

Harlequin wipes out native generalist and tree dwelling ladybirds in Belgium

Population trend, niche overlap and impact of *Harmonia axyridis* on native ladybirds

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Science Facing Aliens
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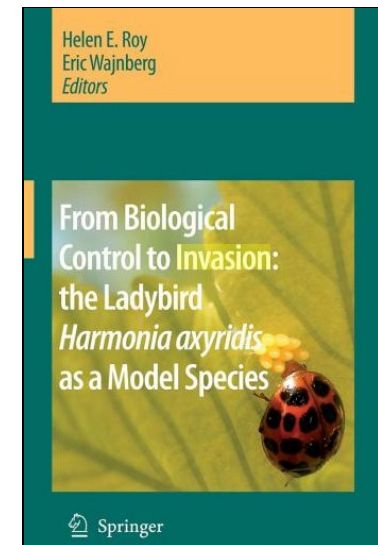
Instituut voor Natuur- en Bosonderzoek
Research Institute for Nature and Forest



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Harlequin ladybird

- “ *H. axyridis*, as an IAS, contributes to biotic homogenization and its threat to biodiversity is unacceptable ”
- “ *Biological control is an essential component of sustainable agriculture but the distinction between a succesful biocontrol agent and an invasive species can be narrow ”*



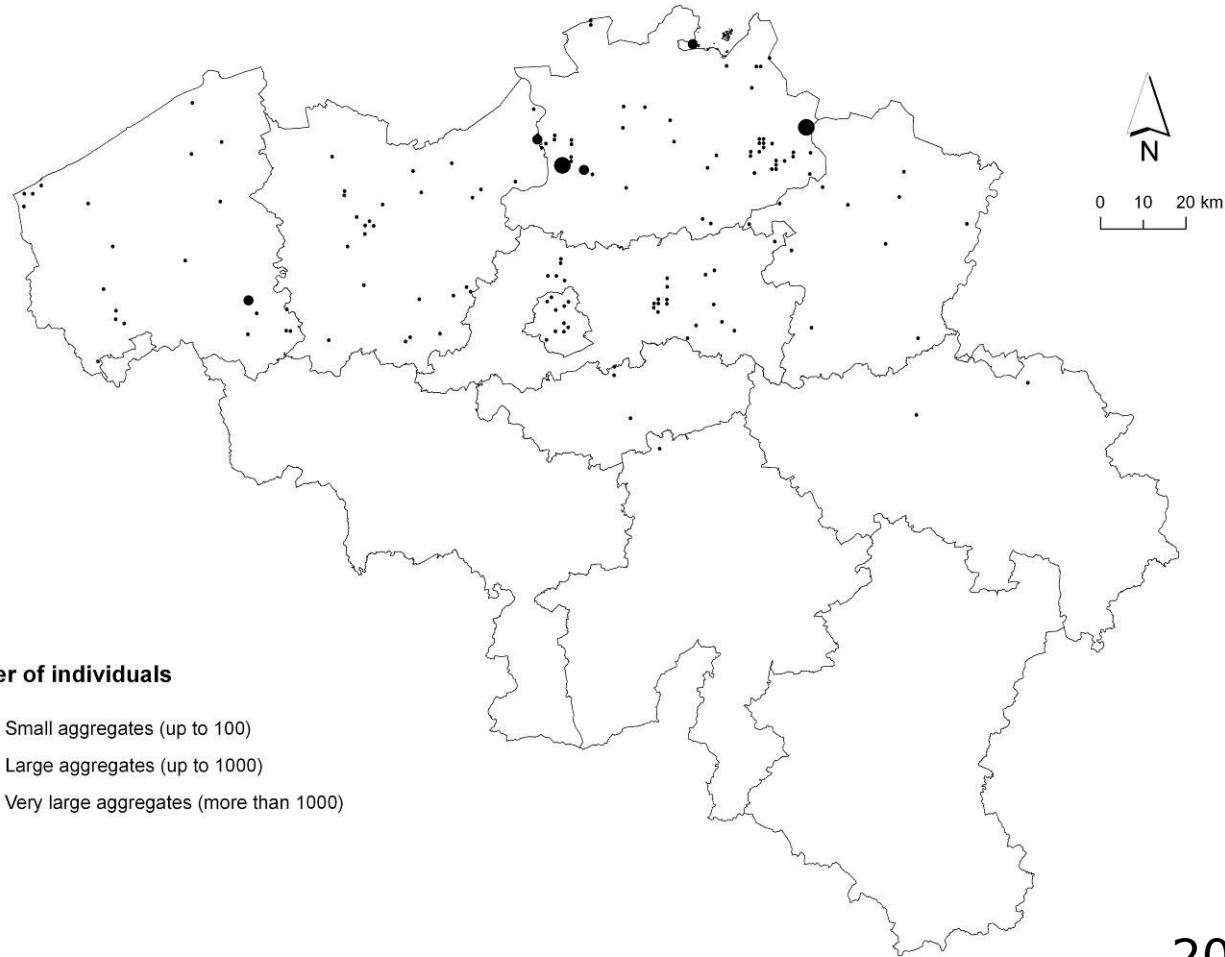
Roy & Wajnberg 2008

H. axyridis impacts

- overwintering aggregates in houses
- clusters of pupating larvae
- seasonal indoor allergen
(Nakazawa et al. 2007 *JAllergyClinImmunol*)



overwintering aggregates



2001-2008

H. axyridis impacts

- potential pest species in fruit production

Am. J. Enol. Vitic. 55:2:153-159 (2004)
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Influence of *Harmonia axyridis* on the Sensory Properties of White and Red Wine


Gary Pickering ¹, James Lin ², Roland Riesen ³, Andrew Reynolds ⁴, Ian Brindle ⁵, and George Soleas ⁶

Sensory Evaluation of Suspected *Harmonia axyridis*-tainted Red Wine Using Untrained Panelists

Authors: Carolyn F. Ross - Carolyn F. Ross, Department of Food Science and Human Nutrition, Washington State University, PO Box 646376, Pullman, WA

DOI: 10.1080/09571260801899881

Publication Frequency: 3 issues per year

Published in:  Journal of Wine Research, Volume 18, Issue 3 November 2007 , pages 187 - 193

Harmonia axyridis and Wine Quality



Source: www.ripnet.com/axyred/axyred.htm

G. J. Pickering ^{1,2}, J. Y. Lin ², R. Riesen ⁴,
A. Reynolds ^{1,2,3}, G. Soleas ⁵, K. Ker ¹, I. Brindle ³

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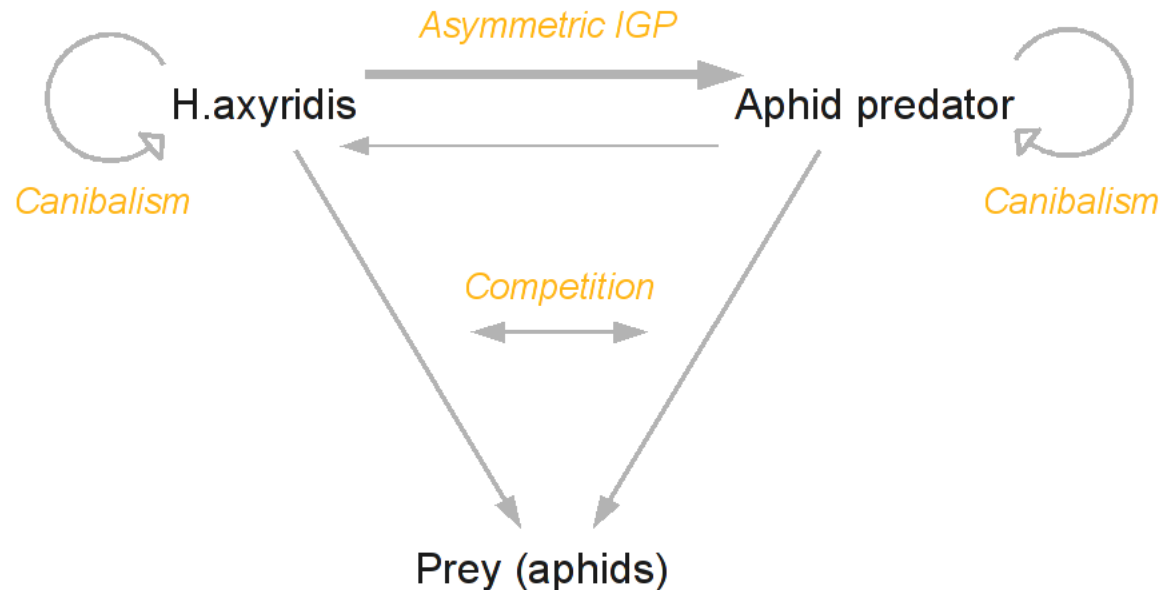
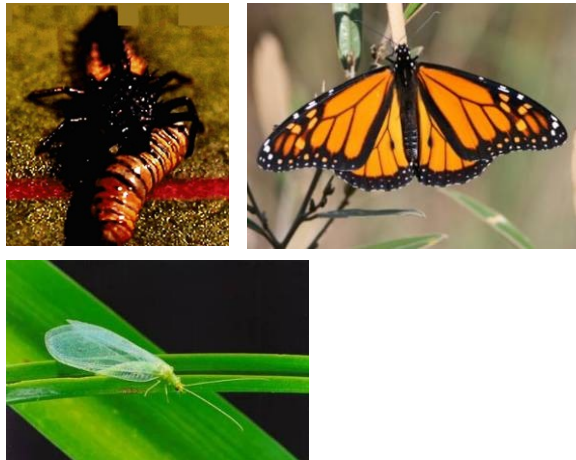
H. axyridis impacts



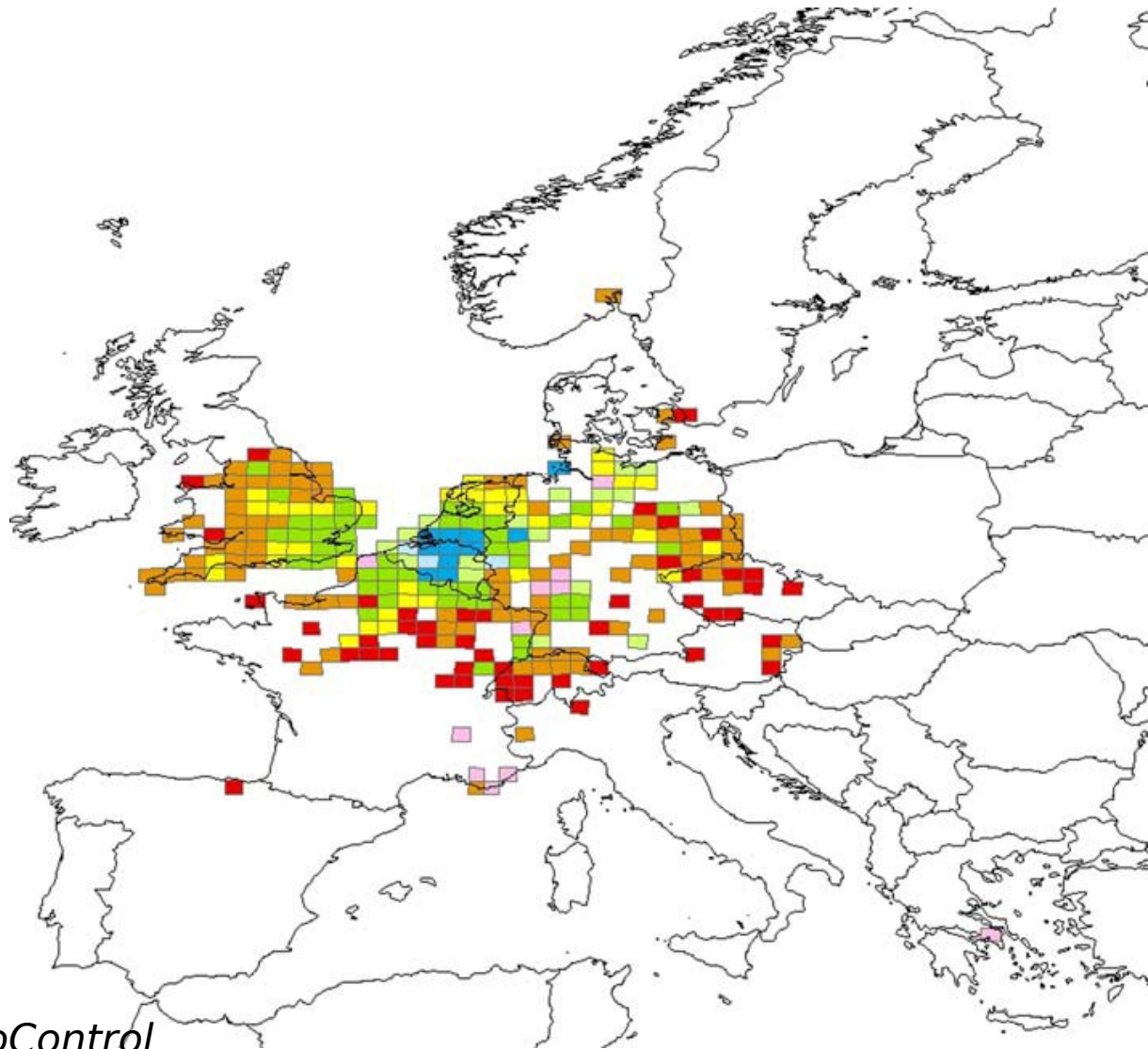
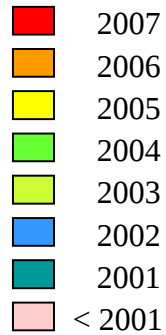
- non-target impacts

(review Koch 2003 *J Insect Sc*)

- intraguild predation (see Hautier et al.)
- extraguild predator of other arthropods



Trend and distribution

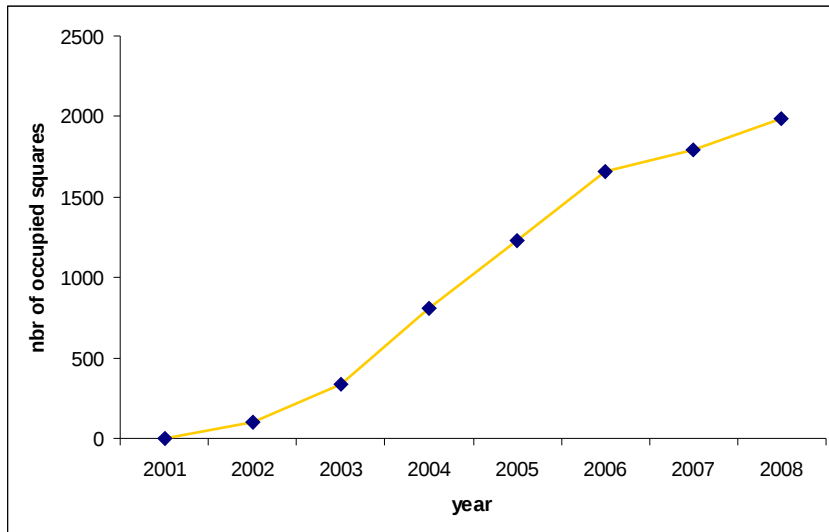


Brown et al. 2008 *BioControl*

H. axyridis trend and distribution

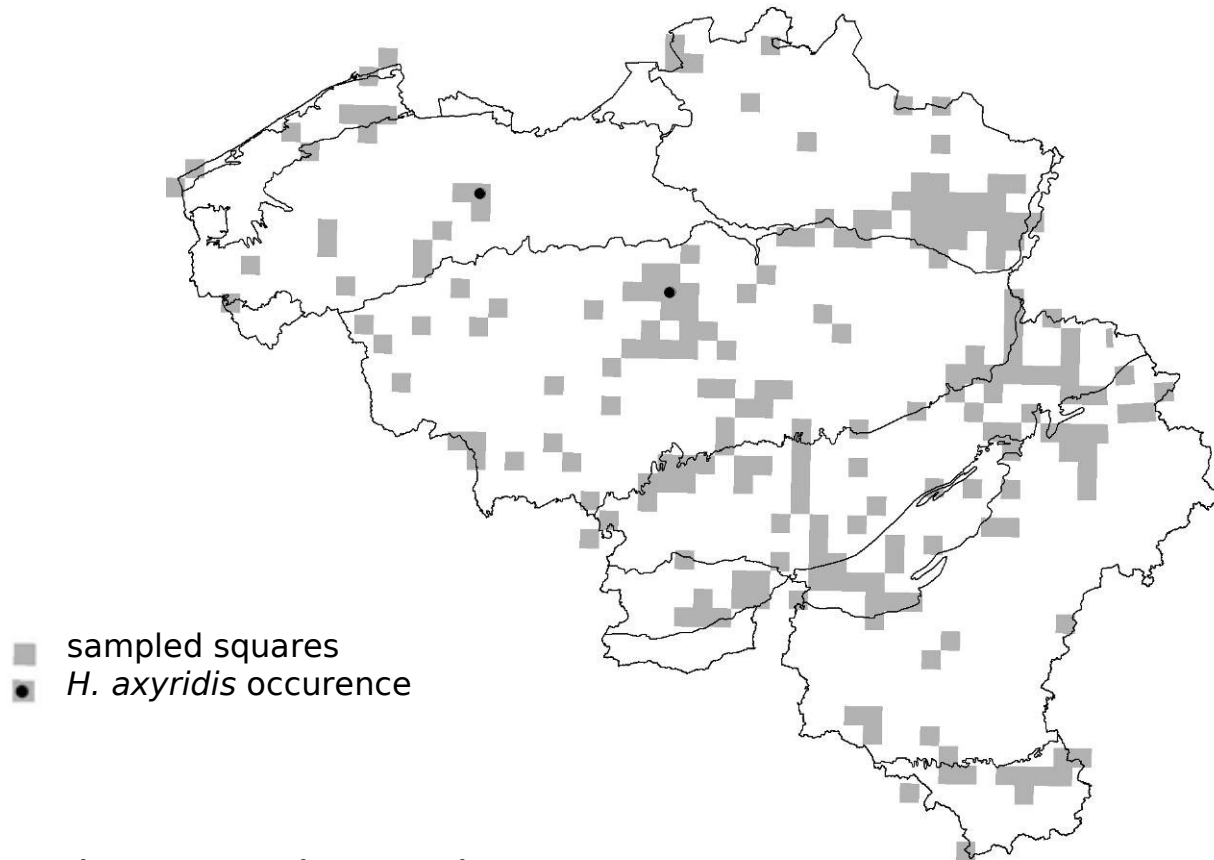
data: large-scale field survey run by the Belgian Ladybird Working Group *Coccinula*

>45.000 data since 1999, 85% of the Belgian territory



Adriaens et al. 2008 *BioControl*

H. axyridis trend and distribution

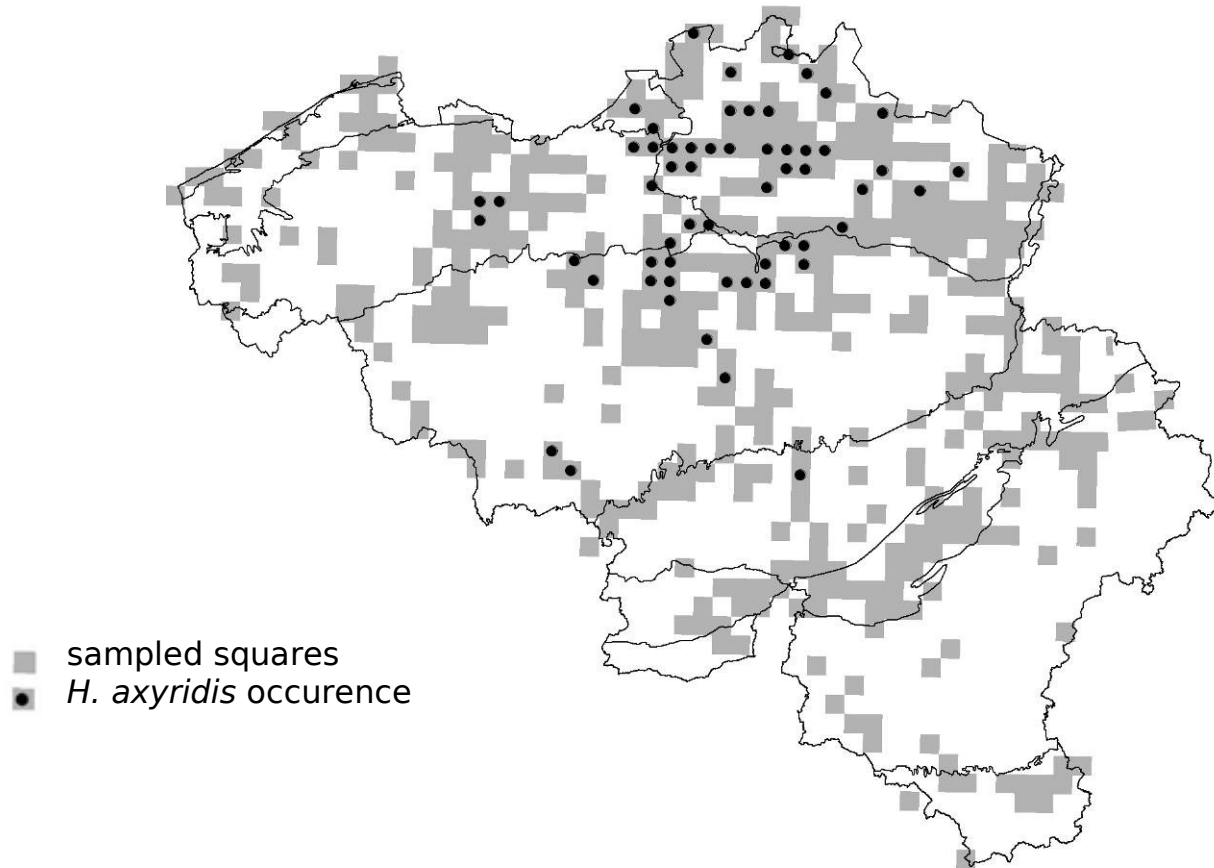


Adriaens et al. 2003 *Belg J Zool*

Adriaens et al. 2007 *BioControl*

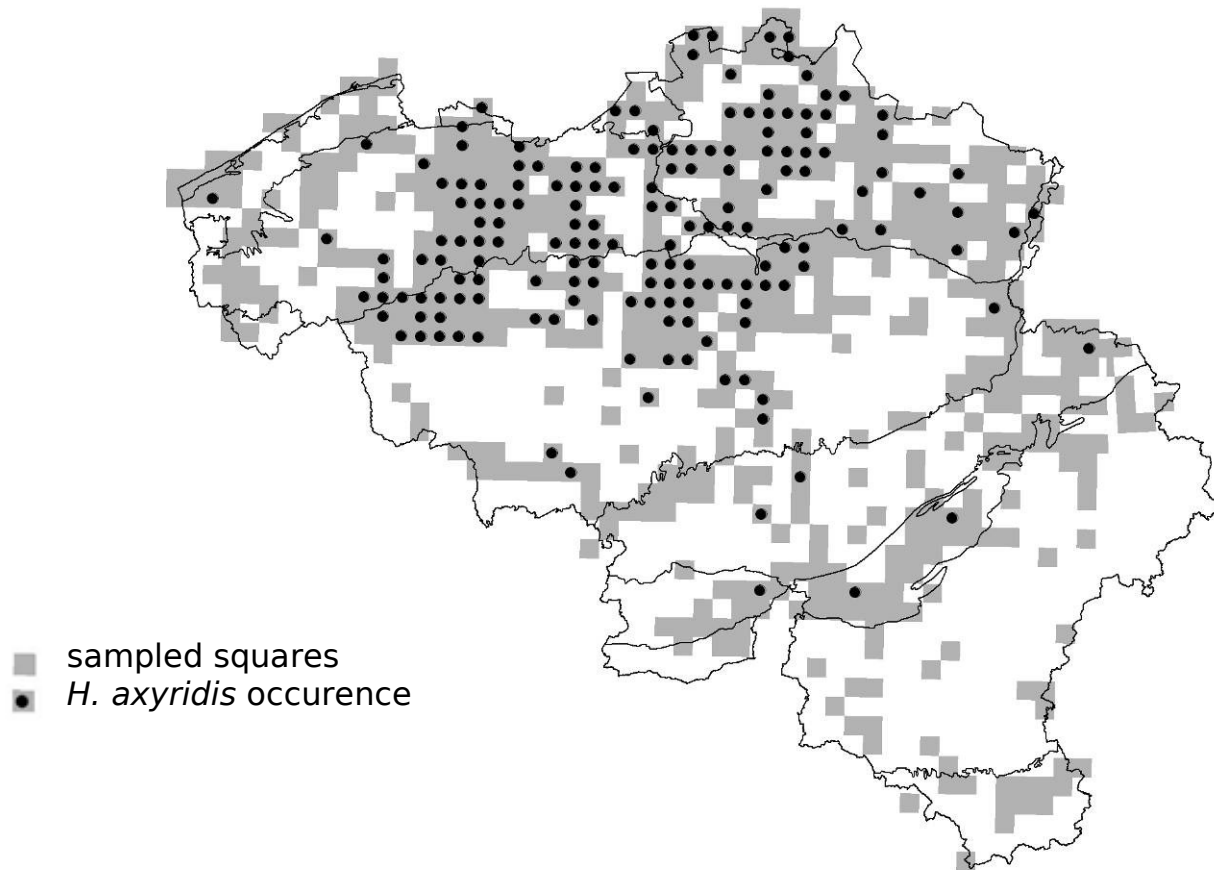
2001 (2)

H. axyridis trend and distribution



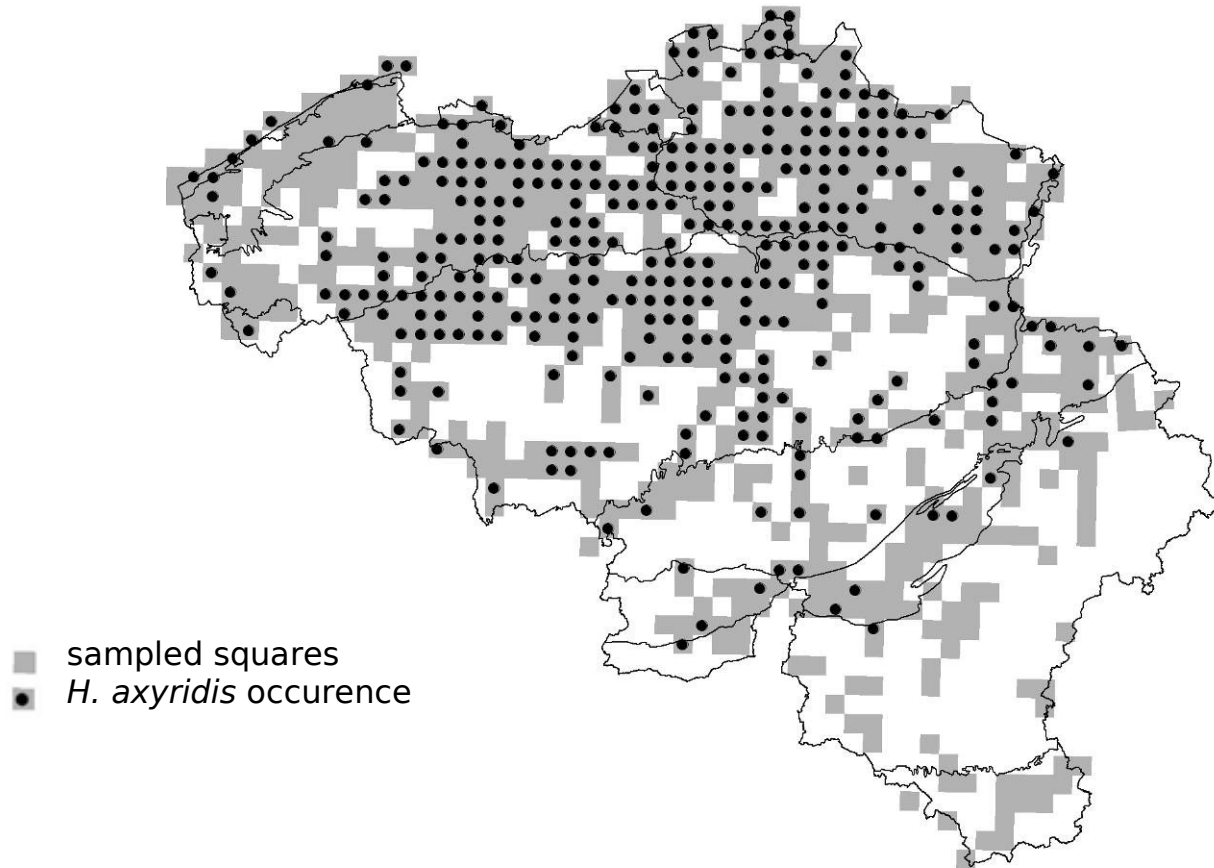
2002 (276)

H. axyridis trend and distribution



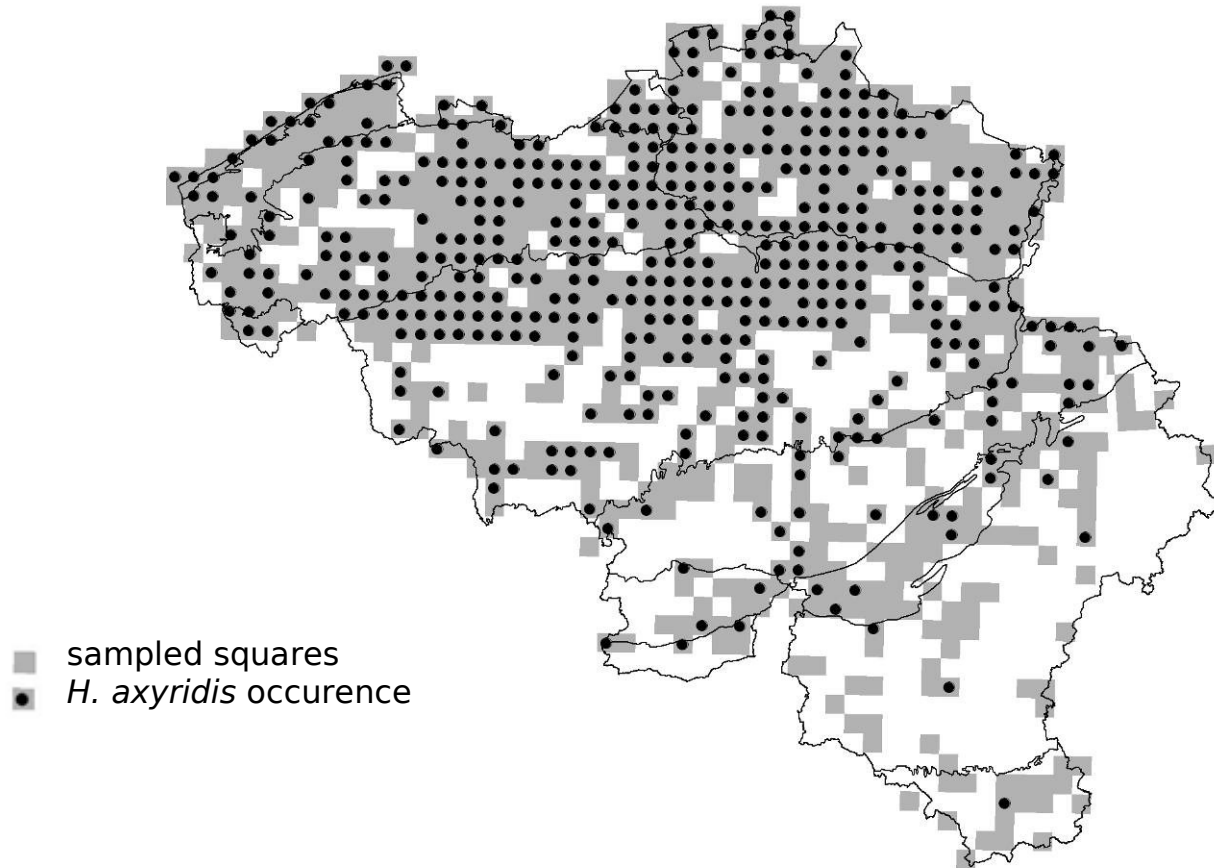
2003 (142)

H. axyridis trend and distribution



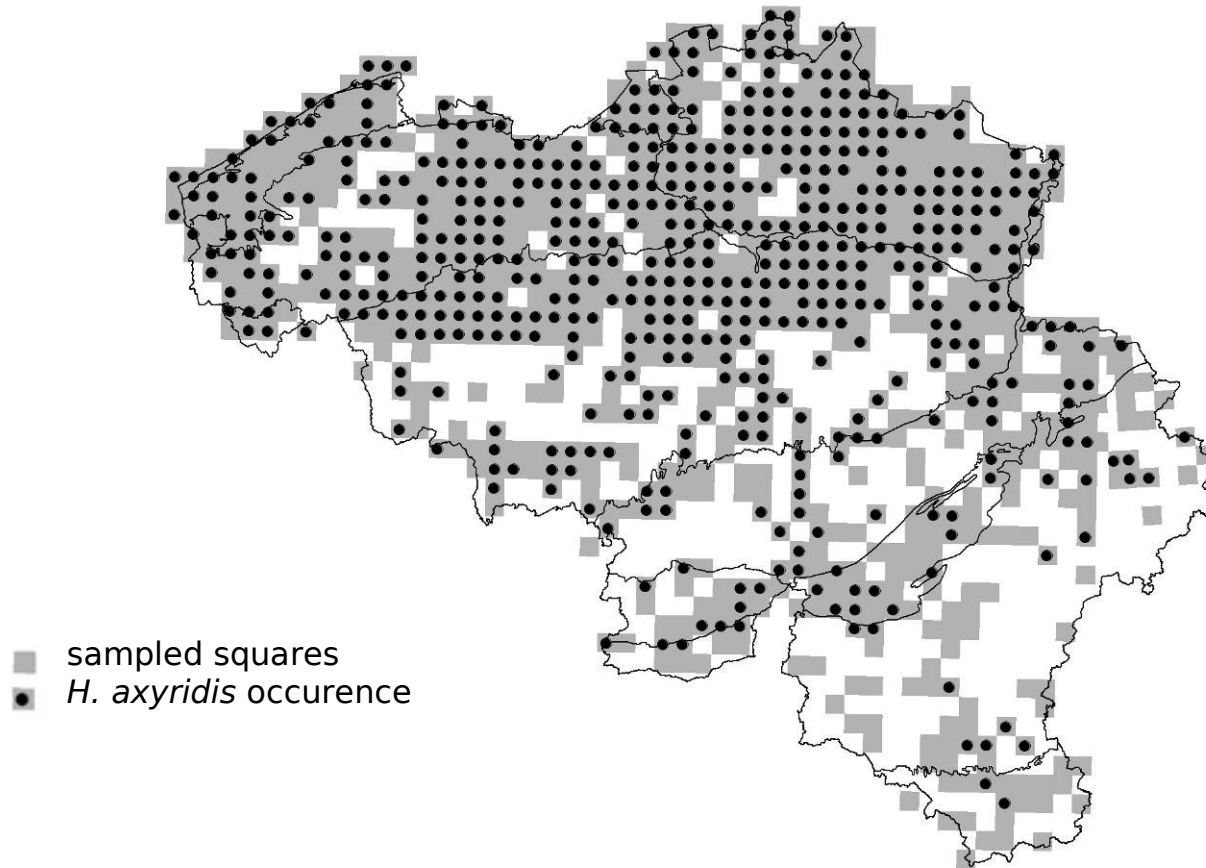
2004 (282)

H. axyridis trend and distribution



2005 (276)

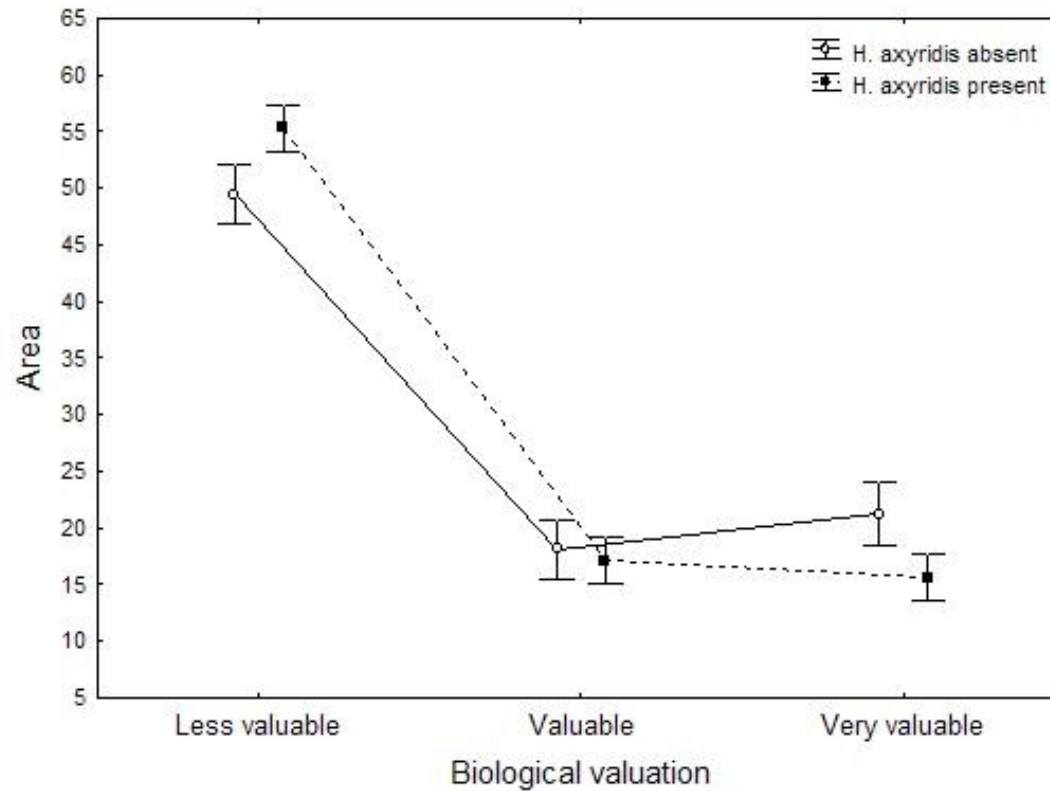
H. axyridis trend and distribution



2006 (243)

Are invaded ecotopes of conservation value ?

Biological valuation map (Wils et al. 2006)



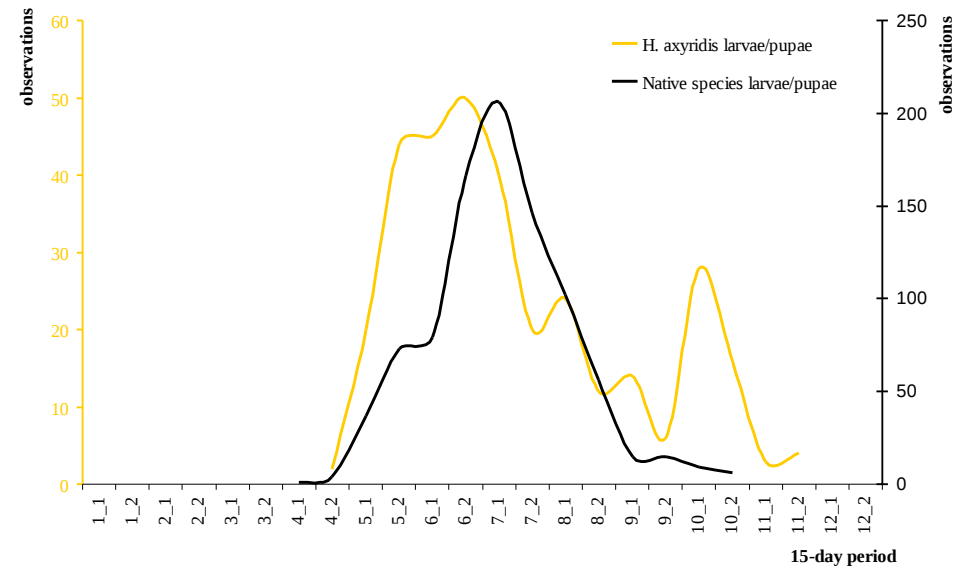
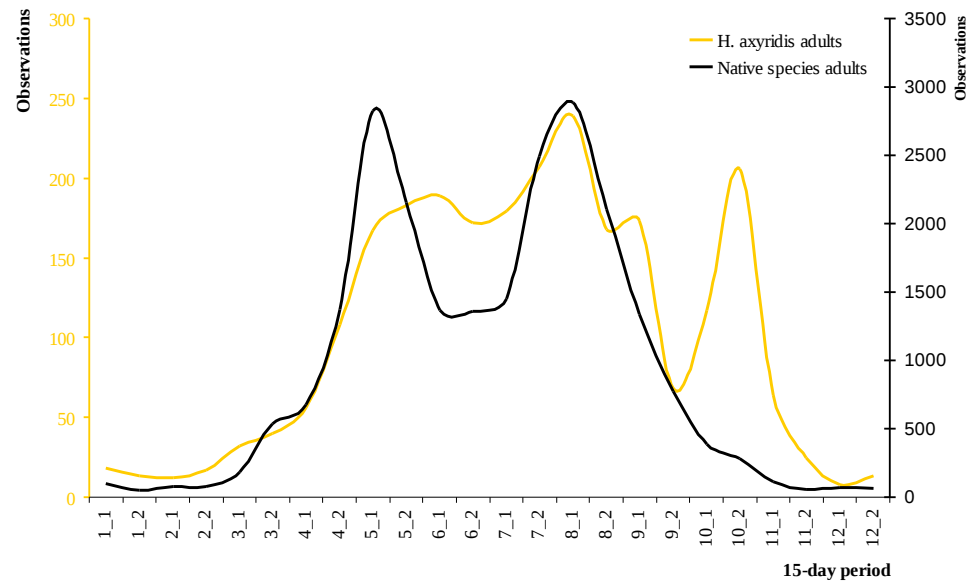
two-way ANOVA $F(2,1887) = 10.901, p < 0.001$

Adriaens et al. 2008 *BioControl*

Successful IAS

Factors contributing to the success of *H. axyridis* :

- multi-voltine
- can better exploit alternative resources
- low susceptibility to fungal pathogens and parasitoids
- high voracity and IGP



Niche overlap with native species

Plant use similarity index

(Hurlbert 1978 *Ecology*)

0 = no resources shared

1 = all resources shared in the same proportion

Niche similarity indices



Niche overlap with native species

**Spatio-temporal
co-occurrence (%)**

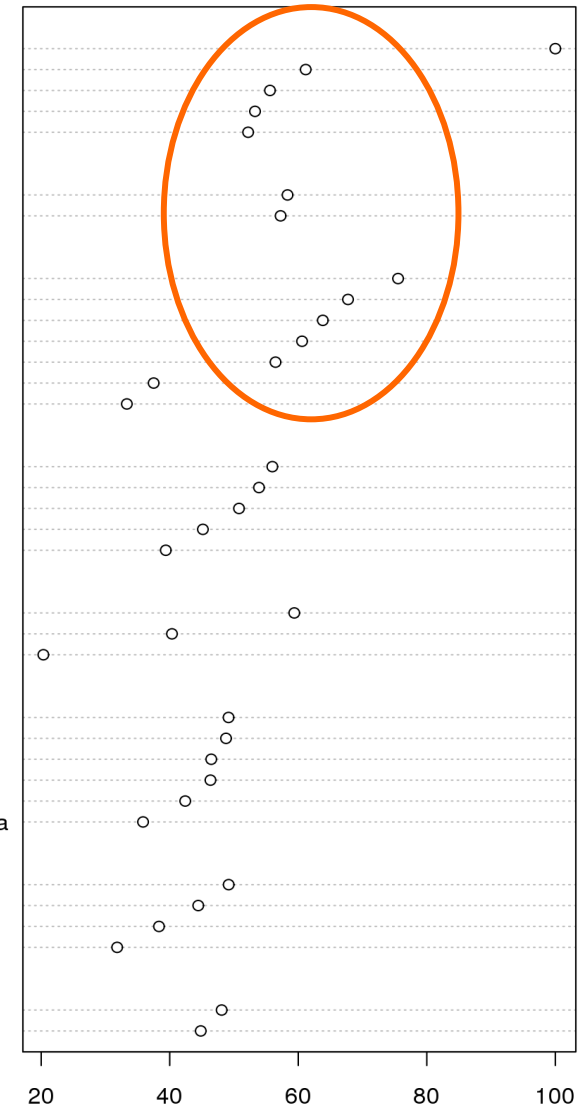
**probability of species to
occur together**

**[# collection events of species x with
H. axyridis]**

[total # collection events of species x]

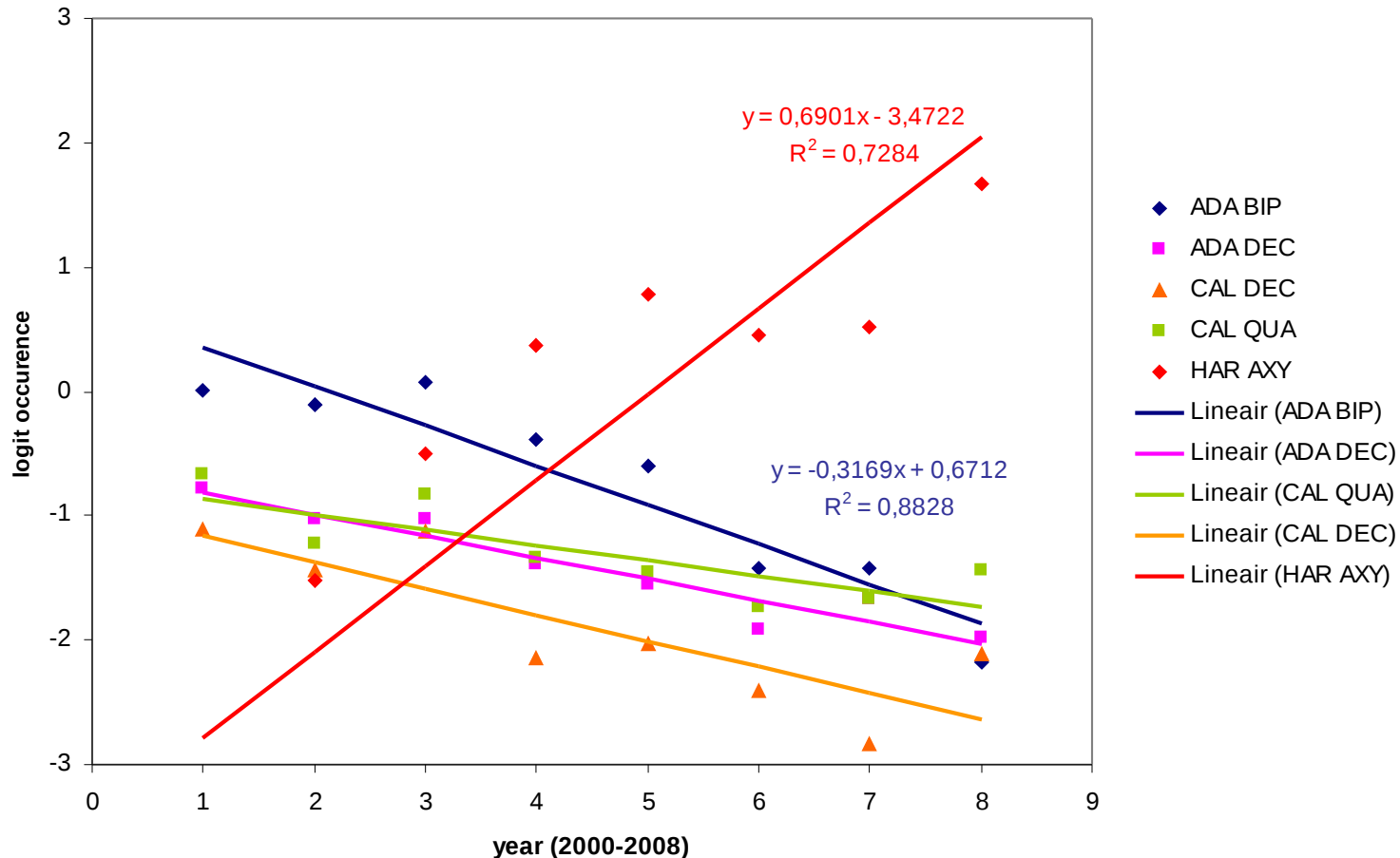
- 1- generalist
Harmonia axyridis
Adalia bipunctata
Psyllobora vigintiduopunctata
Coccinella septempunctata
Propylea quatuordecimpunctata
- 2- trees
Rhyzobius chrysoloides
Exochomus quadripustulatus
- 3- deciduous trees
Oenopia conglobata
Calvia decempunctata
Adalia decempunctata
Calvia quatuordecimpunctata
Halyzia sedecimpunctata
Vibidia duodecimpunctata
Chilocorus renipustulatus
- 4- coniferous trees
Aphidecta obliterata
Harmonia quadripunctata
Anatis ocellata
Myrrha octodecimpunctata
Myzia oblongoguttata
- 5- heathlands
Chilocorus bipustulatus
Exochomus nigromaculatus
Coccinella hieroglyphica
- 6- herb layer
Coccinella quinquepunctata
Coccinula quatuordecimpustulata
Hippodamia variegata
Coccinella undecimpunctata
Tytthaspis sedecimpunctata
Subcoccinella vigintiquatuorpunctata
- 7- hygrophilous herb layer
Anisosticta novemdecimpunctata
Cynegetis impunctata
Coccidula rufa
Hippodamia tredecimpunctata
- 8- myrmecophilous
Coccinella magnifica
Platynaspis luteorubra

Spatio-temporal cooccurrence (%)



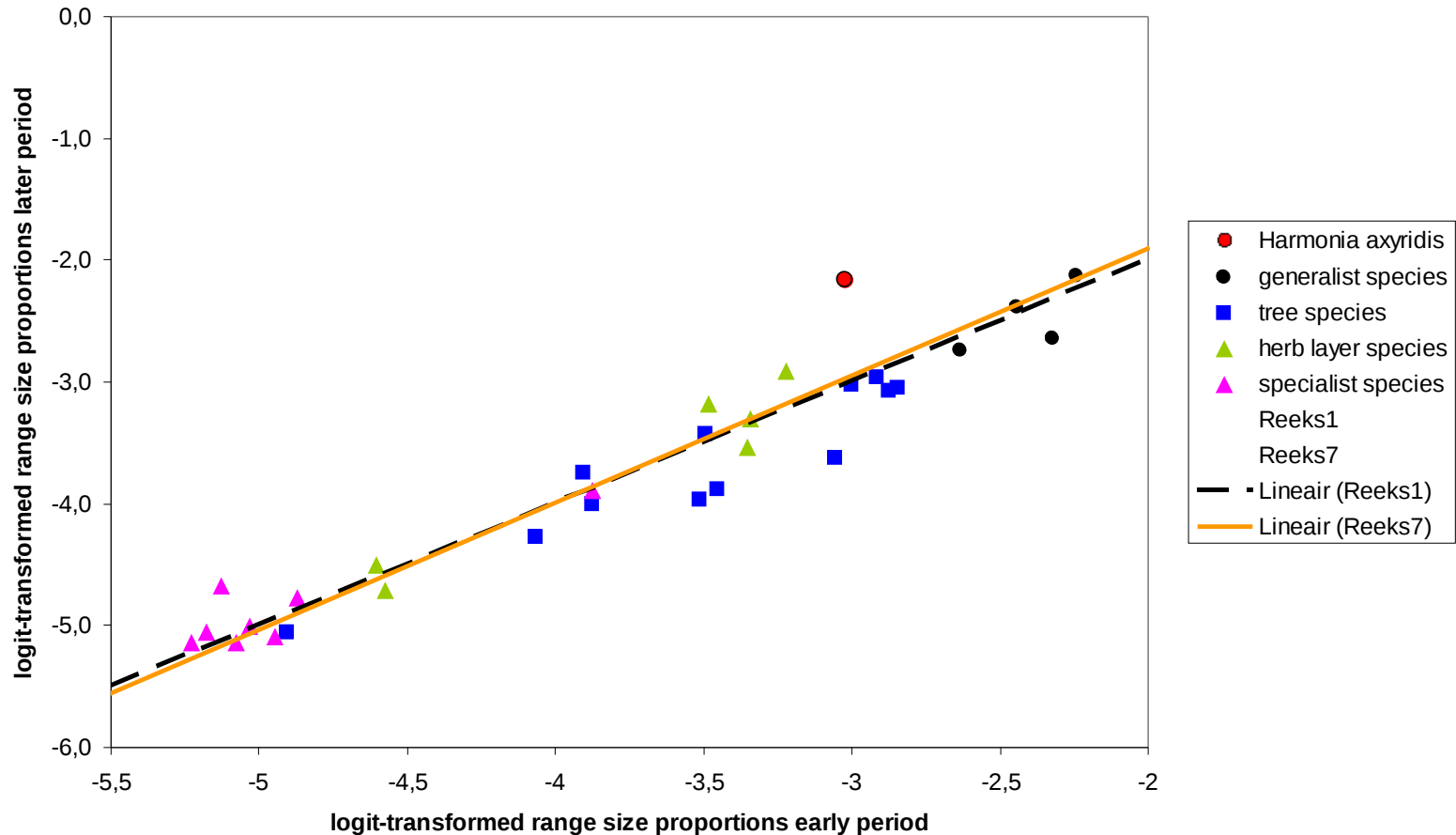
national trend in species with high degree of niche overlap

[proportional occurrence: number of grid cells with species x in year y / number of sampled squares year y]



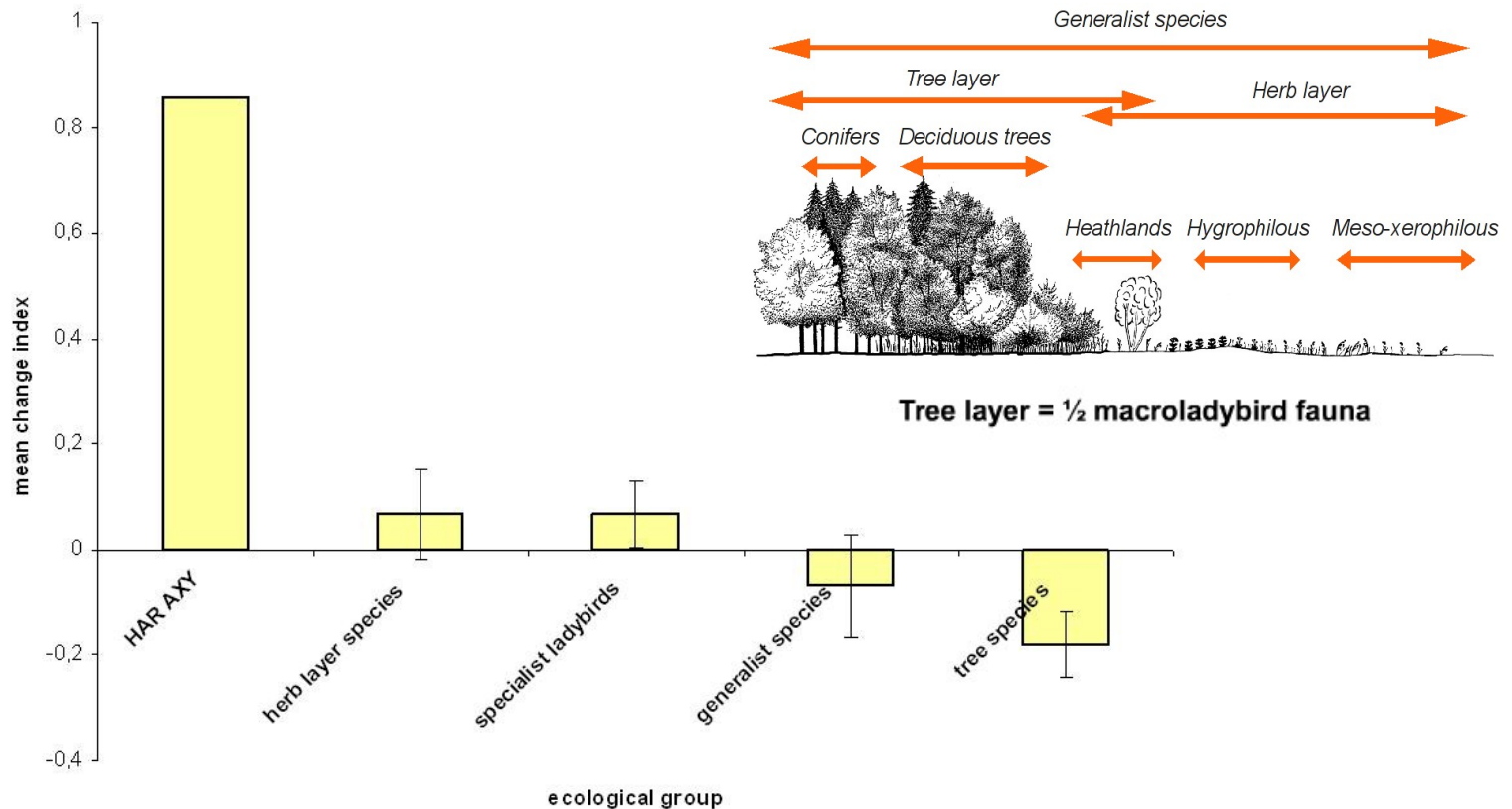
Impact on native species

trend in native ladybirds based on grid cell distribution data for two periods (< > 2004)



Impact on native species

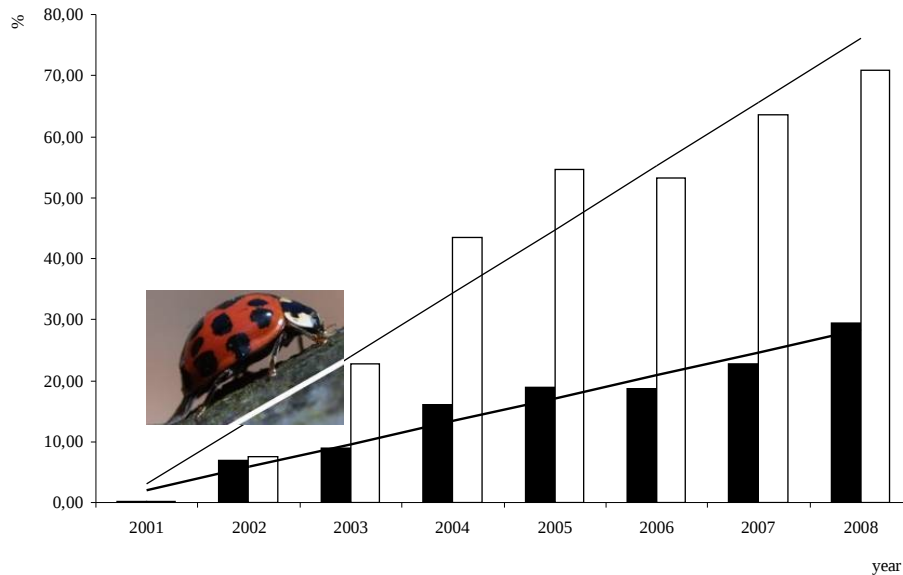
'mean change index' on national level
(mean of residuals to 1:1 line of no change) per group



Impact on native species

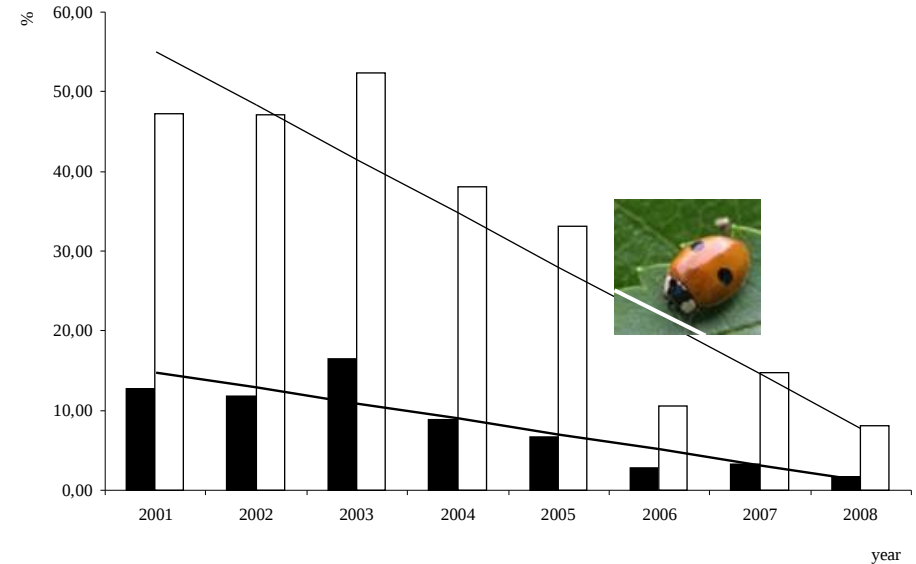
Do we need an Noah's ark for *Adalia bipunctata* ?

On a national scale: absolute decrease of 40% in collection events with ADA BIP in less than 10 years, relative decrease of 80%



■ % of observations

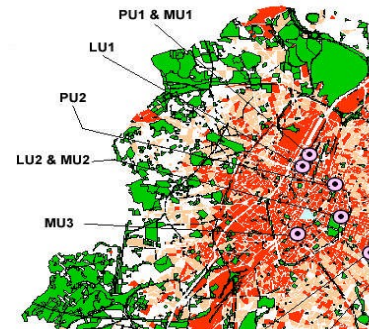
□ number of collection events



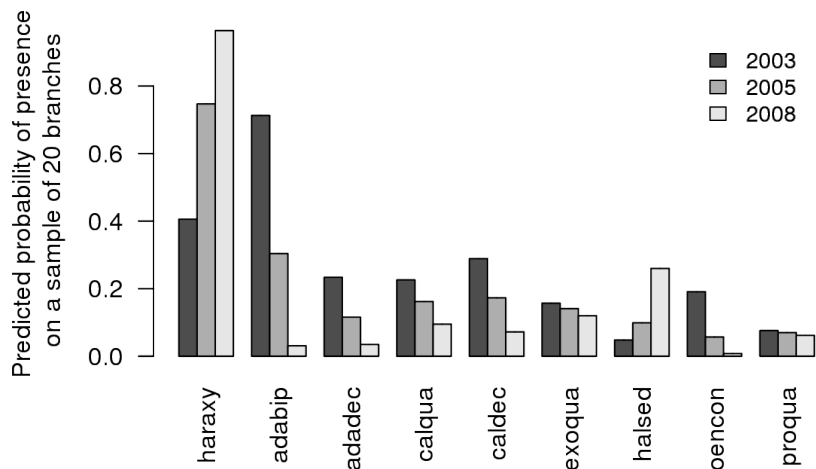
Impact on native species

data < detailed monitoring on 18 (sub)urban sites in Brussels
(2003, 2005, 2008) on pine, lime and maple

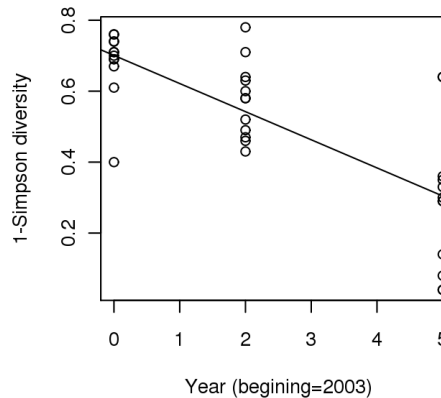
decrease in 6-7 species, changes in native community structure
Adalia bipunctata -100% in 5 years time !



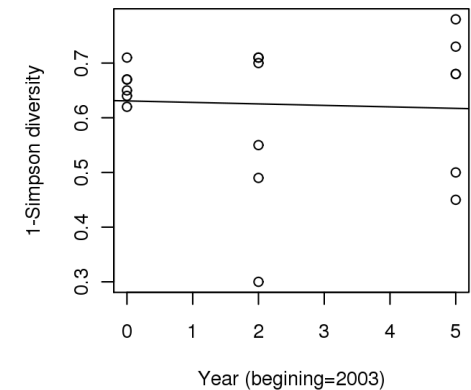
Deciduous trees



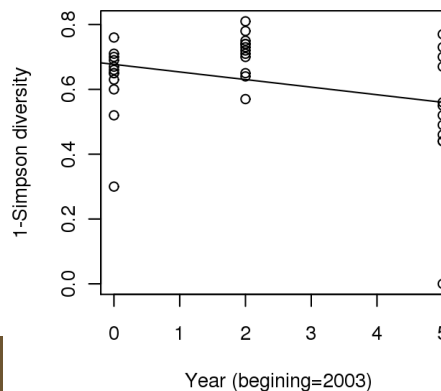
Diversity on deciduous trees (including *H.axyridis*)



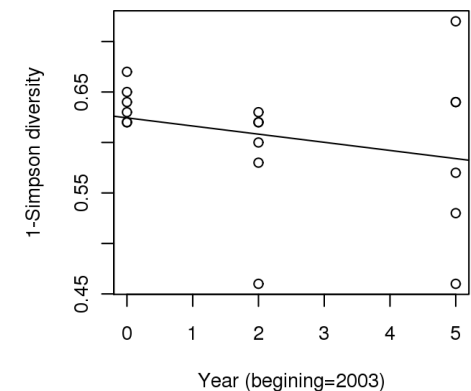
Diversity on Pine trees (including *H.axyridis*)



Diversity on deciduous trees (without *H.axyridis*)



Diversity on Pine trees (without *H.axyridis*)



San Martin, Hautier et al. in prep

Conclusions

- In five years *H. axyridis* has invaded all kinds of man-made and semi-natural habitats in Belgium
- The species shows a high degree of niche overlap with native species, especially with generalist and tree dwelling coccinellids in Belgium
- The increase in *H. axyridis* population coincides with dramatic decline in some native species
- This decline is detectable on a large scale as well as with detailed monitoring of ladybird assemblages
- Mechanism for displacement of native species is possibly IGP since decline appears in species with high degree of niche overlap