

A four-year inventory of the invasive ladybeetle *Harmonia axyridis* in agricultural ecosystems

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gembloux
agro bio tech



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Service public de Wallonie

INTRODUCTION

INTRODUCTION > INVASION

Country	Year of first record in the wild	Deliberately introduced? (Earliest year of introduction)	Evidence of establishment?	No. 50 km ² with <i>H. axyridis</i> by August 2007
Ukraine	Unknown	Yes (1964)	Unknown	Unknown
Belarus	Unknown	Yes (1968)	Unknown	Unknown
Portugal	N/A	Yes (1984)	No	0
France	1991	Yes (1982)	Yes	63
Greece	1998	Yes (1994)	Limited	1
Germany	1999	Yes (1997)	Yes	75
Belgium	2001	Yes (1997)	Yes	21
Netherlands	2002	Yes (1996)	Yes	26

Sf

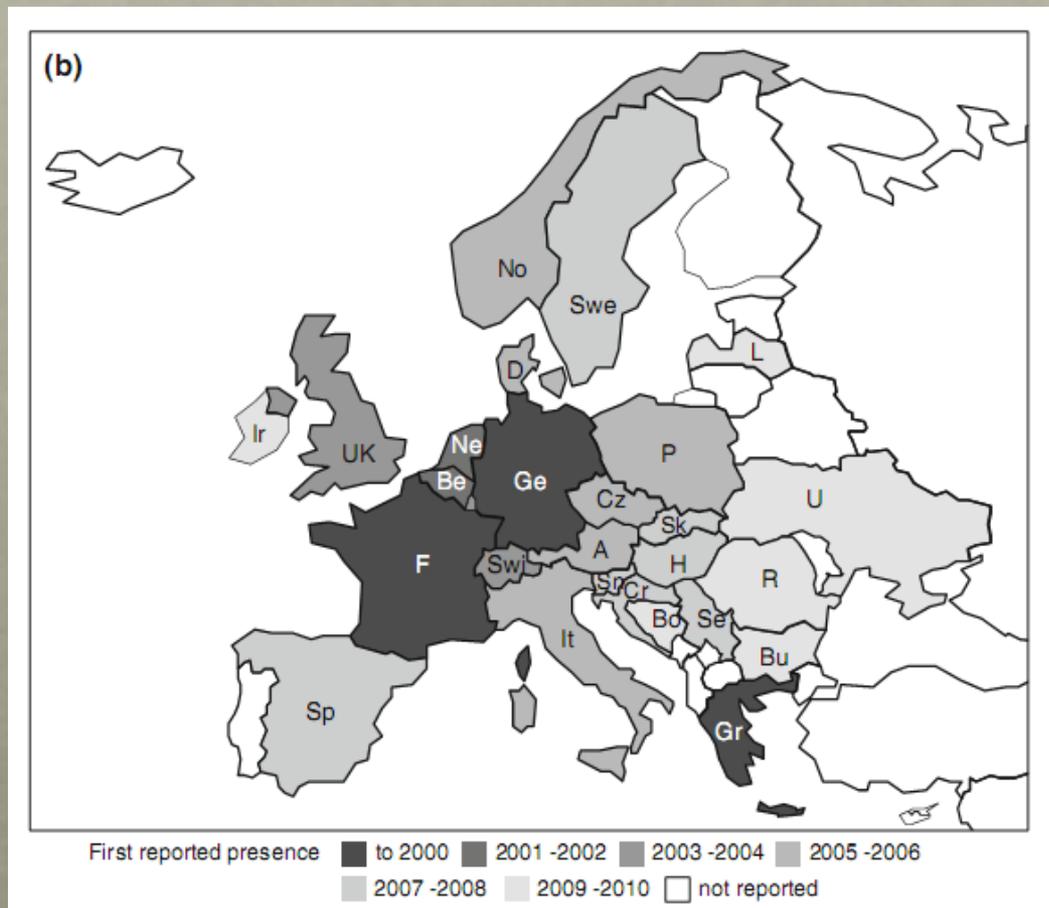
Sv

13 countries invaded in 2007

Luxembourg	2004	No	Yes	2
England and Channel Islands	2004	No	Yes	60
Italy	2006	Yes (1990s)	Yes	1
Czech Republic	2006	Yes (2003)	Yes	11
Austria	2006	No	Yes	7
Denmark	2006	No	Yes	2
Wales	2006	No	Yes	5
Norway	2006	No	No	1
Liechtenstein	2007	No	Yes	1
Sweden	2007	No	No	1

INTRODUCTION IN EUROPE

>25 countries invaded in Europe



STATUS



<http://ias.biodiversity.be/>

Harmonia axyridis - Harlequin ladybird

ISSG DAISIE

French name: Coccinelle asiatique
Dutch name: Veelkleurig aziatisch lieveheersbeestje
Family: Coccinellidae

Group: Arthropods
Origin: Asia
Habitat: terrestrial
Introduction: biological control



Naturalization in Belgium

First observation in the wild: 2000
Invasion stage: spread
Spatial distribution: widespread

Invasiveness

Reproduction in the wild: yes
Dispersion potential: high
Natural habitats: high

More on invasiveness: Lives in a very wide range of habitats: farmlands, orchards, wetlands, forest margins. Se deep forest habitats.

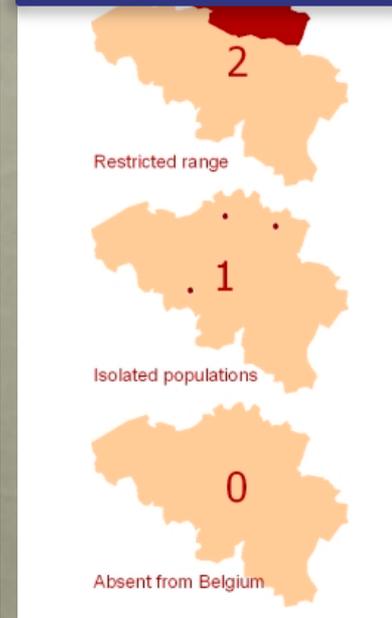
Distribution in Belgium

Established populations

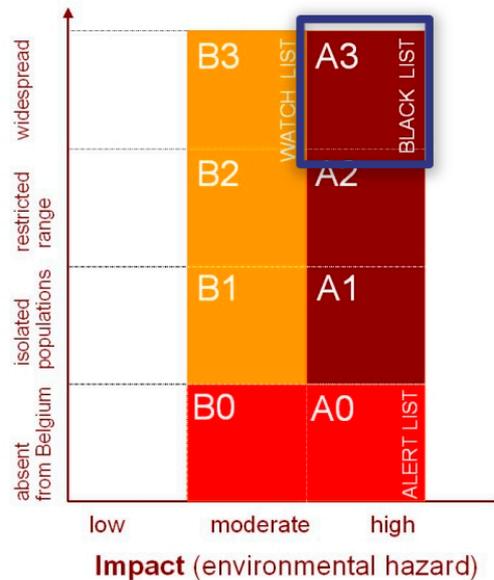


0 21 42 63 km

- absent from district
- isolated populations (1-5 localities per district)
- widespread (>5 localities per district)



Invasion stage in Belgium

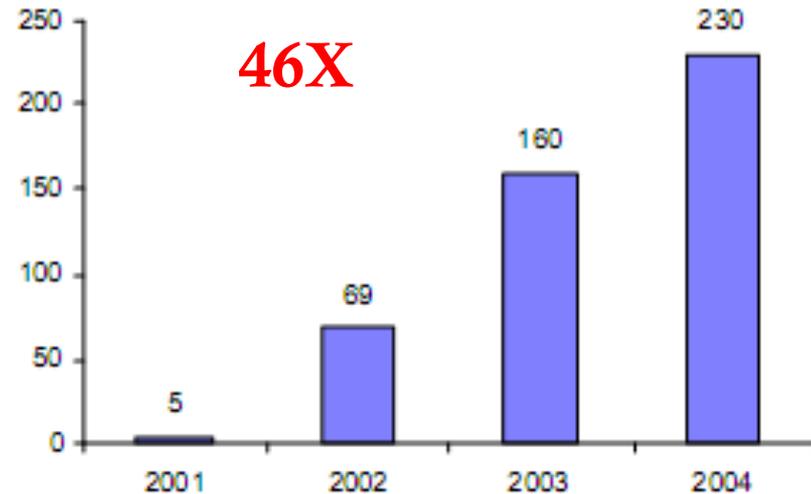


INTRODUCTION > INVASION

- Introduction of *H. axyridis* in 1997
- First observation in 2001



Number of cities with *H. axyridis*



Working group:
Coccinula

(Adriaens, 2007)

IMPACT

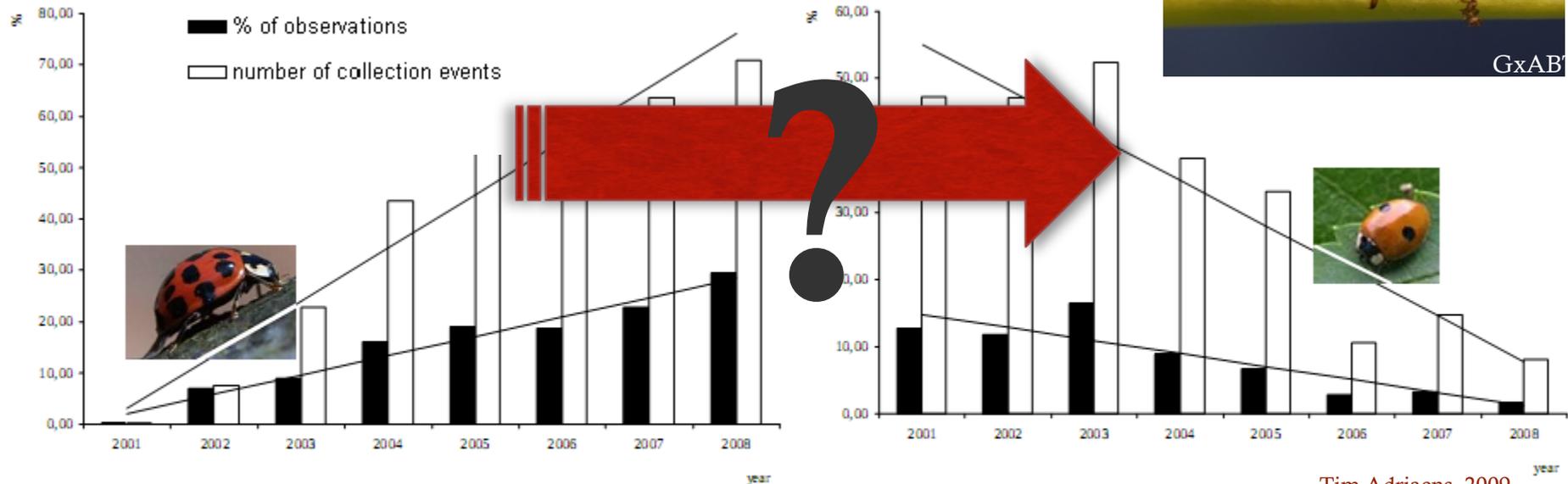
Intraguild predation



Biodiversity damages, population changes, population displacement



Decrease of the native species populations



IMPACT

- Fruits damages (yield loss, financial loss)
- Overwintering in houses (agregation)



A. Vandereycken



A. Vandereycken

OBJECTIVES

OBJECTIVES

Introduction of *H. axyridis*, an IAS in Belgium



Invasion of *H. axyridis*



Belgian ecosystem disturbed



Over four years

Evaluation of the:

agro-habitats of
H. axyridis

occurrence of *H.*
axyridis in these
habitats

occurrence of
other
aphidophagous
predators

phenology of *H.*
axyridis

MATERIAL & METHODS

(1)

MATERIAL & METHODS (1)

- The insectarium of Gembloux Agro-Bio Tech
- 2 000 000 identified insects

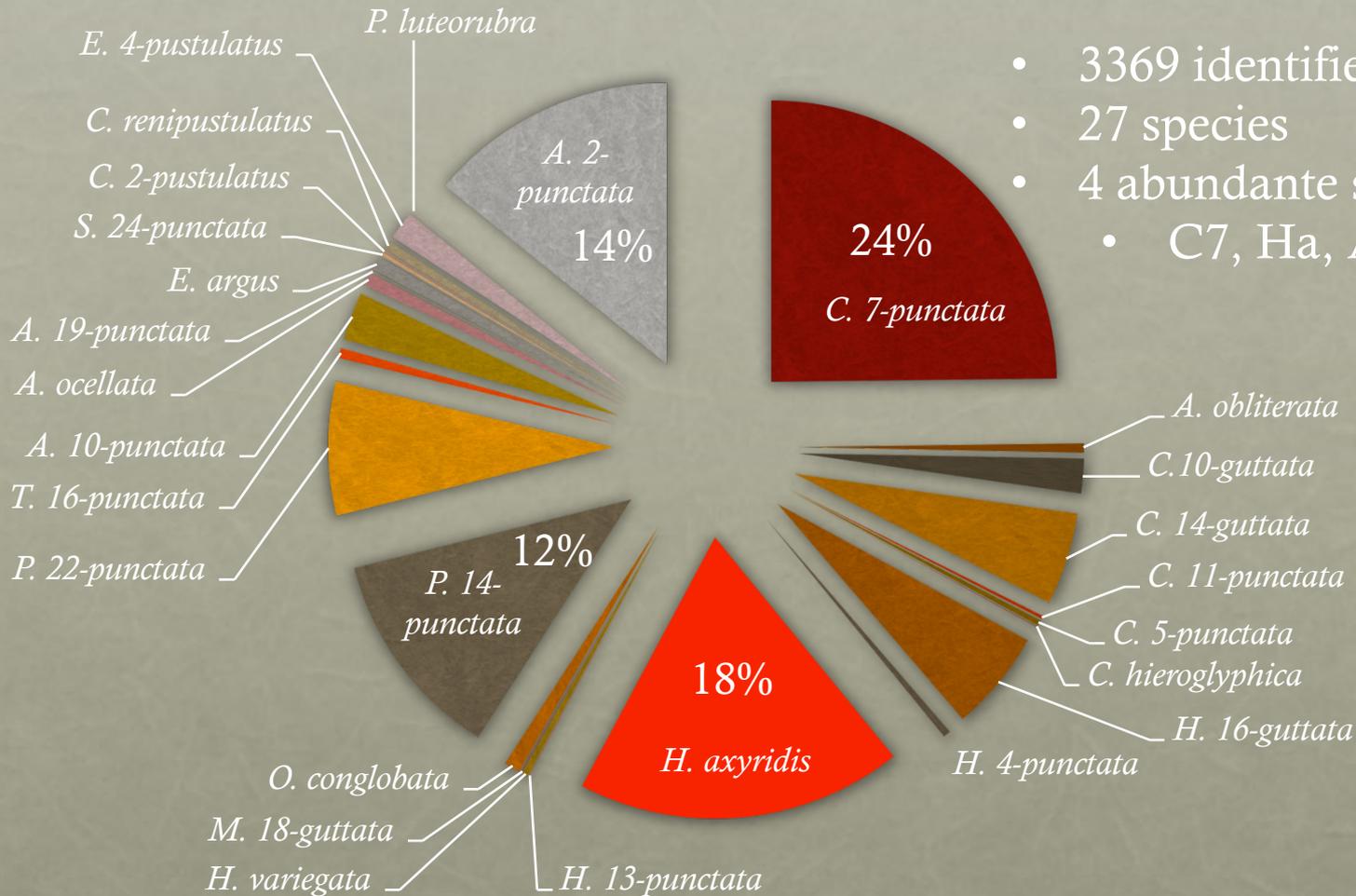


<http://www.gembloux.ulg.ac.be/entomologie-fonctionnelle-et-evolutive/conservatoire/>



RESULTS (1)

RESULTS (1)



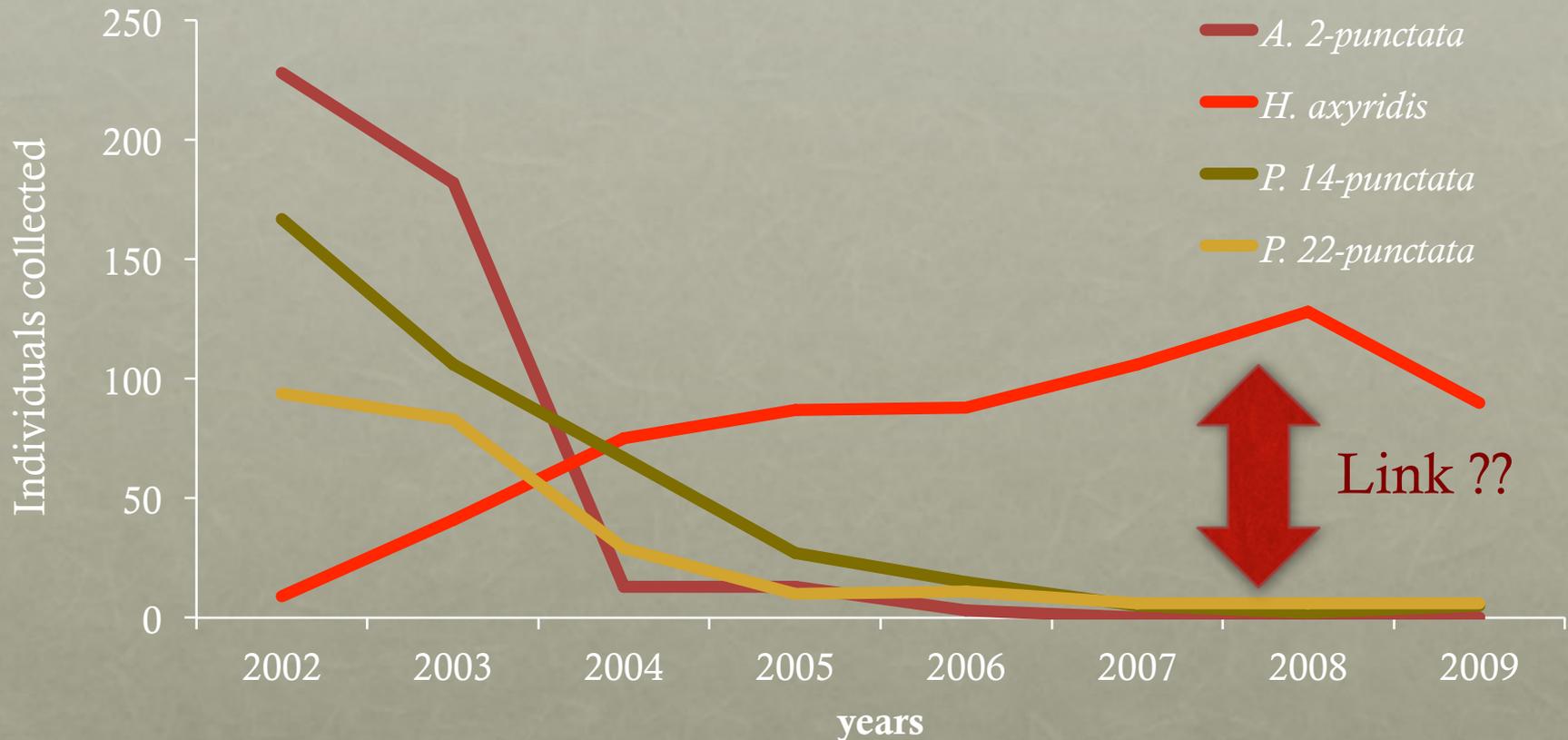
- 3369 identified ladybirds
- 27 species
- 4 abundante species (>10%)
 - C7, Ha, A2, P14

RESULTS (1)

27 species of Coccinellidae

	Years of sampling									Relative abundance (%)
	2001	2002	2003	2004	2005	2006	2007	2008	2009	
<i>Coccinella septempunctata</i>	17.2	21.9	21.7	30.6	35.2	39.3	28.1	17.9	15.5	24.81
<i>Harmonia axyridis</i>		0.9	5.4	17.6	31.9	41.1	53.3	63.7	63.4	18.52
<i>Adalia bipunctata</i>	29.3	22.0	23.9	3.1	4.8	1.4		0.5		14.07
<i>Propylea quatuordecimpunctata</i>	11.2	16.1	13.9	15.8	9.9	7.0	2.5	1.0	3.5	12.08
<i>Psyllobora vigintiduopunctata</i>	11.2	9.1	10.9	6.8	3.7	5.1	3.0	3.0	4.2	7.66
<i>Halyzia sedecimguttata</i>	6.0	6.4	4.9	7.1	7.0	2.8	6.5	6.0	2.8	5.76
<i>Calvia quatuordecimguttata</i>	4.3	7.7	5.8	4.0	1.8	1.4	2.5	5.5	4.9	5.25
<i>Adalia decempunctata</i>	2.6	4.9	3.1	2.8	0.4					2.70
<i>Calvia decemguttata</i>	1.7	1.9	3.8	2.1	1.5				1.4	1.96
<i>Exochomus quadripustulatus</i>	1.7	2.3	0.9	2.8	1.5	0.9	0.5	0.5	0.7	1.60
<i>Oenopia conglobata</i>	5.2	1.5	0.9	0.2						0.89
<i>Anatis ocellata</i>	0.9	0.8	0.4	0.2	0.4	0.5	2.0	1.5	2.1	0.74
<i>Epilachna argus</i>	1.7	1.3	0.5	1.2			0.5			0.74
<i>Tytthaspis sedecimpunctata</i>	0.9	0.4	0.4	1.4	1.1		1.0			0.56
<i>Chilocorus renipustulatus</i>	0.9	0.5	0.9	0.5	0.7					0.50
<i>Aphidecta oblitterata</i>	2.6	0.7	0.5	0.5						0.47
<i>Harmonia quadripunctata</i>	0.9	0.7	0.1	0.7		0.5			0.7	0.42
<i>Coccinella quinquepunctata</i>	0.9	0.3	0.7	0.2	0.4					0.33
<i>Hippodamia variegata</i>	0.9	0.2	0.5	0.7					0.7	0.33
<i>Subcoccinella vigintiquatuorpuntata</i>		0.1	0.3	0.9						0.21
<i>Coccinella undecimpunctata</i>		0.3	0.3	0.2						0.18
<i>Chilocorus bipustulatus</i>			0.1	0.2						0.06
<i>Anisosticta novemdecimpunctata</i>		0.1								0.03
<i>Coccinella hieroglyphica</i>				0.2						0.03
<i>Hippodamia tredecimpunctata</i>			0.1							0.03
<i>Myrrha octodecimguttata</i>								0.5		0.03
<i>Platynaspis luteorubra</i>		0.1								0.03
Species diversity	18	23	23	23	14	10	9	10	11	

RESULTS (1)

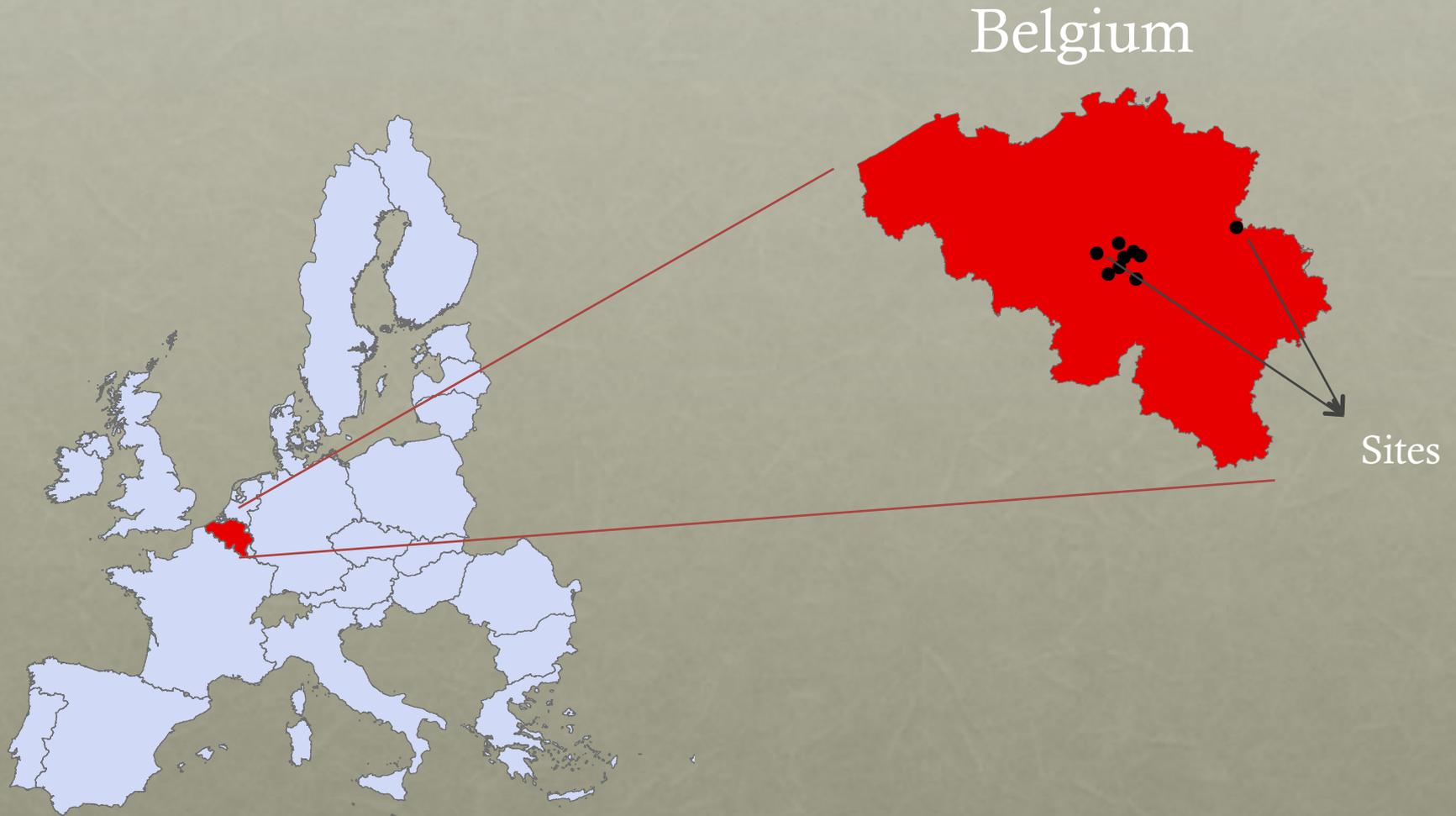


- Increase of *H. axyridis* collected individuals
- Decrease of *A. 2-punctata*, *P. 14-decimpunctata* and *P. 22-punctata*

MATERIAL & METHODS

(2)

MATERIAL & METHODS (2)



MATERIAL & METHODS (2)

- Sampling
 - broad bean
 - wheat
 - potato
 - corn
- 2009, 2010, 2011
- 2012
- 9 fields per crops



MATERIAL & METHODS (2)

Sampling methods

continuous observation
during 7 days)

Sticky trap: yellow Bug-
Scan



Water
Moerick trap



ponctual
observation

Quadrats (1m²)



RESULTS (2)

BIODIVERSITY

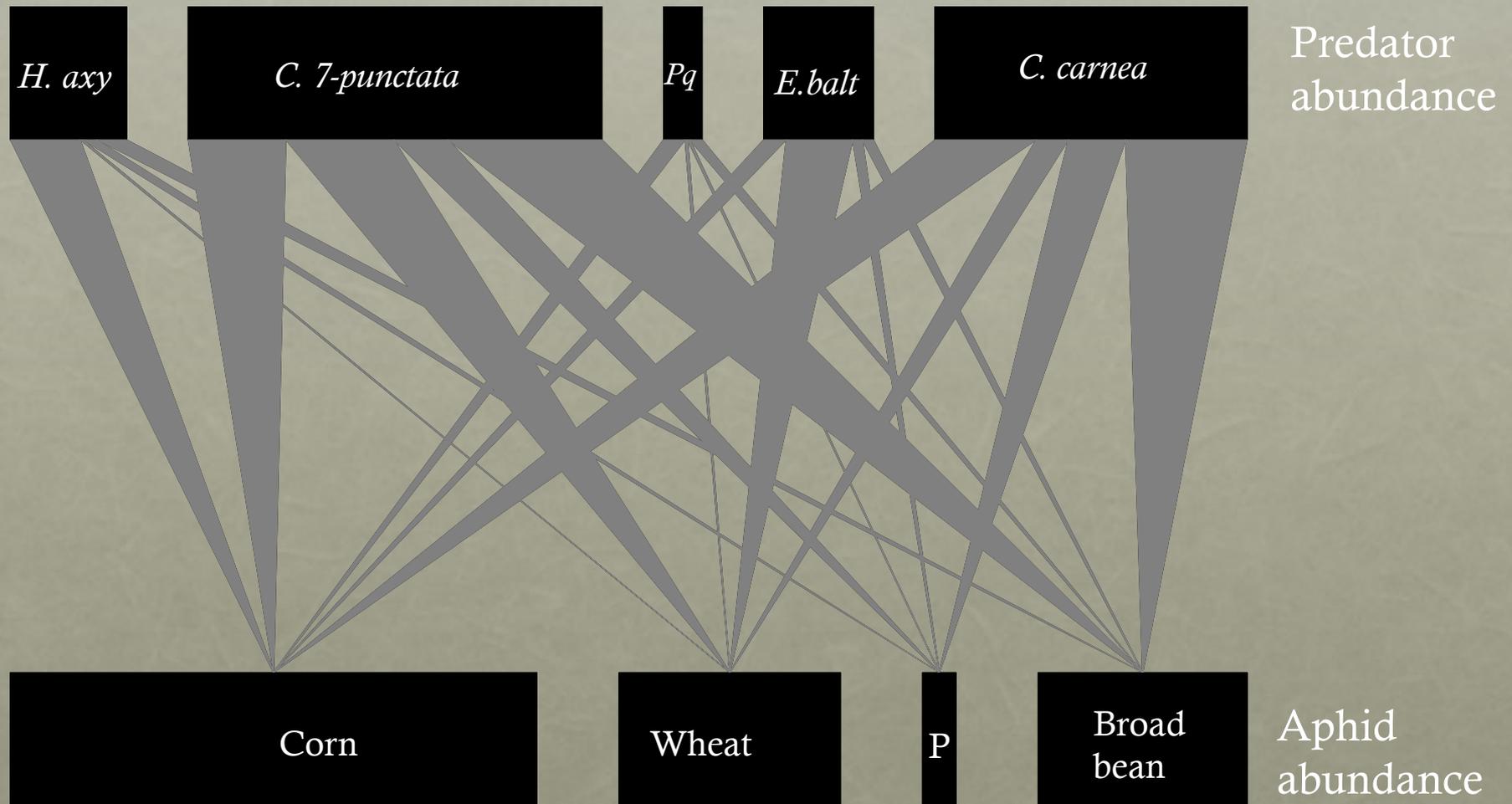
- Diversity: 29 aphid predators species
 - 14 Coccinellidae
 - 13 Syrphidae
 - 1 Hemerobiidae
 - 1 Chysopidae
- 5 abundant species (>10%)
 - *C. septempunctata*
 - *H. axyridis*
 - *P. quatuordecimpunctata*
 - *C. carnea*
 - *E. balteatus*



Family	Broad bean			Wheat			Corn			Potato			
	2009	2010	2011	2009	2010	2011	2009	2010	2011	2009	2010	2011	
<i>Chrysoperia carena s.l.</i>	Cn	X	X	X	X	X	X	X	X	X	X	X	
<i>Coccinella 7-punctata</i>	Co	X	X	X	X	X	X	X	X	X	X	X	
<i>Episyrphus balteatus</i>	Sy	X	X	X	X	X	X	X	X	X	X	X	
<i>Harmonia axyridis</i>	Co	X	X	X	X	X	X	X	X	X	X	X	
<i>Propylea 14-punctata</i>	Co	X	X	X	X	X	X	X	X	X	X	X	
Hemerobiidae	He	X		X	X		X	X				X	
<i>Metasyrphus latifasciatus</i>	Sy		X	X		X		X				X	
<i>Spaerophoria scripta</i>	Sy		X	X		X		X				X	
<i>Metasyrphus corollae</i>	Sy		X	X		X						X	
<i>Sphaerophoria menthastris</i>	Sy		X	X		X		X		X		X	
<i>Coccinella 5-punctata</i>	Co		X	X		X	X	X	X				
<i>Melanostoma mellinum</i>	Sy		X	X		X		X	X			X	
<i>Scaeva pyrastris</i>	Sy			X		X		X	X		X	X	
<i>Adalia 2-punctata</i>	Co			X		X	X		X		X		
<i>Psyllobora 22-punctata</i>	Co		X			X			X		X		
<i>Chilocorus renipustulatus</i>	Co					X		X	X	X			
<i>Hippodamia variegata</i>	Co		X	X		X					X		
<i>Halyzia 16-guttata</i>	Co					X	X		X				
<i>Metasyrphus luniger</i>	Sy					X					X	X	
<i>Parasyrphus macularis</i>	Sy							X	X			X	
<i>Syrphus ribesii</i>	Sy			X		X			X				
<i>Syrphus vitripennis</i>	Sy			X		X						X	
<i>Adalia 10-punctata</i>	Co		X										
<i>Calvia 14-guttata</i>	Co						X						
<i>Coccinella 11-punctata</i>	Co							X					
<i>Exochomus 4-pustulatus</i>	Co						X						
<i>Hippodamia 11-notata</i>	Co					X							
<i>Metasyrphus nitens</i>	Sy					X							
<i>Platycheirus clypeatus</i>	Sy			X									
Species diversity per years		6	14	18	6	15	19	10	15	19	7	14	15
Species diversity per crops			20			23			22			19	

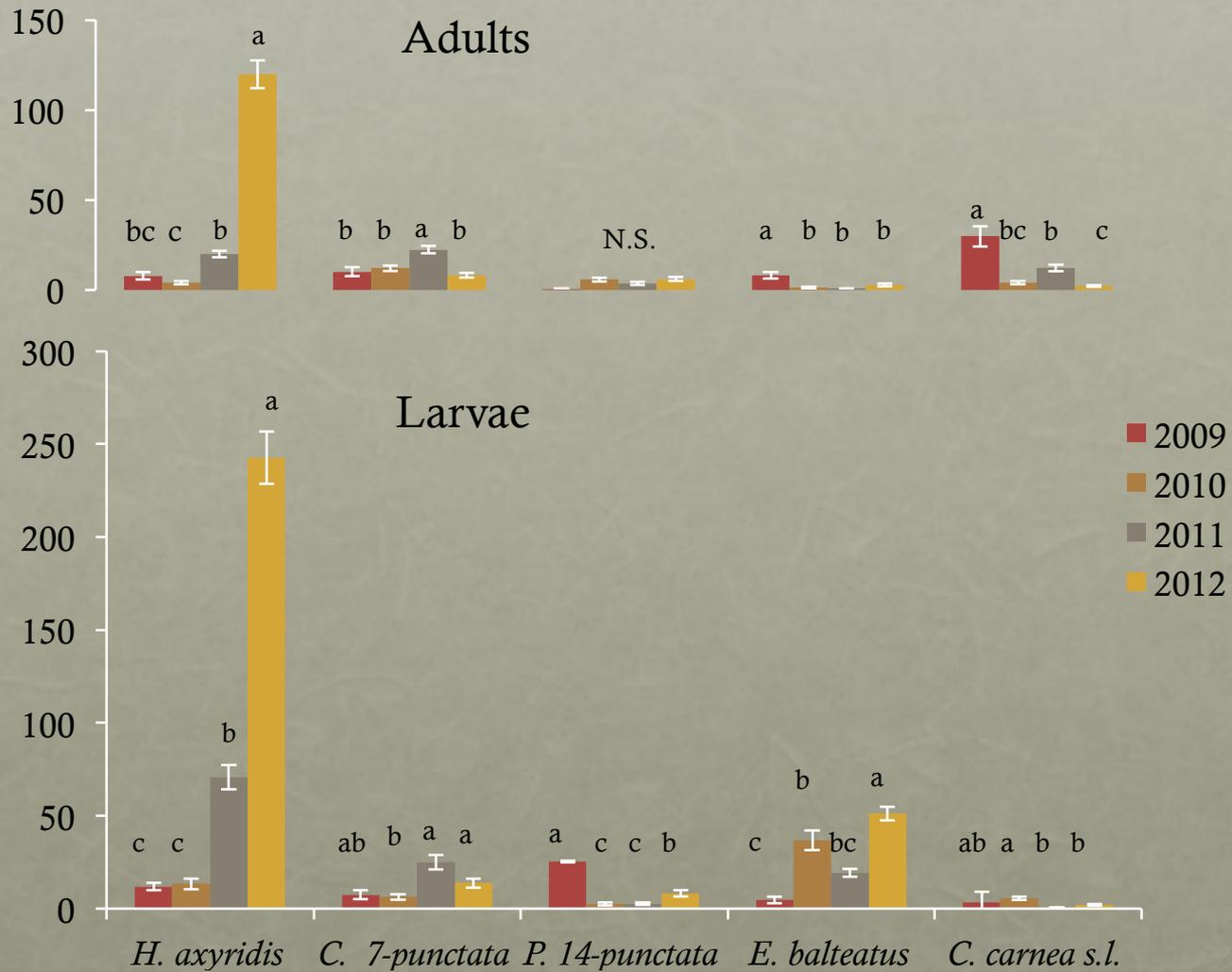
99,9% of species

PREDATORS REPARTITION

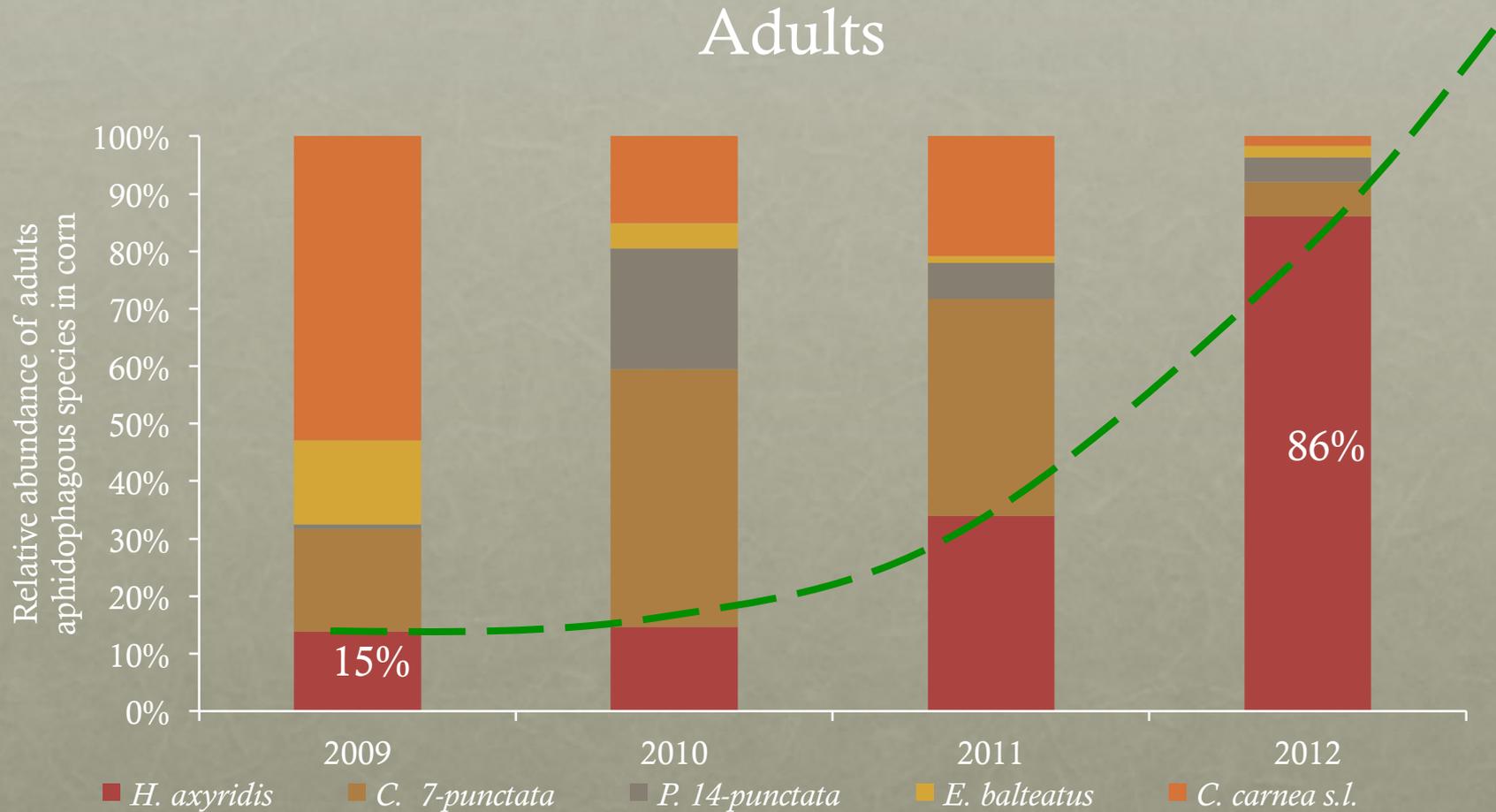


ABUNDANCE IN CORN

Mean number
of *H. axyridis*
per 100 m²

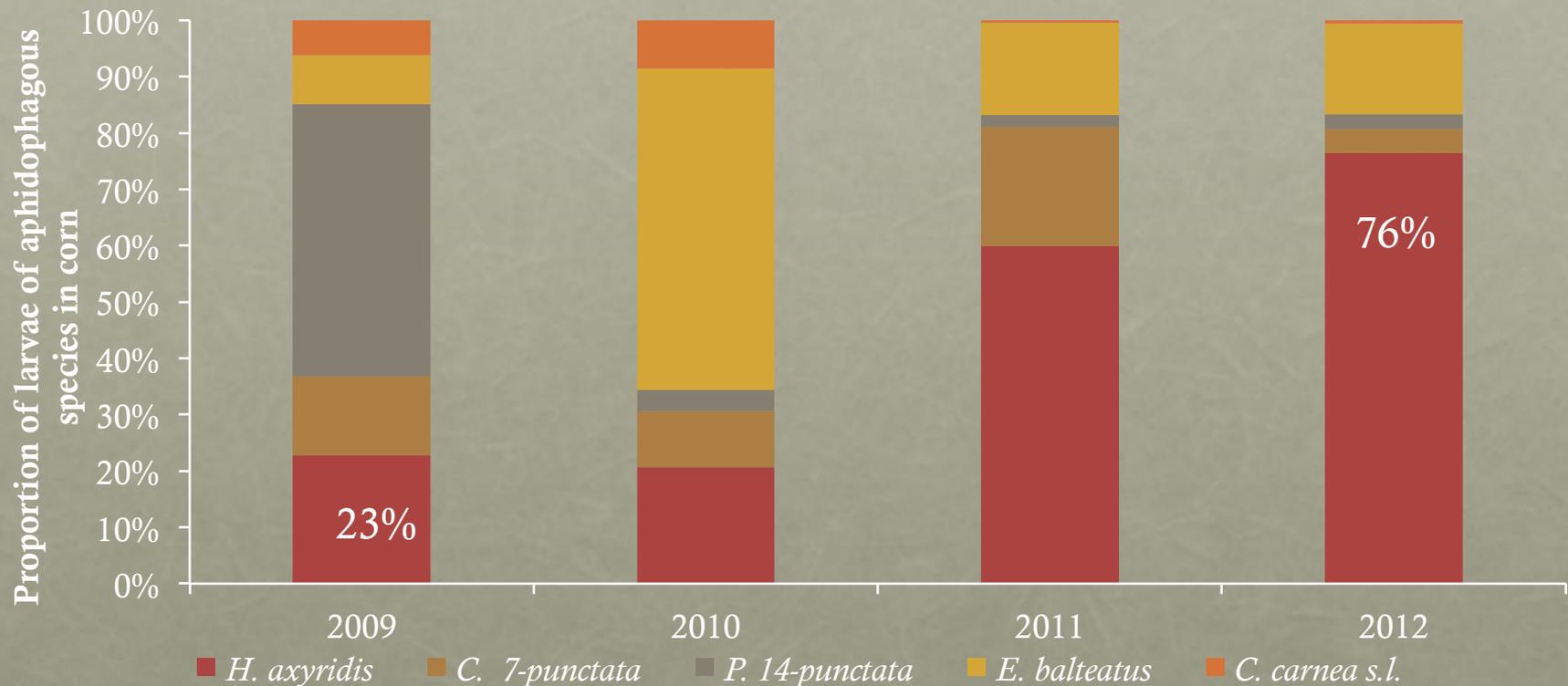


EVOLUTION OF RELATIVE ABUNDANCE IN CORN

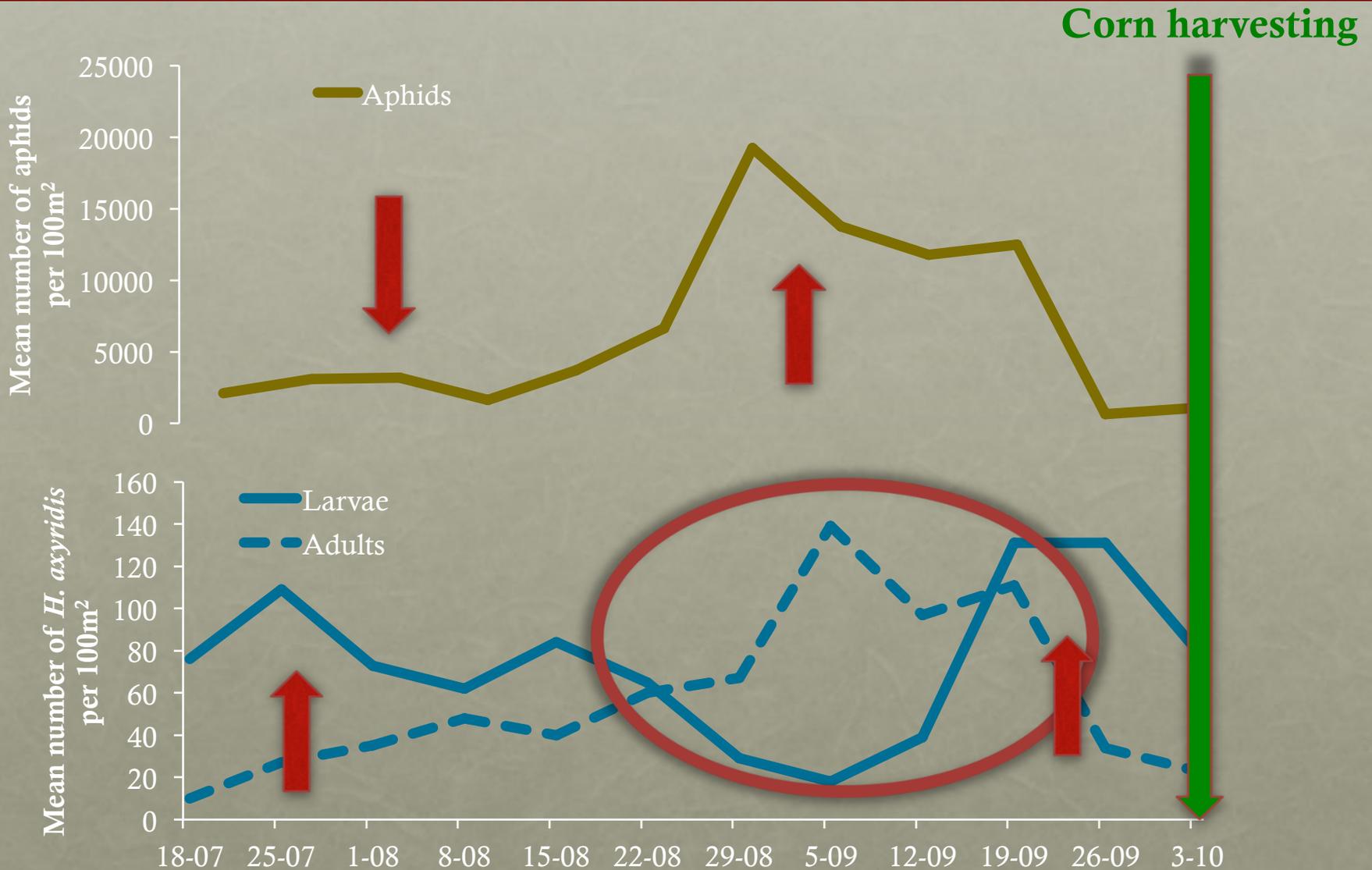


EVOLUTION OF RELATIVE ABUNDANCE IN CORN

Larvae



PHENOLOGY IN CORN



SUMMARY

SUMMARY

- Introduction of *H. axyridis* in **1997**
- First observation in **2001** and ordinary in 2002
- Outside of agroecosystems:
 - 27 species of Coccinellidae
 - **Increase** of *H. axyridis* and **decrease** of 3 native species populations
- In agroecosystems:
 - 29 species of natural enemies
 - *H. axyridis* is the **most abundant** species in **corn** : impact to native species ?
 - *H. axyridis* population is increasing since 2002
 - **Community** of aphid predators **is changing** (15% to 86%)
 - **No observation** of species **diversity change**

PUBLICATIONS

- Vandereycken A., Brostaux Y., Joie E., Haubruge E. & Verheggen F.J. (2013). Occurrence of *Harmonia axyridis* (Coleoptera: Coccinellidae) in field crops. *European Journal of Entomology* **110**(2), p. 285-292.
- Vandereycken A., Durieux D., Joie E., Sloggett J.J., Haubruge E. & Verheggen F.J. (2013). Is *Harmonia axyridis* the most abundant aphidophagous species in agroecosystems? *Journal of Insect Science* **In press**.
- Vandereycken A., Joie E., Francis F., Haubruge E. & Verheggen F.J. (2013). Occurrence of aphid predator species in both organic and conventional corn and broad bean *Entomologie Faunistique - Faunistic Entomology* **66**, p. 77-87.
- Vandereycken, A., Durieux, D., Joie, E., Francis, F., Haubruge, E. and Verheggen, F.J. Aphid species and their natural enemies in field crops: what about the alien coccinellid? *Journal of Applied Entomology* **Submitted**

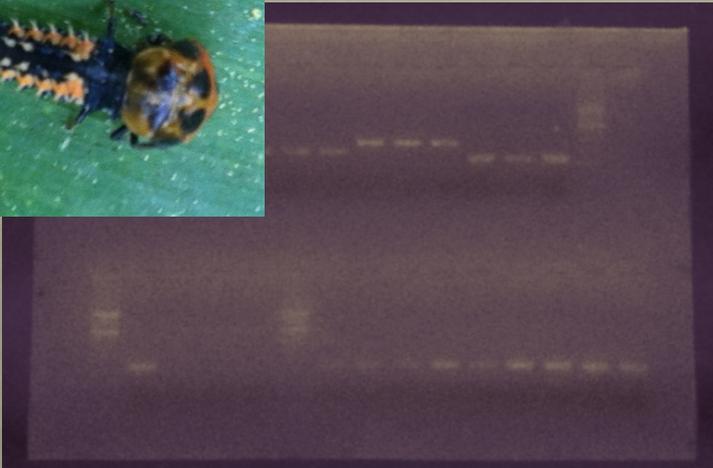
PERSPECTIVES

- Intraguild predation study by PCR

BioControl (2011) 56:429–440
DOI 10.1007/s10526-011-9378-2

Detecting arthropod intraguild predation in the field

Alexandre Aebi · Peter M. J. Brown · Patrick De Clercq ·
Louis Hautier · Andy Howe · Brecht Ingels · Hans-Peter Ravn ·
John J. Sloggett · Renate Zindel · Alison Thomas



- Trap strategy by pheromones





Technician: Emilie Joie Promotor: Pr Eric Haubruege Co-promotor: Dr François Verheggen



Department director: Pr Frederic Francis

Department of Entomology



Thank you

