

Harmonia axyridis in Britain



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Research

Outline

1. The arrival of the harlequin ladybird
2. The harlequin ladybird survey
3. The UK ladybird survey
4. Research 2004-2007
5. Future plans



The arrival of the harlequin ladybird

First record: 19/9/2004, in Essex (Ian Wright)



Harlequin ladybird
Harmonia axyridis

“The Ladybird has Landed!

A new ladybird has arrived in Britain. But not just any ladybird: this is *Harmonia axyridis*, the most invasive ladybird on Earth.”

Majerus, Press Release, 5th October 2004

Arrival of the harlequin in Britain

- Melanic male found in Essex pub: 19th September, 2004
- Press release circulated on 5th October, 2004
- Provoked massive media response
- Caught imagination of British public



By **Geoff Marsh**

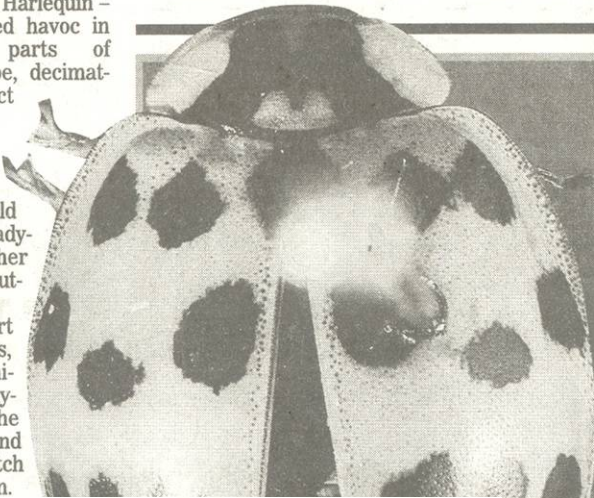
A KILLER ladybird has landed in Britain – and it could mean the end for our own beloved red and black insect.

The most invasive ladybird on the planet – the Harlequin – has already caused havoc in America and parts of Continental Europe, decimating native insect populations.

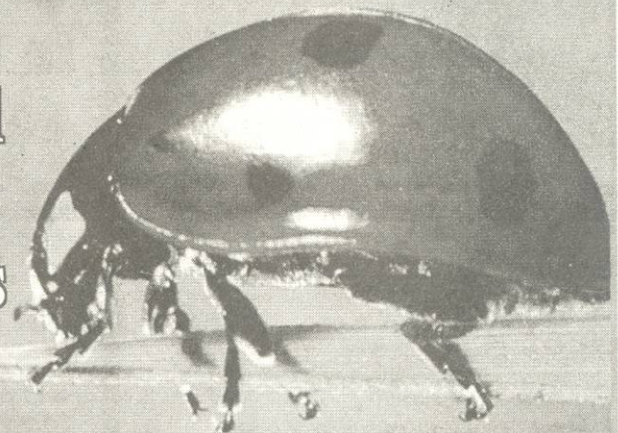
Now scientists have found it in Britain and are warning that it could annihilate native ladybirds and other insects, including butterflies.

Ladybird expert Dr Michael Majerus, of Cambridge University, is urging anyone who spots the distinctive yellow and black insect to catch it and send it to him.

The killer ladybird



This foreign invader could wipe out our native insects



Foreign invasion threatens our native ladybirds

A species of ladybird with the potential to wipe out half of Britain's natives has been found in the country. The voracious Harlequin is larger than domestic rivals and if it becomes established it could drive traditional species to extinction within decades, scientists say.



6 news.telegraph.co.uk

News

The ladybird killers fly in

Native species threatened by voracious insect that even bites people. David Derbyshire reports

A DEADLY species of ladybird with the potential to wipe out half of Britain's native species has arrived in the country.

The voracious Harlequin, also known as the multi-coloured Asian ladybird, was discovered in a pub garden two weeks ago.

The insects are larger, hungrier and more adaptable than their domestic rivals. If they become established, they could drive traditional species, such as the seven spot or two spot, to extinction within decades, scientists say.

Dr Michael Majerus, a ladybird specialist from Cambridge University's genetics department who identified the "odd-looking" Harlequin, said: "This is the ladybird I have least wanted to see here. Given its proximity in Holland, I knew it was on its way. But I hoped that it wouldn't be soon."

"Now many of our ladybirds will be in direct competition with this aggressively invasive species. Some will not cope."

Harlequin ladybirds, *Harmonia axyridis*, originated in Asia. They were introduced to North America in the 1970s as

an "environmentally friendly" alternative to pesticides and quickly swept across the continent, driving out domestic species and other aphid-eating bugs. Numbers of the insects are also rising steeply in France, Belgium and the Netherlands.

Harlequins are more adaptable than most species, living in trees as well as the ground. In the spring, they out-compete rivals for aphids. Once aphid numbers start to fall in the summer, they turn their attention to hoverflies, lace wings, butterfly eggs and even other ladybirds.

The species is a threat not only to other ladybirds: in America in the autumn, some houses are inundated with swarms of harlequins seeking warmth for the winter.

When stressed, they release oily, foul-smelling yellow blood from their legs which stains carpets and fabrics, and may trigger allergic reactions.

Reports of Harlequins biting people as they run out of aphid prey have risen, Dr Majerus said. They also damage soft fruit.



Two weeks ago, Dr Majerus's colleague Ian Wright spotted an "odd" ladybird in the garden of the White Lion in Sible Hedingham, Essex. Dr Majerus identified it as a Harlequin.



"As far as we know, this is the first to be reported in Britain," he said. "If it becomes established, I could well imagine we could lose half of our 40 species of ladybird."



There are around 40 species of ladybird in Britain, ranging from the common seven spot and two spot to the more unusual and specialist



pine ladybird to post it in a sealed matchbox or film canister to his laboratory at Cambridge with details of where and when it was found.



"It is critical to monitor this ladybird before it starts to annihilate our own British ladybirds," he said. Harlequins vary in colour and pattern. Some have black spots on orange wing covers, others have big orange or red spots on black wing covers.

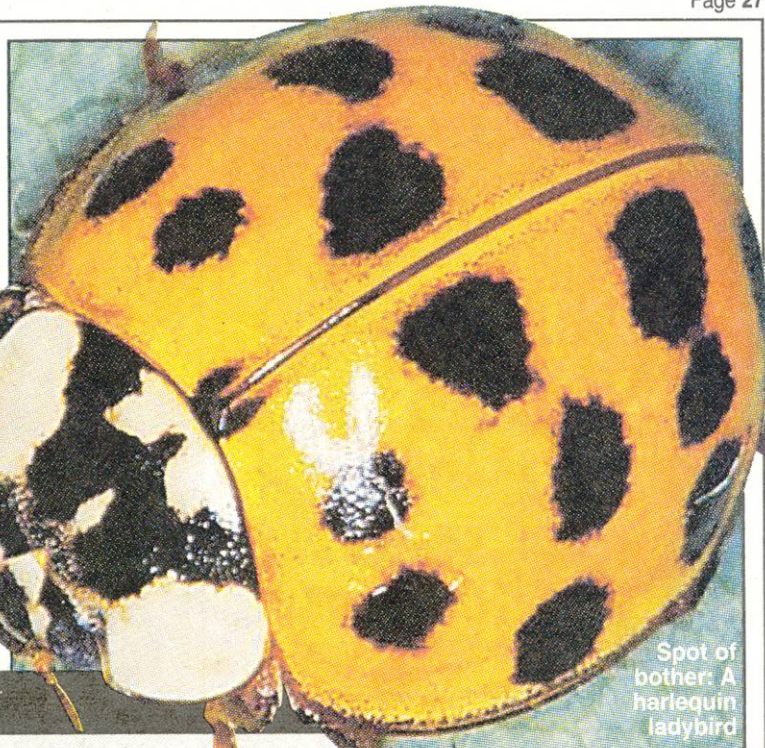


They are around 6mm to 8mm long. Most also have a distinctive W or M mark on the area separating their heads from their wing covers. Send them, in clean, dry containers, to: Dr Michael Majerus, Department of Genetics, Cambridge University, CB2 3EH.

Tuesday, October 5, 2004 THE DAILY TELEGRAPH

Picture: NHPA / JIM KRALJICH

Marching in, the mother of all ladybirds



Spot of bother: A harlequin ladybird

Our ladybirds in peril from foreign invaders

Daily Express Tuesday March 15 2005 21



HOME GROWN

In danger of being eaten up

Majerus. "It's just starting to warm up now, which makes it the ideal time to launch our ladybird survey."

The harlequin is rounder and slightly larger than most British species, measuring 5mm to 8mm in diameter. There are three types of harlequin in Britain - orange with 15 to 20 black spots, black with two orange or red spots, and black with four orange or red spots.

For more information or to join the national ladybird survey, go to www.harlequin-survey.org or www.ladybird-survey.org, or call the Natural History Museum on 020 7942 5000.

OPINION: PAGE 10

en hungry, they can arm like bees, land on and bite. The bites are eating than painful

ricans vacuum up the invaders if they nto houses as they can stain walls e a stench

bird is a British term that dates from Middle Ages when the bug was dedi- the Virgin Mary and known as the Our Lady

land, y are d in x on lady- o see erus, rom ment first harlequin. 'Given its proximity in Holland, I knew it was on its way, but I hoped that it wouldn't be so soon. 'Now many of our ladybirds will be in direct competition with this aggressively invasive species, and some will simply not cope. 'It is critical to monitor this ladybird now, before it gets out of control and starts to annihilate our own British ladybirds.' The harle-

quin is native to Asia and was introduced to the U.S. around 25 years ago in an attempt to control aphids.

Thanks to their aggressive nature, they have eaten their way to become the most common ladybird in the U.S., while the numbers of other species have plummeted. They also feed on the eggs of butterflies and lacewings.

Despite the problems, harlequins are still sold by biocontrol companies in Europe.

Andrew Halstead, principal entomologist at the Royal Horticultural Society, said: 'It's conceivable if you get a new, aggressive predator coming in, that it could threaten some of the native species of ladybird because there is not an endless supply of aphids.'

'It appears from the U.S. experience that it is quite an aggressive species.'

r.yapp@dailymail.co.uk

BRITAIN'S ladybirds are under threat from an Asian invader, scientists revealed yesterday.

The newcomer - the harlequin ladybird - eats more than its fair share of greenfly, depriving its British relatives of food. And when supplies run out, it starts eating our ladybirds.

The Natural History Museum has called on gardeners, farmers and wildlife enthusiasts to help insect experts keep tabs on the predator's progress across the country.

In a bid to save our vulnerable varieties, scientists from the museum, the University of Cambridge, Anglia Polytechnic University, the Centre for Zoology and Hydrology and the Wildlife Trusts want sightings of the harlequin to be reported as part of a nationwide ladybird survey.

Dr Michael Majerus, of the University of Cambridge, said:

By Rachel Porter

"The harlequin is a deadly threat to our own British ladybirds. We need to monitor them closely to assess the impact of the insect."

"We are worried that some of Britain's 46 native ladybirds could become extinct, particularly those that feed on aphids. Unfortunately, it looks like more than half of our species are in trouble."

Sightings

"By our reckoning, the harlequin will have spread across the whole of the British mainland by 2008. We're asking for as many people as possible to log on to our websites and record their findings."

The harlequin was first spotted in Britain last September, and it was almost certainly brought in on imported flowers. Most sightings so far have been confined to

the South-east, extending to Hampshire in the west and Norfolk in the east.

Originally from east Asia, the tough little bug was introduced to North America 20 years ago to control plant pests. It is now the most common ladybird species there. In France, Belgium and Holland numbers are also soaring.

Ladybirds sleep throughout the winter and re-emerge in the spring in search of a mating partner.

They can be found wherever there is a ready supply of food. Any plant, shrub or tree covered with greenfly would be attractive to them.

Harlequins are also fond of butterfly eggs, caterpillars and lacewing larva and soft fruit. "We're very pleased that the weather has been cold for the last three or four weeks," said Dr

Pictures: NIGEL CATTING/HOLT STUDIOS





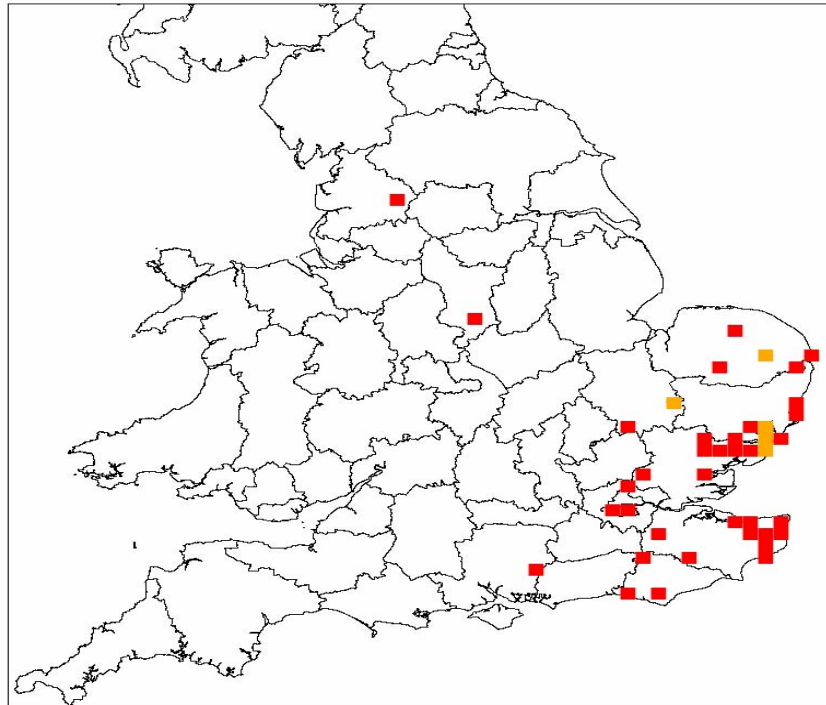
Records soon arrived

- Within a week, records started to arrive from the public.
- Became apparent that the harlequin was established in S.E..
- Isolated records from Derby and Burnley.
- Records from moth trappers, etc. showed that it had been in Britain since the summer.
- Earliest record was June 2004.

October 2004

Harlequin ladybird verified records

-  All previous 10km squares
-  New 10km squares



How did it get to Britain?

- Established in France, Belgium and Holland around 2000
- Flown / blown across English Channel
- Arrived with flowers and vegetables
- By ferry / through Channel Tunnel
- In packing cases from Canada
- Not known to have been deliberately introduced



Funding

- Various bodies contacted Cambridge, interested in collaboration.
- Sought and gained funding from: DEFRA through NBN Gateway, Biological Records Centre, NERC, Natural History Museum, RSPB.
- Thanks to rapid response, had a Project Officer by March 2005

Surveys & Monitoring

*The Harlequin
Ladybird Survey*

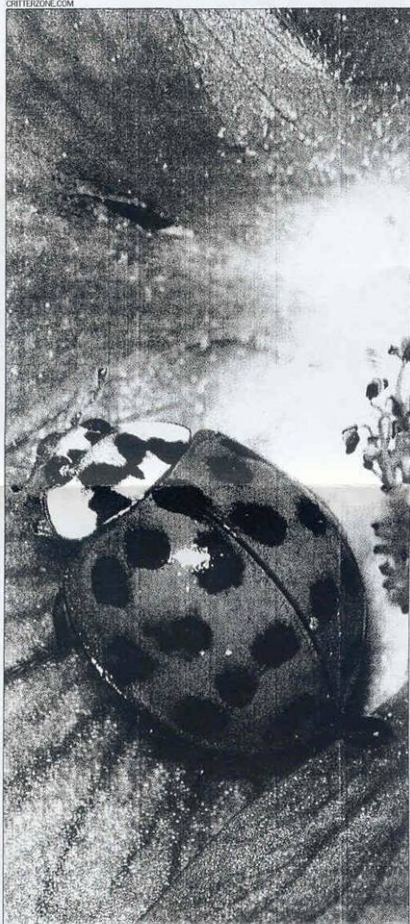


- Survey launched, 15th March 2005
- Collaborating scientists from Cambridge University, Anglia Ruskin University and the Biological Records Centre
- Surveys funded by Defra, through the National Biodiversity Network
- Featured on front page of The Times



No. 68335 ■ TUESDAY MARCH 15 2005 ■ www.timesonline.co.uk ■ 50p

Ladybird falls prey to hungry invader



The harlequin ladybird from Asia is eating so much that it is dominating the less aggressive native species. Scientists want to map the insect populations to track the danger Page 15

LADYBIRD, LADYBIRD

Some relatives must be made to feel unwelcome

It has never been easy to be a British ladybird, all red and spotty. Yet it is considered good luck, at least by hopeful little girls who make wish upon wish.

fly away home". And now Britain's native ladybirds are under vicious attack by a seriously meddlesome cousin: the harlequin ladybird. This aggressive native of Asia usually appears in

leading expert in this field, concludes. It is not that British ladybirds are morally spotless. They digest their share of aphids. But now, as they wake from their winter dormancy and start

THE TIMES TUESDAY MARCH 15 2005

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NEWS 15

Spot the difference in battle of ladybirds

By Mark Henderson
Science Correspondent

A CENSUS of ladybirds is being launched today to help to protect native insects from a voracious alien competitor.

Britain's native species are under threat from the harlequin ladybird, an aggressive and invasive relative first seen here last year, and scientists want to map populations of both types to reveal the extent of the danger.

Gardeners, farmers and wildlife enthusiasts are being invited to contribute to the survey by examining trees, bushes and other plants for ladybirds of either sort and reporting their finds.

"The harlequin is a deadly threat to British ladybirds," said Michael Majerus, of Cambridge University, who is leading the project with colleagues from the Natural History Museum in London. "We need to assess their spread and impact."

There are 46 species of the ladybird family native to Brit-

THE HARLEQUIN AND THE NATIVE



Areas where harlequin ladybirds have been found:



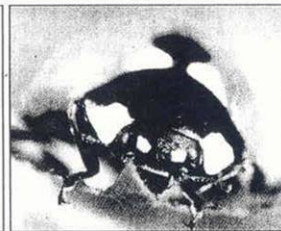
● Harlequin ladybirds are rounder and slightly larger than native British ladybirds

● Most harlequins found in Britain are either orange with fifteen to twenty black spots, or black with two or four orange or red spots



● There are 46 species of native British ladybird. Of these, 27 are large enough to be seen easily and have the familiar seven-spot markings

● When ladybirds are attacked they ooze a goo from their knees which contains toxins and tastes unpleasant. This stops predators from eating them



ain and all are potentially threatened by the harlequin, *harmonia axyridis*. The species originates from Asia and was introduced to North America and continental Europe as a natural method of pest control.

It has become the most common ladybird in those regions in just 20 years.

It is a potential danger to native ladybirds as it is much more voracious in competition for food. Its preferred prey are

greenfly and scale insects, but it will also eat other ladybird species, butterfly eggs, caterpillars and lacewing larvae, as well as soft fruit such as pears.

If it becomes firmly established in Britain, several native

ladybird populations are likely to diminish in numbers and possibly even to die out.

The harlequin was first sighted last September in Sible Hedingham, north of Braintree, Essex. It has since been sighted

across much of the South East. More information is needed to show the extent of the threat. Scientists are launching the national census as ladybirds start to become active, having been dormant through the winter. Participants are being asked to record details of all the ladybirds — native species and harlequins — that they find, along with a grid reference or post-code, the date, and number of insects seen. Photographs would aid verification.

Harlequins are slightly larger than most of the British species and have different colour patterns. (see left) All have a white plate just behind the head, with a large black marking in the shape of a letter M.

Information can be submitted online at www.harlequin-survey.org, or sent to the UK Ladybird Survey, Biological Records Centre, Centre for Ecology and Hydrology, Monks Wood, Abbots Ripton, Cambridgeshire, PE28 2LS.

Leading article, page 17

Aims of the survey

1. Monitor spread across Britain

- www.harlequin-survey.org
- Online submission of records
- Verified records used for distribution maps

2. Assess impact on British ladybirds


- www.ladybird-survey.org
- Recording of all British ladybirds
- 10 target species chosen to represent a range of habitat and dietary specialisations



www.harlequin-survey.org


- On-line recording facility
- Website hosting and record verification
 - Biological Records Centre (CEH Monks Wood)
 - Specimen or photo

The Harlequin Ladybird Survey



[HOME](#) • [What is a ladybird?](#) • [Recognising the Harlequin ladybird](#) • [Fact File](#) • [Recording sightings](#) • [For young people](#) • [Contacts](#) • [Useful links](#)

Welcome to the Harlequin Ladybird Survey website



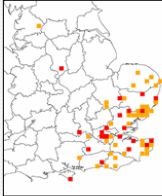
[see larger image](#)

The Harlequin Ladybird has landed!

A new ladybird has arrived in Britain. But not just any ladybird: this is the harlequin ladybird, *Harmonia axyridis*, the most invasive ladybird on Earth.

The harlequin ladybird was introduced to North America in 1988, where it is now the most widespread ladybird species on the continent. It has already invaded much of northwestern Europe, and arrived in Britain in summer 2004.

The distribution map on the left shows that it has spread rapidly throughout the southeast of England since its first sighting.




[see larger image](#)


There are 46 species of ladybird (Coccinellidae) resident in Britain and the recent arrival of the harlequin ladybird has the potential to jeopardise many of these. The **Harlequin Ladybird Survey** will monitor its spread across Britain and assess its impact on native ladybirds.

Monitoring ladybirds across the country has never been more important. We want **YOU** to get involved! [Please record your harlequin ladybird sightings.](#)


You can find out more about the UK's native ladybirds by visiting the [UK Ladybird Survey website.](#)




National Biodiversity Network




defra
Department for Environment
Food and Rural Affairs




NATURAL ENVIRONMENT RESEARCH COUNCIL




JOINT NATURE CONSERVATION COMMITTEE



UNIVERSITY OF CAMBRIDGE



CEH Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL



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UK Ladybird Survey

Striped ladybird (*Myzia oblongoguttata*)

Size: 6 - 8mm

Basic colour: chestnut

Pattern colour: cream stripes and spots

Number of spots: 0-15

Spot fusions: common

Melanic (black)form: rare

Pronotum: white with chestnut m-mark of trapezium

Leg colour: brown

Habitat: Scots pine woodland

Host plant: Scots pine

Overwintering: Unknown

Food: aphids

Other notes: Commonest on mature Scots pine trees. Preferred prey are the large brown aphids of the genus *Cinara*.



Ladybird identification

Find out more about our native ladybirds by selecting a species from the following table. A window will pop up with its details.

[24 spot ladybird](#)

[Hieroglyphic ladybird](#)

[Red ladybird](#)

[Red](#)

[Red](#)

[Red](#)

[Red ladybird](#)

[Red](#)

[Red](#)

[Red ladybird](#)

[Red ladybird](#)

[Red ladybird](#)

each other

the head and the hard wingcases

er

ladybird identification in the field.

Done

Disabled





Site Menu

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LADYBIRD SPOTTERS

This part of the website is aimed at younger people and children. You will find out lots of interesting facts about ladybirds, and activities you can do to learn more about them.

What do ladybirds eat?

A few species feed on plants or mildew but most ladybirds eat aphids (greenfly) or scale insects. Both are garden pests and this is why so many people love to see ladybirds. The seven-spot ladybird can eat 5000 aphids during its year long lifespan.



Do ladybirds get more spots as they get older?

No! The number of spots does not relate to age at all!

Do ladybirds get bigger as they get older?

No. When an adult ladybird is formed, it stays the same size for the rest of its life. Humans have a skeleton *inside* their bodies, called an "endoskeleton", but beetles like ladybirds have theirs *outside* (an "exoskeleton"). This hard skeletal outside means that they can't grow any bigger.

Any other questions?

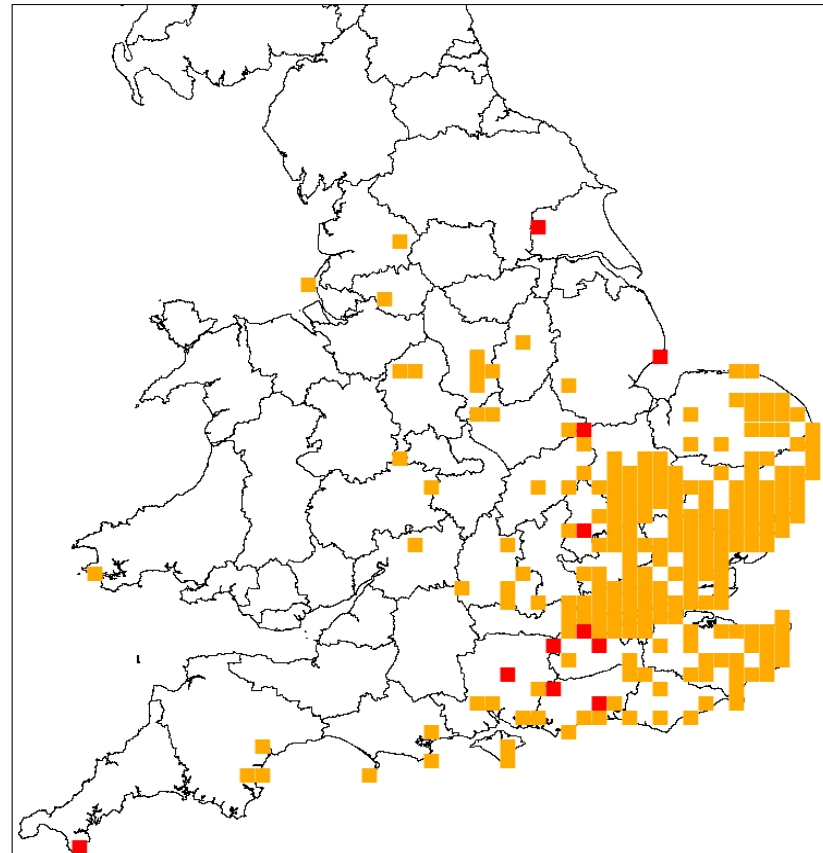
Spotters latest...

- [Drawing competition winners](#)

Other stuff...

- [Drawings gallery](#)
- [WildSquare](#) (Word doc)
- [What's been spotted?](#)

August 2006



Harlequin ladybird
verified records

■ All previous 10km
squares

■ New 10km squares

Latest records extend
distribution to County
Durham and Jersey
(March 2007)

*Predicted to be across all
of lowland, mainland
Britain by end of 2008:
currently seems realistic*

Threat to biodiversity

- Eats non-target species of aphid, coccid and others
- Eats other invertebrates as alternative food including - immature stages of butterflies, moths, beetles and probably many other invertebrates
- Attacks other predators, parasites and parasitoids of aphids
- Out competes other aphid predators
- If parasites and parasitoids of aphidophages included, probably over 1000 species at risk.

Two *H. axyridis* larvae
Eating a *C. 7-punctata* larva



Initial work on impacts on native coccinellids

- *H. axyridis* eats all immature stages of many native coccinellids



Harlequin larva feeding on 7-spot eggs on a flower pot



Harlequin larva feeding on 7-spot larva and drawing blood!

Which native coccinellids are at risk? Harlequin habitats in UK

- Most on *Tilia* and *Acer*
- Also on other deciduous trees
- In *Urtica* beds
- On various crops
- In conifer woodland
- Only *Calluna* heathland not invaded to date



Assessing impact on natives

- Compare with Cambridge Ladybird Survey 1984-1994
- Regular walks in specific habitats
- Uniform methods of monitoring (e.g. by eye, sweeping, beating)



Assess impact on key species



Reed bed specialist, e.g. *Anisosticta 19-punctata*



Myrmecophile, e.g. *Coccinella magnifica*



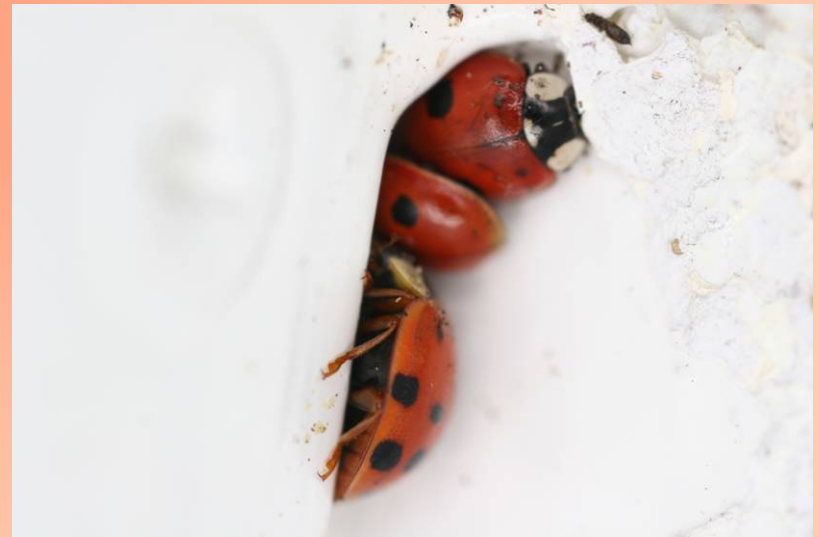
Conifer specialist, e.g. *Myzia oblongoguttata*



Mycophagous, e.g. *Halyzia 16-guttata*

Comparisons at overwintering sites

- Counts at known coccinellid overwintering sites
- Around window frames, in lofts etc.
- E.g. 2004 = 0/378;
2005 = 0/487;
2006 = 15/289



Native ladybirds at risk: predictions

Most

- Aphidophagous, habitat generalists
- Aphidophagous, habitat specialists (except: eyed and cream-streaked - well defended)
- Coccidophagous species
- Heather and hieroglyphic ladybirds (*Erica/Calluna* heathland).
- Mycophagous and phytophagous species

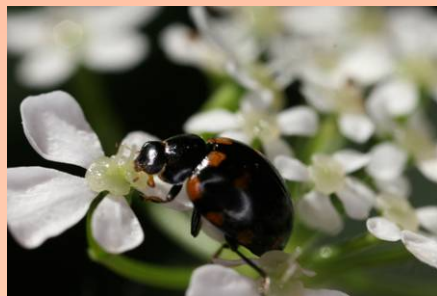
Least



Do British ladybirds lack the protection that may have evolved in some of the Japanese species?

- Japanese ladybirds

- *Cheilomenes 6-maculatus*
- *Coccinella 7-punctata brucki*
- *Propylea japonica*
- *Eocaria muiri*
- *Coccinula sinensis*
- *Coccinula crotchii*



- British ladybirds

- *Adalia 2-punctata*
- *Coccinella 7-punctata*
- *Propylea 14-punctata*
- *Calvia 14-guttata*
- *Adalia 10-punctata*
- *Harmonia 4-punctata*



Egg predation

- Harlequin eggs most palatable
- *Harmonia 4-punctata* (congeneric) and *Propylea* species the next most palatable
- All eggs had some nutritional benefit
- *Calvia 14-guttata* and *Eocaria muii* eggs usually avoided (surface chemicals)
- *Coccinula crotchi* eggs left after tasting
- Japanese spp. Not better defended.



Neonate harlequin larva feeding on non-conspecific eggs



Calvia 14-guttata



Eocaria muii

Carnage in the field!



Fighting larvae (lab.)

- First instar
 - Harlequin wins more often than it loses against all species except cream-streaked and eyed
- Fourth instar
 - Harlequin always wins against all species, except cream-streaked and eyed
- *Propylea* spp. seem to be the most palatable
- Harlequin larvae are very spiky
 - Cream-streaked and eyed similar

Harlequin larva vs.
Coccinella 7-punctata brucki
larva (4th instar)



Larvae of *H. axyridis* have physical defence



- Compare larvae of *M. oblongoguttata* (left) and *H. axyridis* (right)

Vulnerabilities of pre-pupae and pupae

- *Propylea* and *Cheilomenes* readily eaten at pre-pupal and pupal stages
- 2-spot, 7-spot and 10-spot pre-pupae also vulnerable but pupae have more defence
- Harlequin rarely attacked, except by cream-streaked, eyed and conspecific larvae



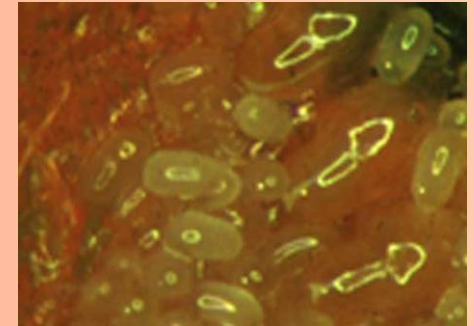
4th instar harlequin larva vs. 7-spot pre-pupa (above) and pupa (below)



Enemies of British ladybirds



Parasitoid dipterans *Phalocrotophora fasciata*
& *P. berolinensis*



Sexually transmitted mite
Coccipolipus hippodamiae



Parasitoid wasp
Dinocampus coccinellae



Soil fungus *Beauveria*
bassiana

Dinocampus coccinellae

- *D. coccinellae* recorded from *H. axyridis* in UK (rarely)
- Koyama has shown that UK wasps prefer C-7 to *H. axyridis*, but Japanese wasps show no preference for C-7 *brucki* over *H. axyridis*



Fungal studies (i)

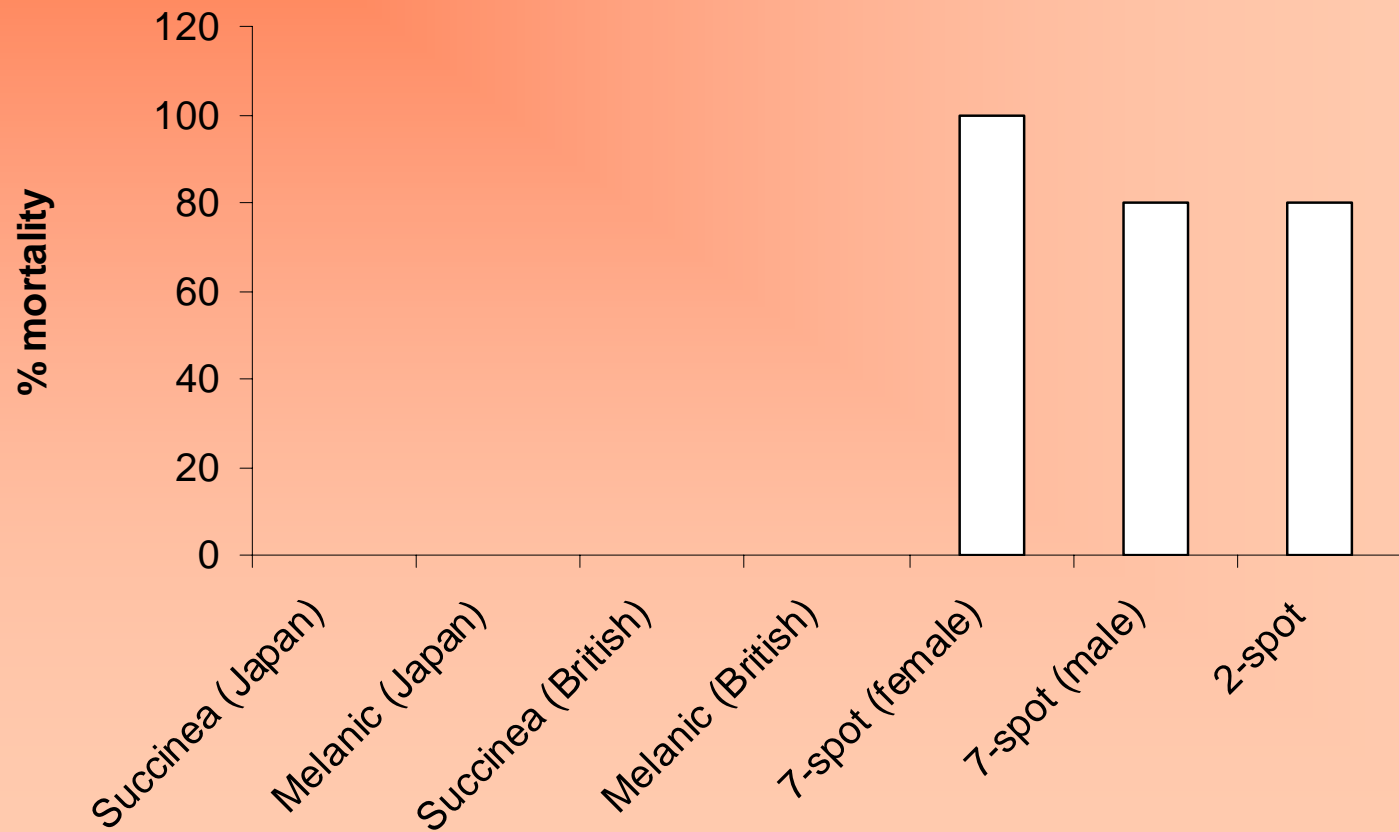
- Predation of aphids affected by the aphid-specific fungus *Pandora neoaphidis* by *H. axyridis*
- In choice tests, UK *H. axyridis* attacked fungal affected cadavers more than did C-7
- *H. axyridis* likely to have greater impact on occurrence and persistence of *P. neoaphidis*



Fungal studies (ii)

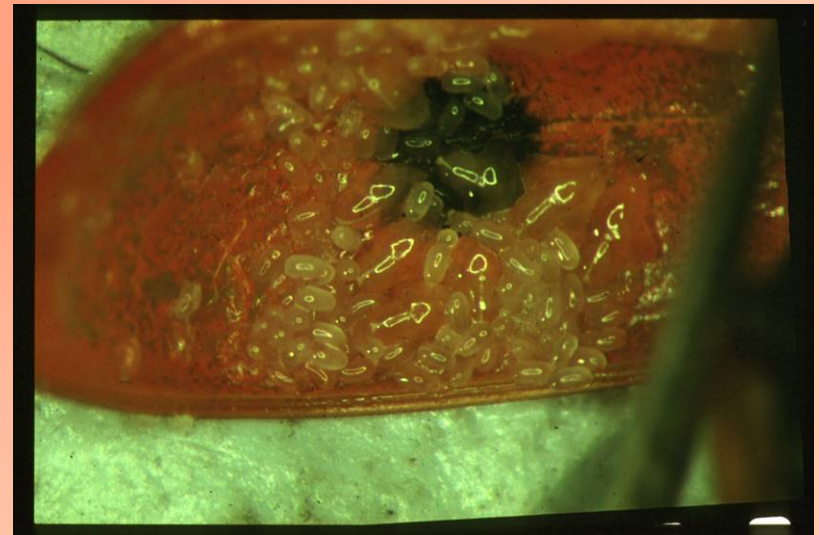
- Effect of *Beauveria bassiana* on three species of ladybird
- Larvae of *H. axyridis*, *C-7* and *A. 2-punctata* all highly susceptible to *B. bassiana*
- *H. axyridis* significantly less susceptible than other two species.

Susceptibility of the harlequin to a fungal pathogen



Infection of *H. axyridis* by *Coccipolipus hippodamiae*

- *H. axyridis* infected by the sexually transmitted mite in Japan
- Only *C. magnifica* infected by this mite in Britain
- Due to longevity and multivoltinism, *H. axyridis* likely to be more susceptible to this mite than most other UK species



Male-killing in *H. axyridis*

- Across native range, *H. axyridis* carries a male-killing *Spiroplasma* at varying prevalence (0.03-0.8)
- As yet, no record of male-killing in UK populations of *H. axyridis*
- Possibly due to culture methods prior to release
- Will continue to monitor

Recently initiated avenues

- Changes in the frequencies of colour forms (melanics have declined in UK from 40% in 2004 to 20% in 2006)
- Effect of temperature on colour pattern
- Changes in environmental oviposition cues (breeds abnormally late in the year in UK: oviposition as late as October)

Colour pattern variation



f. *succinea*: orange with 0-21 black spots



f. *conspicua*: black with 2 red spots



f. *spectabilis*: black with 4 red spots



f. *axyridis*: black and red chequered

Recent avenues

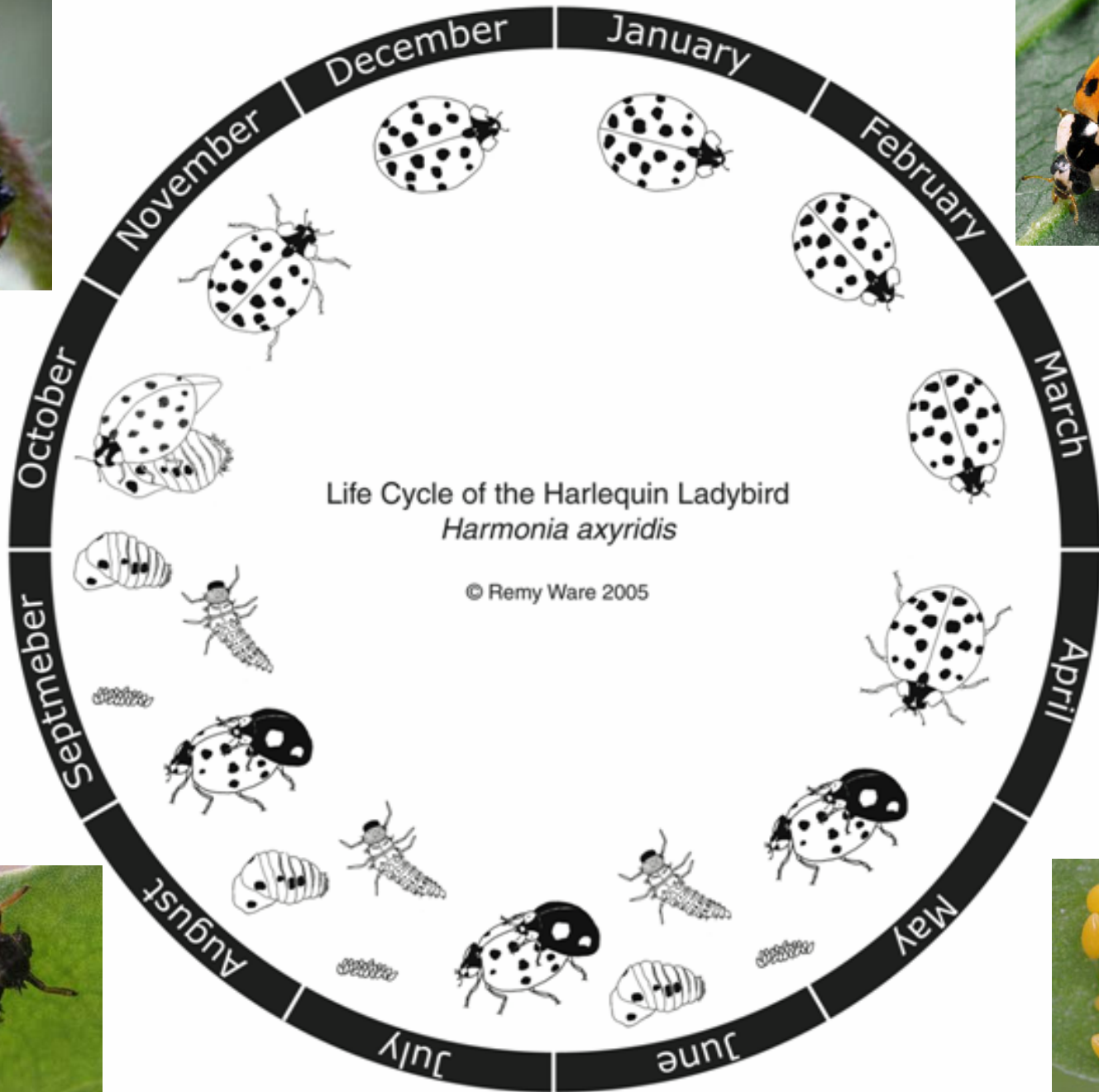
- Changes in the frequencies of colour forms (melanics have declined in UK from 40% in 2004 to 20% in 2006)
- Effect of temperature on colour pattern
- Changes in environmental oviposition cues (breeds abnormally late in the year in UK: oviposition as late as October)



Pupa

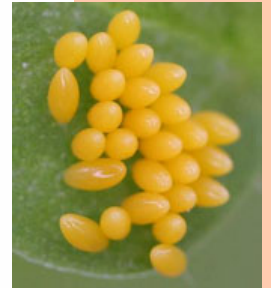


Adult



Larva (4 instars)

Eggs



In summary *H. axyridis* provides

- Unique opportunity to study the spread and impact of a new invasive species from a very early stage after initial establishment
- Chance to address range of interesting evolutionary questions
 - Founder effects
 - Evolution and maintenance of polymorphism
- Possible negative impacts
 - On native biodiversity
 - On humans

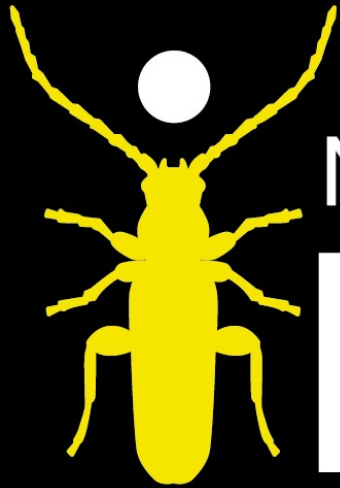


Continued media attention

- Try to maintain high profile of survey
- Good contacts with TV
- Good contacts with entomological societies (e.g. RES and AES)
- Media interested in plagues (e.g. November 2006)



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NATIONAL
insect
WEEK

19th
— *to* —
25th
JUNE
2006

Harlequin survey was headline survey for 2006 week

The future (i) collaborations

- Collaborative work with Obara/Koyama (Japan), Hemptinne/Arnaud (France), Zakharov (Russia), Sloggett (USA).
- Expand collaborations: ensure communication between continents

The future (ii) networks

- Initiate co-ordination of research on *H. axyridis*
- Use existing avenues (e.g. Aphidophaga)
- Be open (avoid repetition and gaps)
- Broad range publication and dissemination of results (refereed journals, popular journals, the media, the web).
- Put in context of other invasive alien species

Many thanks to.....

- All here
- All those who helped in the failed COST application
- All those in the UK who have helped with the harlequin work there to date
- All those in my group, Helen's group, at CEH Monk's Wood and at Rothamsted Research who have given so much of their time
- And the wonderful ladybird-loving British public

Thank you!

