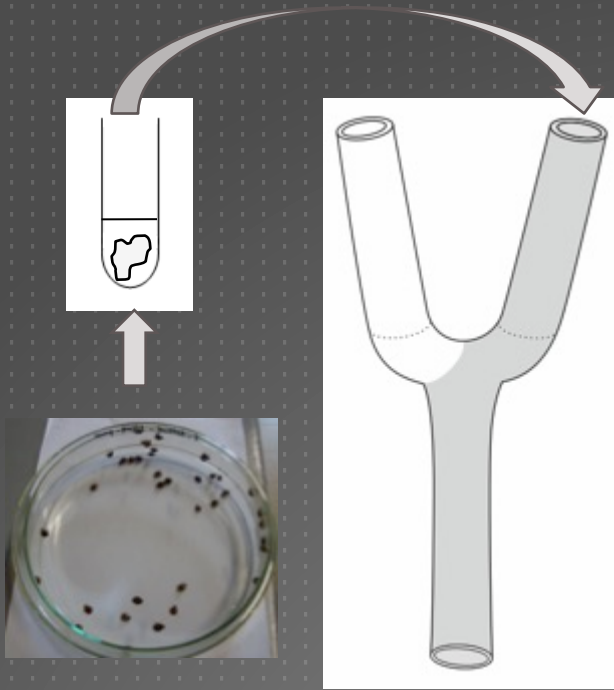
$\chi^2 : P < 0,001$

2. DO THEY MARK THE WAY TO THE AGGREGATION SITE ?



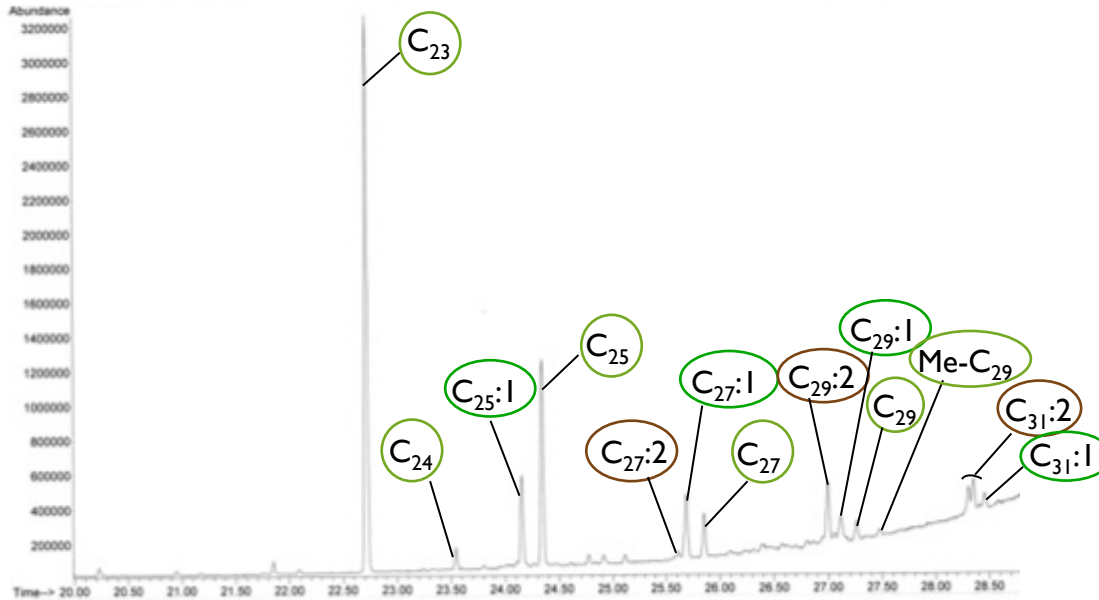
χ^2 : P < 0.001 (males) and P = 0.024 (females)

2. DO THEY MARK THE WAY TO THE AGGREGATION SITE ?



χ^2 : P = 0.002 (males) and P = 0.001 (females)

3. WHAT IS THE CHEMICAL COMPOSITION OF THE MARKING ?



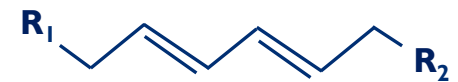
Saturated hydrocarbons



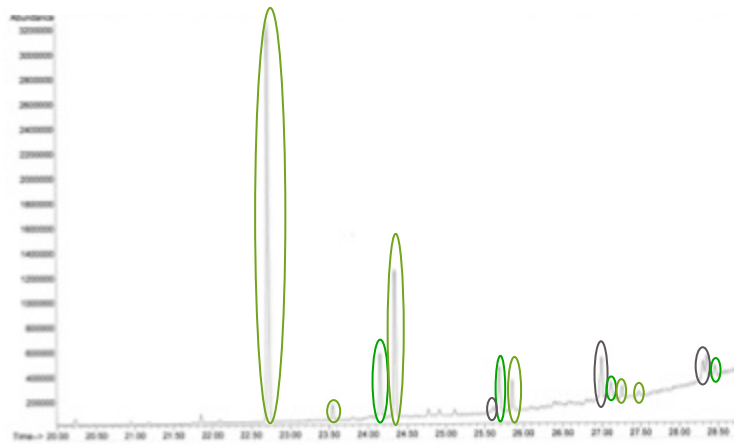
Mono-unsaturated hydrocarbons



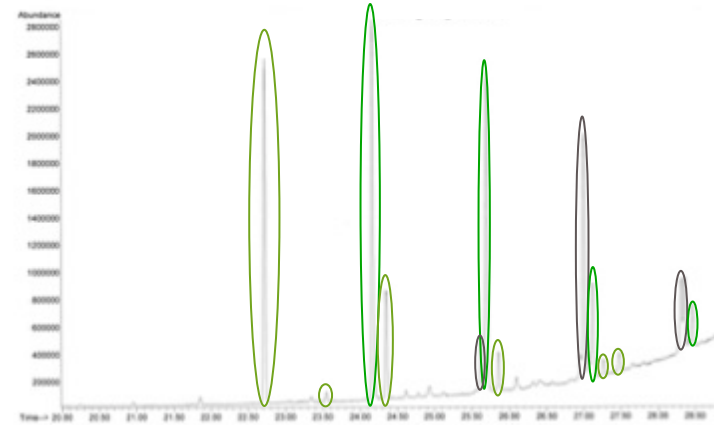
Di-unsaturated hydrocarbons



3. WHAT IS THE CHEMICAL COMPOSITION OF THE MARKING ?



Inside aggregates





Around aggregates

1. Do they mark the aggregation site ?
2. Do they mark the way to the aggregation site ?
3. What is the chemical composition of the marking ?

Journal of Insect Physiology 58 (2012) 801–807

Contents lists available at [SciVerse ScienceDirect](#)

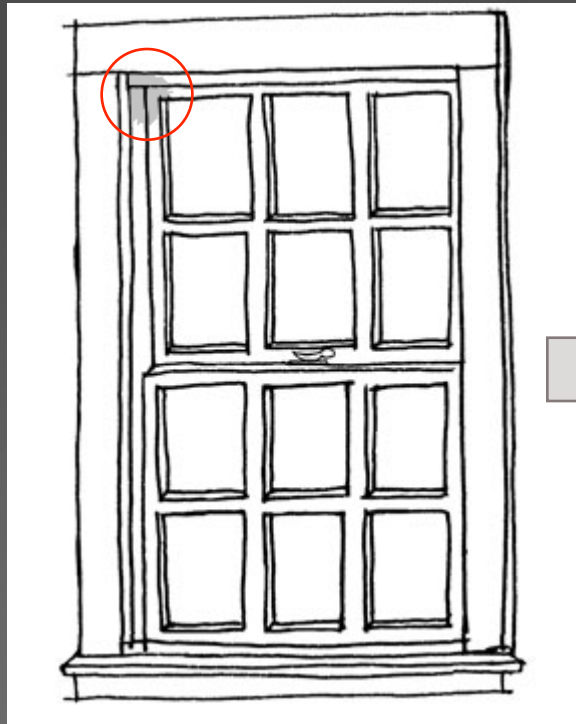
 **Journal of Insect Physiology** 

journal homepage: www.elsevier.com/locate/jinsphys

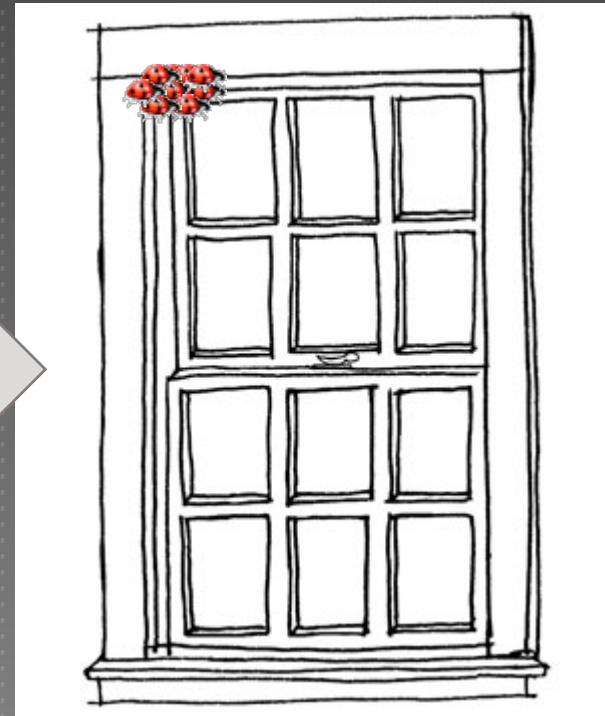
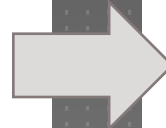
Role of long-chain hydrocarbons in the aggregation behaviour of *Harmonia axyridis* (Pallas) (Coleoptera: Coccinellidae)

Delphine Durieux^{a,*}, Christophe Fischer^b, Yves Brostaux^c, John J. Sloggett^d, Jean-Louis Deneubourg^e, Axel Vandereycken^a, Emilie Joie^a, Jean-Paul Wathelet^f, Georges Lognay^b, Eric Haubruge^a, François J. Verheggen^a

4. IS THE MARKING USED FROM ONE YEAR TO THE OTHER ?

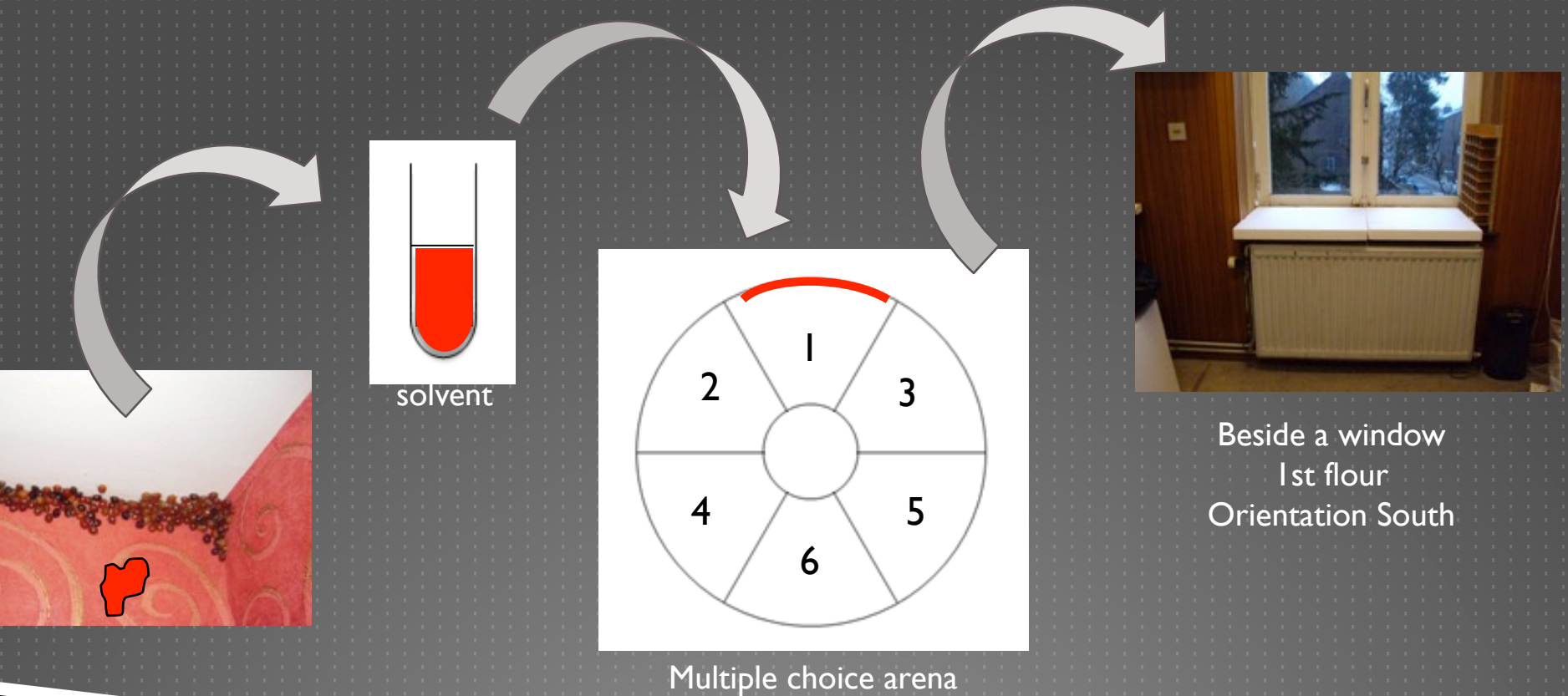


Year 1



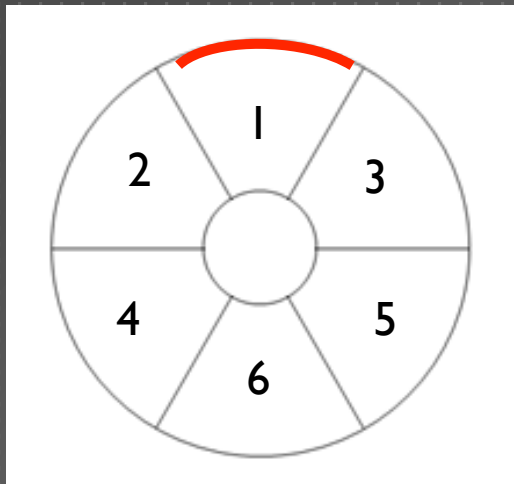
Year 2

4. IS THE MARKING USED FROM ONE YEAR TO THE OTHER ?

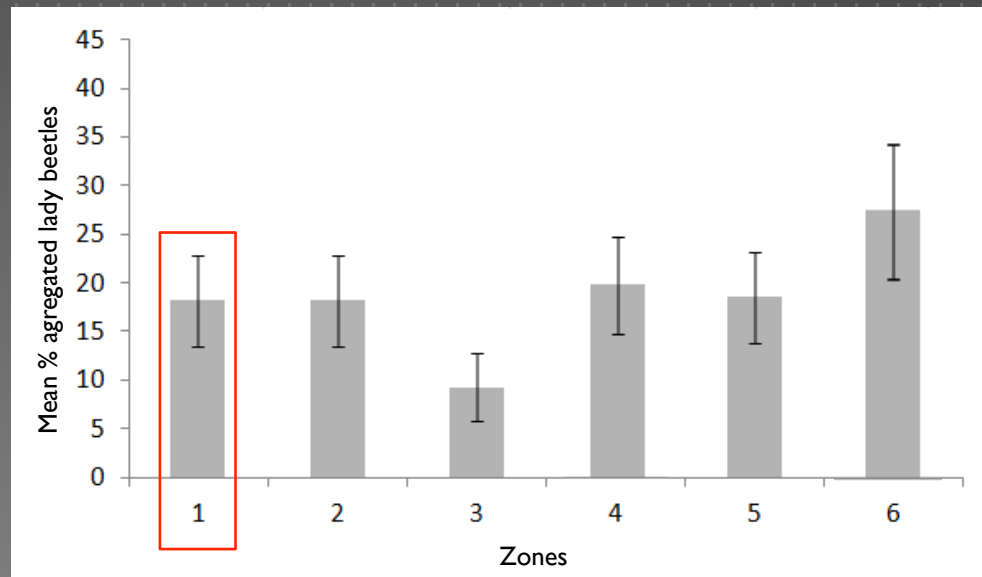


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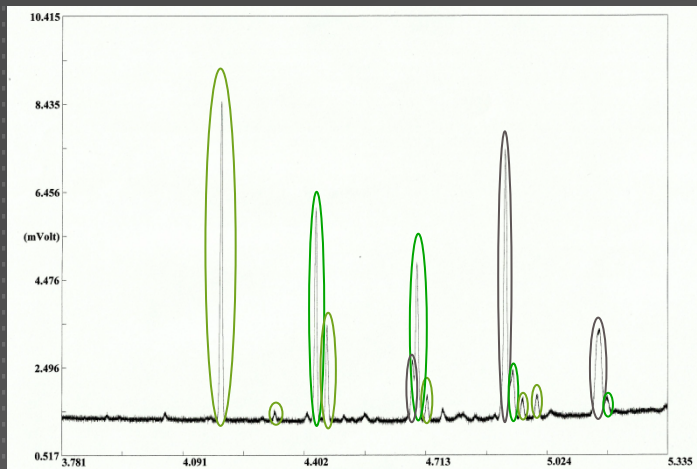
8 hours later :



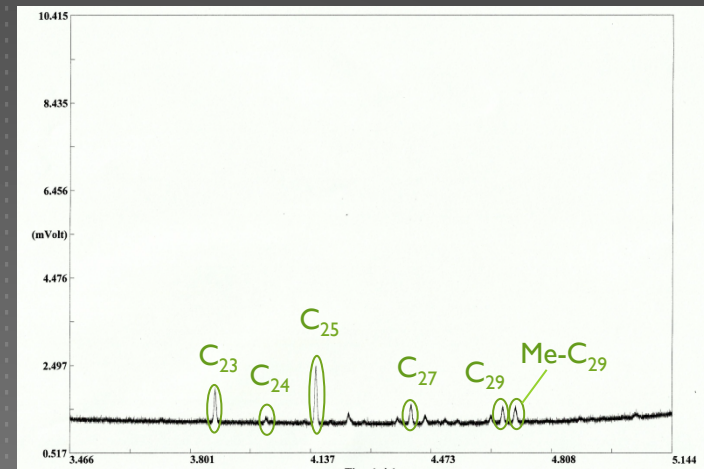
Multiple choice arena



4. IS THE MARKING USED FROM ONE YEAR TO THE OTHER ?



Fresh marking



One year old marking



Unsaturated hydrocarbons absent !

4. IS THE MARKING USED FROM ONE YEAR TO THE OTHER ?

JOURNAL OF APPLIED ENTOMOLOGY

J. Appl. Entomol.

ORIGINAL CONTRIBUTION

Is conspecific substrate marking a long-term external memory of previously colonized overwintering sites in *Harmonia axyridis*?

D. Durieux¹, B. Fassotte¹, M. Vanderplanck², Y. Brostaux³, C. Fischer⁴, G. Lognay⁴, E. Haubruge¹ & F. J. Verheggen¹

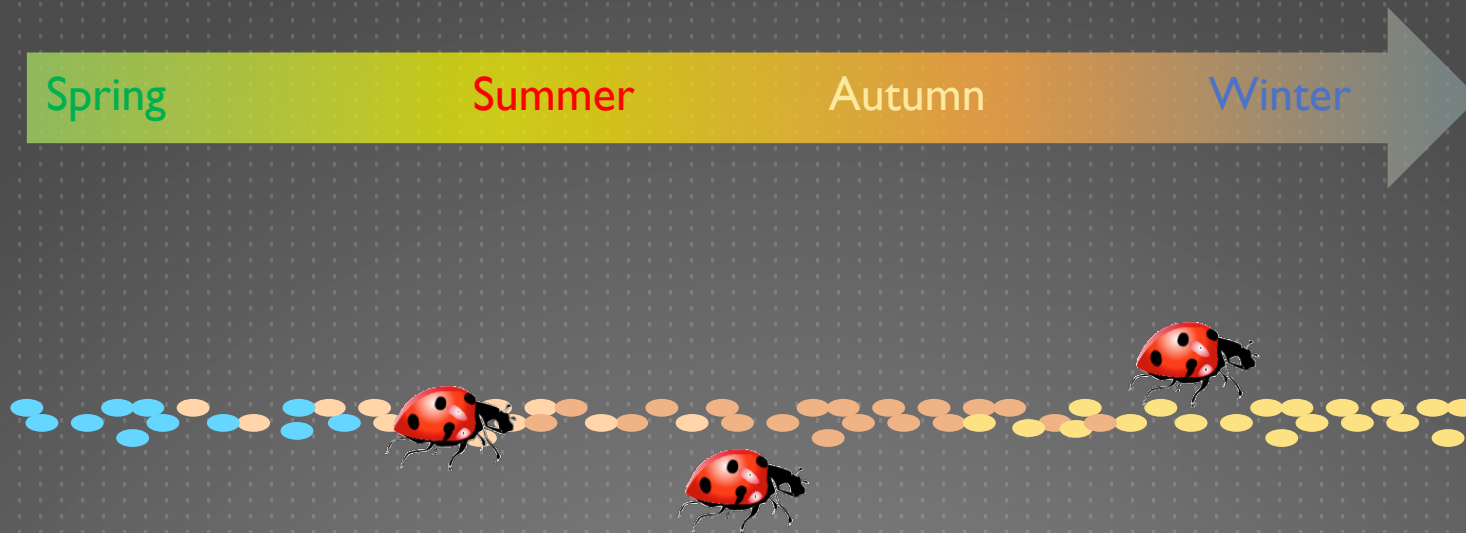
¹ Functional and Evolutionary Entomology, Gembloux Agro-Bio Tech, University of Liege, Gembloux, Belgium

² Laboratory of Zoology, Research Institute of Biosciences, University of Mons, Mons, Belgium

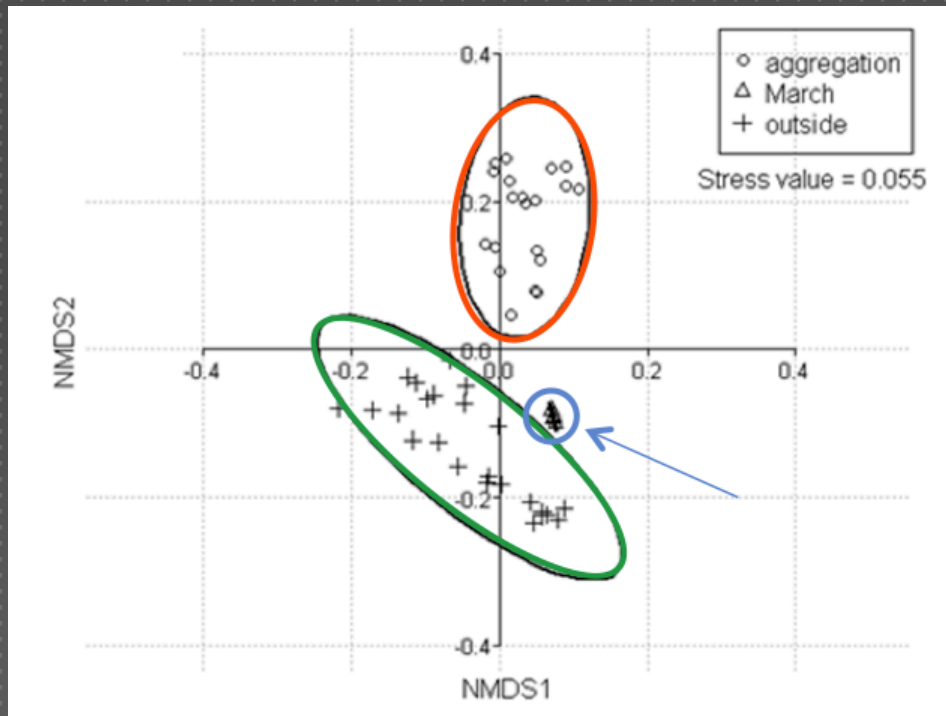
³ Applied Statistics, Computer Science and Mathematics, Gembloux Agro-Bio Tech, University of Liege, Gembloux, Belgium

⁴ Laboratory of Analytical Chemistry, Analysis Quality and Risk, Gembloux Agro-Bio Tech, University of Liege, Gembloux, Belgium

5. DOES THE COMPOSITION OF THE MARKING CHANGES OVER TIME ?



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(perMANOVA, $P < 0.001$)

From April to September
(outside)

From October to February
(aggregates)

March
(leaving aggregates)

5. DOES THE COMPOSITION OF THE MARKING CHANGES OVER TIME ?

OPEN ACCESS Freely available online

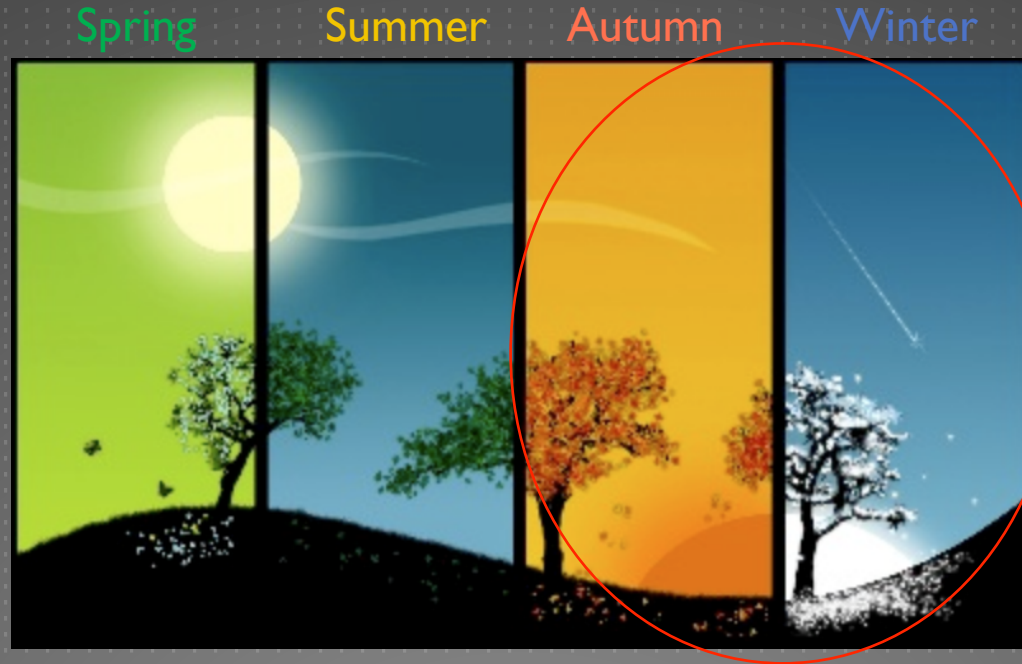
PLOS ONE

Substrate Marking by an Invasive Ladybeetle: Seasonal Changes in Hydrocarbon Composition and Behavioral Responses

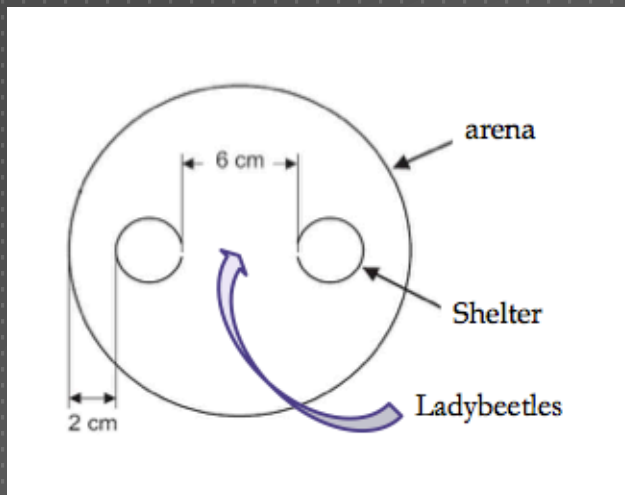
Delphine Durieux^{1*}, Bérénice Fassotte¹, Maryse Vanderplanck², Jean-Louis Deneubourg³, Christophe Fischer⁴, Georges Lognay⁴, Eric Haubruge¹, François J. Verheggen¹

1 Unit of Functional and Evolutionary Entomology, Gembloux Agro-Bio Tech, University of Liege, Gembloux, Belgium, **2** Laboratory of Zoology, University of Mons, Mons, Belgium, **3** Unit of Social Ecology, Université libre de Bruxelles, Brussels, Belgium, **4** Unit of Analysis Quality and Risk, Laboratory of Analytical Chemistry, Gembloux Agro-Bio Tech, University of Liege, Gembloux, Belgium

6. IS THE AGGREGATIVE BEHAVIOUR SPECIFIC TO WINTER CONDITIONS ?



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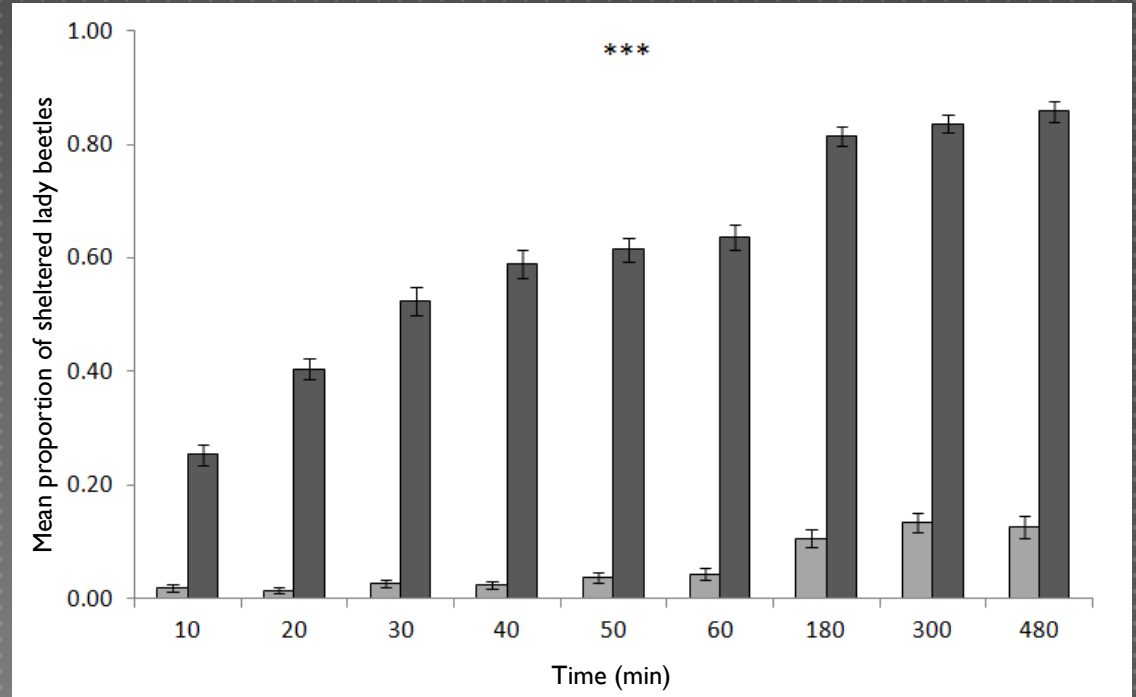
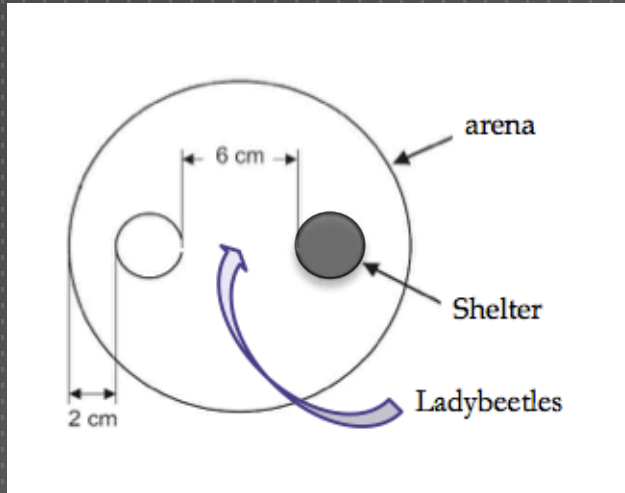
20 individuals

temps d'observation	P valeur
10 min	0.028 *
20 min	0.107
30 min	0.007 **
40 min	0.108
50 min	0.012 *
1 h	0.080
3h	< 0.001 ***
5h	< 0.001 ***
8h	< 0.001 ***

50 individuals

temps d'observation	P valeur
10 min	0.106
20 min	0.002 **
30 min	< 0.001 ***
40 min	< 0.001 ***
50 min	< 0.001 ***
1 h	< 0.001 ***
3h	< 0.001 ***
5h	< 0.001 ***
8h	< 0.001 ***

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Insect
science

Insect Science (2014) 00, 1–9, DOI 10.1111/1744-7917.12144

ORIGINAL ARTICLE

Aggregation behavior of *Harmonia axyridis* under non-wintering conditions

Delphine Durieux¹, Bérénice Fassotte¹, Jean-Louis Deneubourg², Yves Brostaux³, Axel Vandereycken¹, Emilie Joie¹, Eric Haubruge¹ and François J. Verheggen¹

CONCLUSION

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