Ladybirds: ecology, identification, and the effects of an invader

Beds NHS
17 Nov. 2018

Peter Brown

Image: Richard Naylor

Anglia Ruskin University

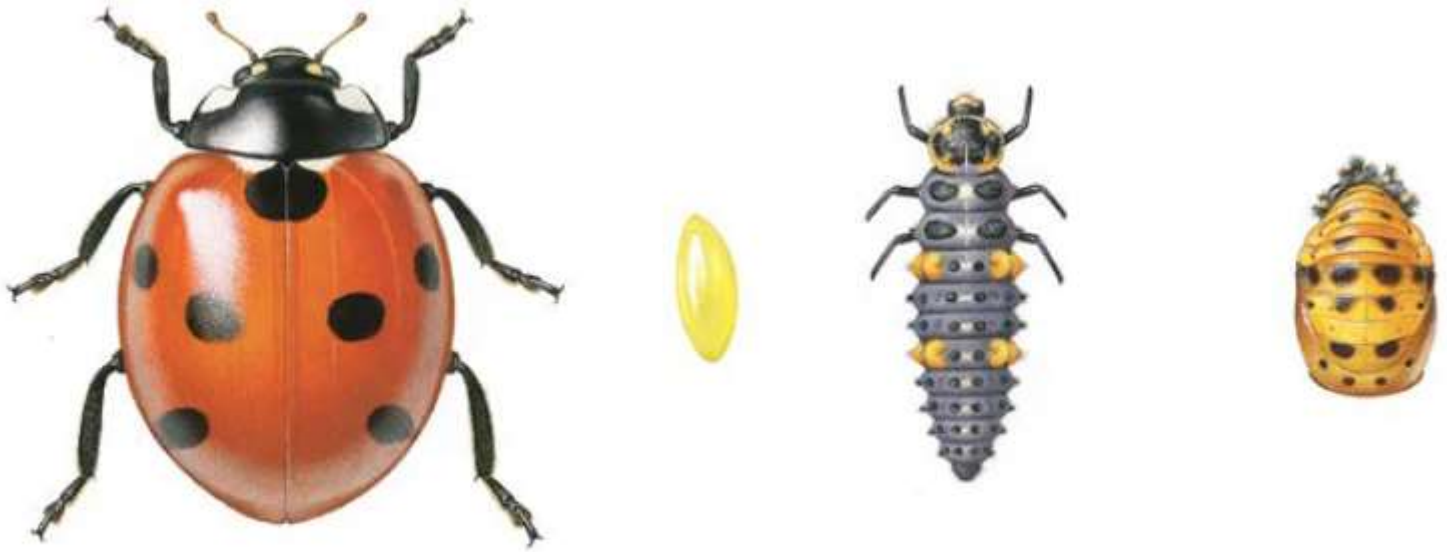
Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

UK Ladybird Survey

‘Our Lady’s Bird’

47 ladybird species in UK

Images: FSC / Chris Shields



▲ Life cycle of 7-spot Ladybird.

Images: Richard Lewington

Ladybird food

- Most species are carnivorous
  - Aphids (inc. Adelgids – conifer aphids)
  - Jumping plant lice (Psyllids)
  - Scale insects (Coccids)
- 3 mildew feeding species
- 2 herbivorous species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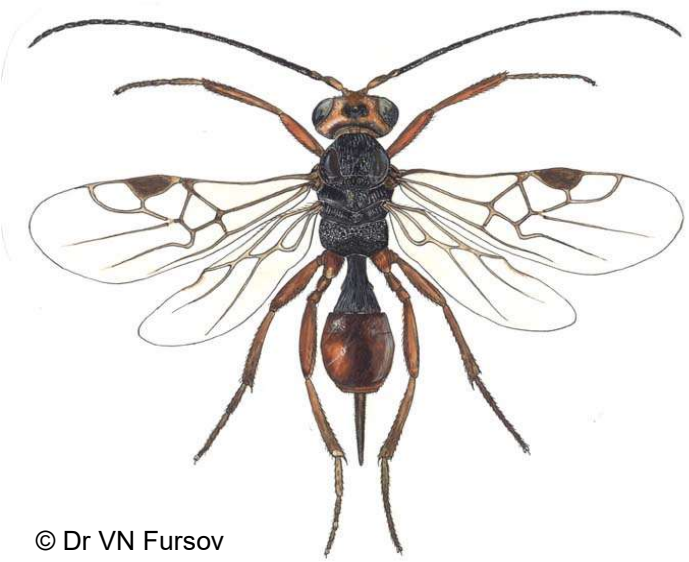
Natural enemies of ladybirds

- (Birds)
- Ants & spiders
- Parasites – parasitic wasps, flies, roundworms, mites
- Fungal pathogens

Araneus diadematus predating *Harmonia axyridis*, © Louloubelle

Natural enemies of ladybirds

- *Dinocampus coccinellae* – a parasitoid wasp
- Recorded in at least 10 ladybird species
- Can affect high proportion of individuals



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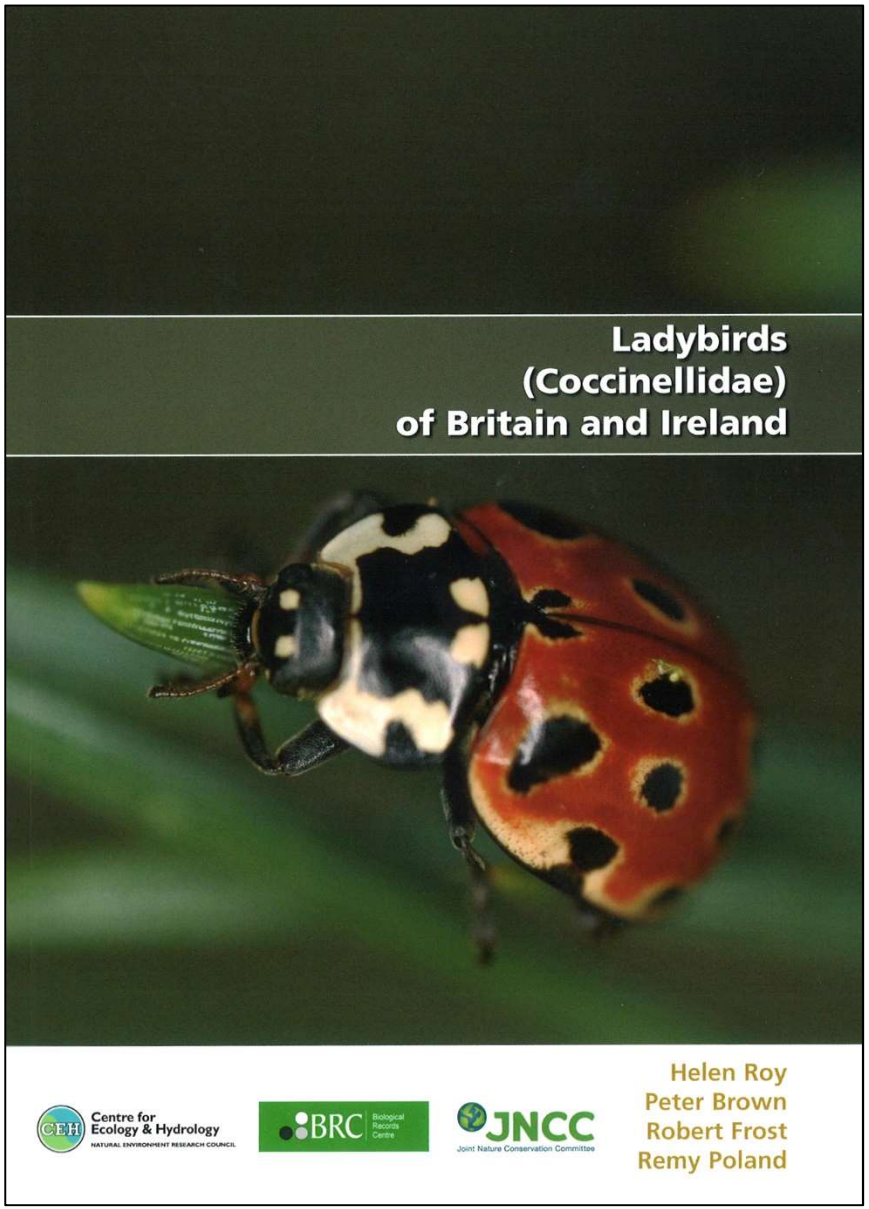
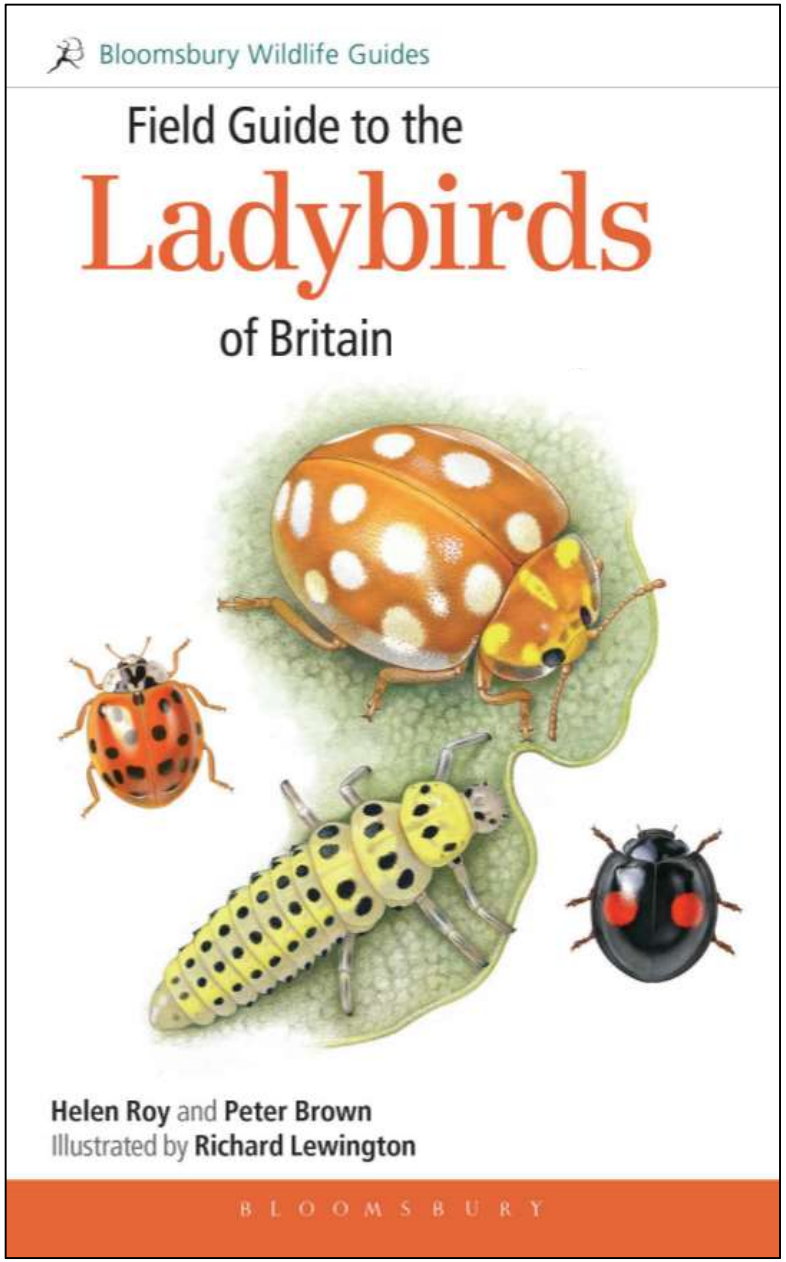
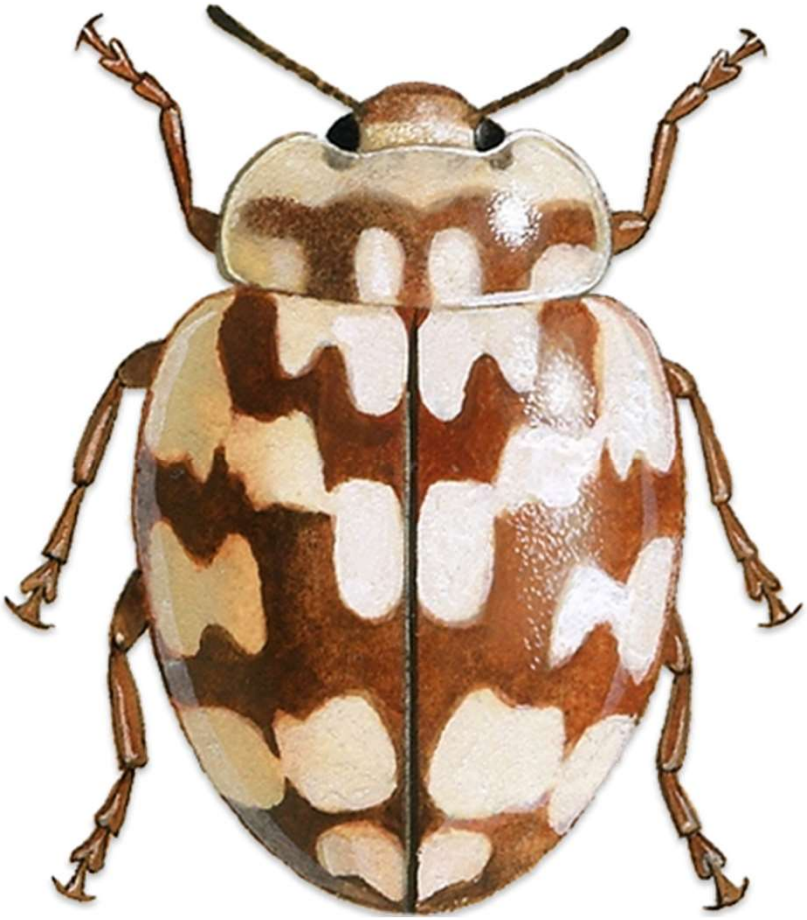
From ladybird atlas to field guide





Naming the ladybirds

Exochomus quadripustulatus
Image: Richard Comont



Myrrha octodecimguttata
Image: FSC / Chris Shields

TRIBE COCCIDULINI

Elongate and rather flattened
Marshes, riversides, pondsides

Red Marsh Ladybird
pp.126

Distinct triangular marking behind pronotum
Marshes, riversides, pondsides

Spotted Marsh Ladybird
pp.127

U-shaped mark towards end of elytra
Coniferous and deciduous trees

Dark Brown Rhyzobius
pp.128

U-shaped mark towards end of elytra
Grassland; low-growing vegetation

Pale Brown Rhyzobius
pp.129

Dull orange head and pronotum
Coniferous and deciduous trees

Red Headed Rhyzobius
pp.130

TRIBE SCYMNINI

Orange-red spots at tip of elytra
Often coastal or wet habitats

False-spotted Rhyzobius
pp.131

Yellow-cream horseshoe mark
Coniferous and deciduous trees

Horseshoe Rhyzobius
pp.132

Reddish kidney-shaped spots; anterior larger than posterior pair
Often where Ivy is prevalent

Four-spotted Nephus
pp.134

Large irregular red patches on sides of elytra
Often coastal

Red-patched Nephus
pp.135

Abdomen reddish-tipped
Damp habitats

Red-rumped Scymnus
pp.136

Black stripe along centre line widening at top and bottom
Deciduous trees, marshy habitats

Bordered Scymnus
pp.137

Reddish edge to head (male)
Oak trees

Oak Scymnus
pp.138

Dark T-shape on elytra
Coniferous habitats

Pine Scymnus
pp.139

Reddish-brown legs, antennae and mouthparts
Heathlands and dry habitats

Heath Scymnus
pp.140

Elongate red spots near front of elytra
Heathlands and dry habitats

Angle-spotted Rhyzobius
pp.141

Triangular red spots to edge of elytra

Red-flanked Scymnus
pp.142

Black except for pale to dark brown tips to legs
Coniferous habitats

Black Scymnus
pp.143

Mostly coastal

Schmidt's Scymnus
pp.144

Yellowish legs

Dot Ladybird
pp.145

Images: Richard Lewington

Scymnus interruptus
Image: Mat Kitchener

Horseshoe Ladybird *Clitostethus arcuatus*

- Up to 1.5 mm
- Woodland, esp. ivy
- Prefers warm climates
- Recently in Worcs

Image: Gilles San Martin

Horseshoe Ladybird *Clitostethus arcuatus* (Rossi, 1794)

Tiny ladybird with an attractive and distinctive horseshoe-shaped mark on its elytra (easily visible when viewed through a hand lens).

Identification (adult)
Length 1.2–1.5mm.
Background colour Dark brown to black.
Pattern Pale yellow/cream horseshoe-shaped mark in the centre of the elytra.
Number of spots 0.
Pronotum Dark brown but cream at sides, or sometimes mostly cream.
Leg colour Cream.
Other features Hairy; head dark brown to black, or sometimes cream.

Food
Clitostethus arcuatus is a predatory ladybird that feeds on whitefly.

Habitat
Clitostethus arcuatus is found in coniferous and deciduous woodland or other habitats with trees. It favours Ivy, but has also been recorded on Honeysuckle, viburnum and Holly.

C. arcuatus overwinters in bark crevices and under the bark of coniferous and deciduous trees.

Suggested survey method
Beating appropriate shrubs. Most often found by beating Ivy growing on trees such as oak.

Range
The very few records partly reflect this species' preference for warm climates; it is more common in Mediterranean countries. Indeed, most of the few records that we do have are southerly and are recent, including a first Worcestershire record in 2017. It may be that the species is becoming more abundant with climate warming. It is probably also under-recorded, partly because of its very small size.

National conservation status
Very local.

Distribution trend (1995–2015)
Insufficient data.

adult

Image: Richard Lewington

Four-spotted Nephus *Nephus quadrimaculatus*

- Up to 2 mm
- Ivy

Image: Gilles San Martin

Four-spotted Nephus — *Nephus quadrimaculatus* (Herbst, 1783)

Bears four distinctive markings on its elytra and can be commonly seen on Ivy covering south-facing walls.

Identification (adult)
Length 1.5–2mm.
Background colour Black.
Pattern Two pairs of reddish-brown kidney-shaped spots, the front pair being larger than the rear pair.
Number of spots 4.
Pronotum Black.
Leg colour Pale.
Other features Hairy; abdomen has a reddish-brown tip; head black.

Food
Nephus quadrimaculatus is a predatory ladybird that feeds on scale insects.

Habitat
Nephus quadrimaculatus may be found in gardens, woodlands (deciduous and coniferous) and other habitats where Ivy is prevalent. It can be found (sometimes in large numbers) in patches of Ivy on garden walls and trees, as well as in woodlands. It has also been recorded on Alder and Sycamore (not always with Ivy) and shrubs such as Firethorn.
N. quadrimaculatus probably overwinters primarily in Ivy.

Suggested survey method
Beating or visual searching of Ivy.

Range
Once considered a rare species, with most records coming from Suffolk, it was found during the 1990s in other southeastern counties, particularly Surrey, where it is now common. It is still largely restricted to southeast England (but at least as far north as Norfolk and Cambridgeshire), and most of the records have been made since 2000. However, there are various recent records from more westerly areas, including Worcestershire and Shropshire, suggesting that the species may be increasing and spreading.

National conservation status
Very local.

Distribution trend (1995–2015)
Stable.

Image: Richard Lewington

Red-headed Rhyzobius *Rhyzobius lophanthae*

- 2 mm
- Urban
- Leyland cypress

Image: Andrew Jewels

Red-headed Rhyzobius — *Rhyzobius lophanthae* (Blaisdell, 1892)

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Small black ladybird with a dull orange head. *Rhyzobius lophanthae* is smaller and has shorter antennae than the other *Rhyzobius* species found in Britain, and has different and distinctive colouration, with black elytra and an orange pronotum.

Identification (adult)
Length 2mm.
Background colour Black.
Pattern None.
Number of spots 0.
Pronotum Dull orange.
Leg colour Dull orange.
Other features Entire dorsal surface covered in short hairs; long antennae; head dull orange, margins of the elytra with long hairs.

Food
Rhyzobius lophanthae is a predatory ladybird that feeds on scale insects. It was widely used in Europe throughout the twentieth century as a biological control agent of armoured scale insects and is now widespread around the Mediterranean basin.

Habitat
Rhyzobius lophanthae can be quite urban, and many of the records are from parks and gardens. It is often found on cypress trees, particularly Leyland Cypress, with other records from Juniper, viburnum and spindle. However, it has more rarely also been recorded on broad-leaved trees such as oak, Ash and Lime.

Overwintering sites are largely unknown, but are probably similar to its breeding habitat, for example evergreen trees such as cypresses.

Suggested survey method
Tree beating.

Range
Rhyzobius lophanthae is native to Australia. First found in Britain by D.A. Coleman on an Ash tree in Morden Park, Surrey, in 1999. It has since been recorded as breeding outdoors in London. It has been spreading quickly over the last 10 years, and there are recent records from many counties across southern England and as far north as Nottinghamshire and Lincolnshire. There are records from all times of year, so the species is evidently now surviving winters in Britain (something that seemed in doubt when it was first recorded).

National conservation status
Very local.

Distribution trend (1995–2015)
Insufficient data.

Image: Richard Lewington

Rhyzobius forestieri

- London (2014), Kent, Cambs (’17), Essex (’17), Herts (‘18)
- Similar size to 24-spot ladybird

Image: Andrew Jewels

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Rhyzobius forestieri

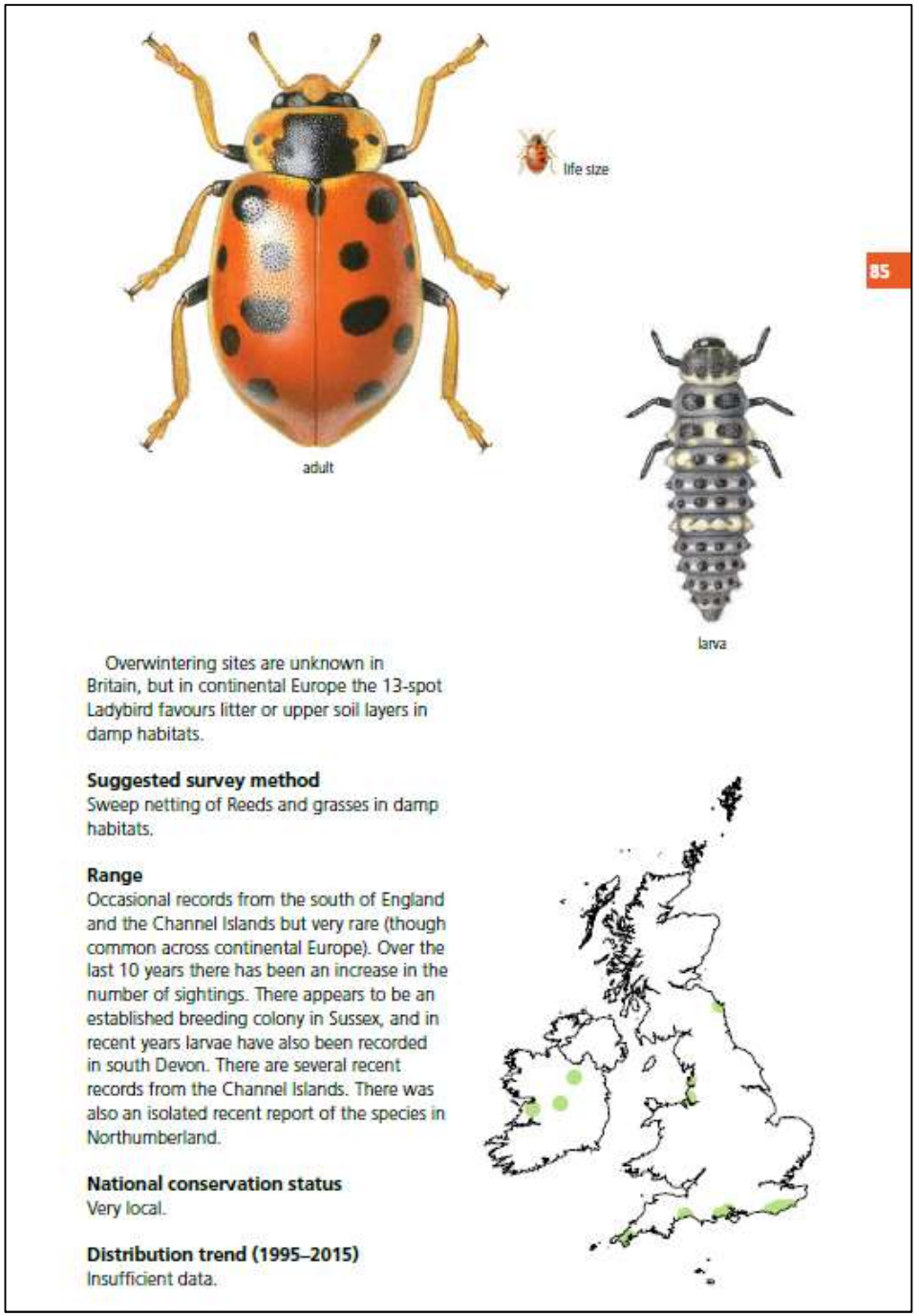
The most recent ladybird species to arrive in Britain is *Rhyzobius forestieri*. First discovered in London in 2014, *R. forestieri* is a hairy inconspicuous ladybird that is native to Australia. It is larger than most of the other small ladybirds, and approaches the size of a 24-spot Ladybird. *R. forestieri* is black on top, but when viewed from underneath the rear segments of the abdomen are a bright orange colour, making it quite distinctive. There have since been other records of the species in London and Kent, and in 2017 it was found for the first time in both Cambridgeshire and Essex. This species should probably now be added to the list of established ladybird species in Britain.

Image: Harry Taylor / NHM

13-spot Ladybird *Hippodamia tredecimpunctata*

- Marshy lowland habitats

Image: Peter Brown

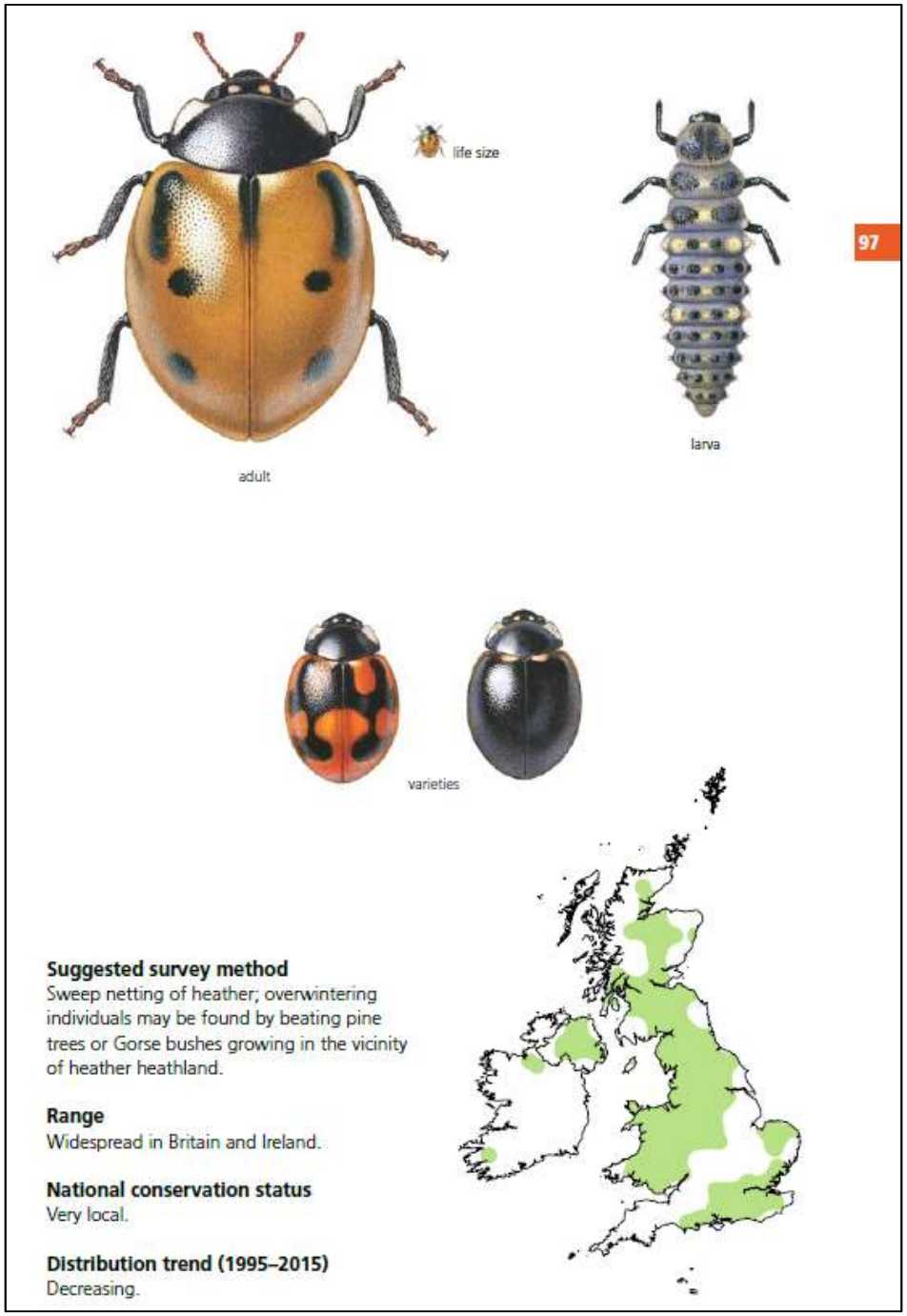


Images: Richard Lewington

Hieroglyphic Ladybird *Coccinella hieroglyphica*

- Heather heathland

Image: Ewan Parry

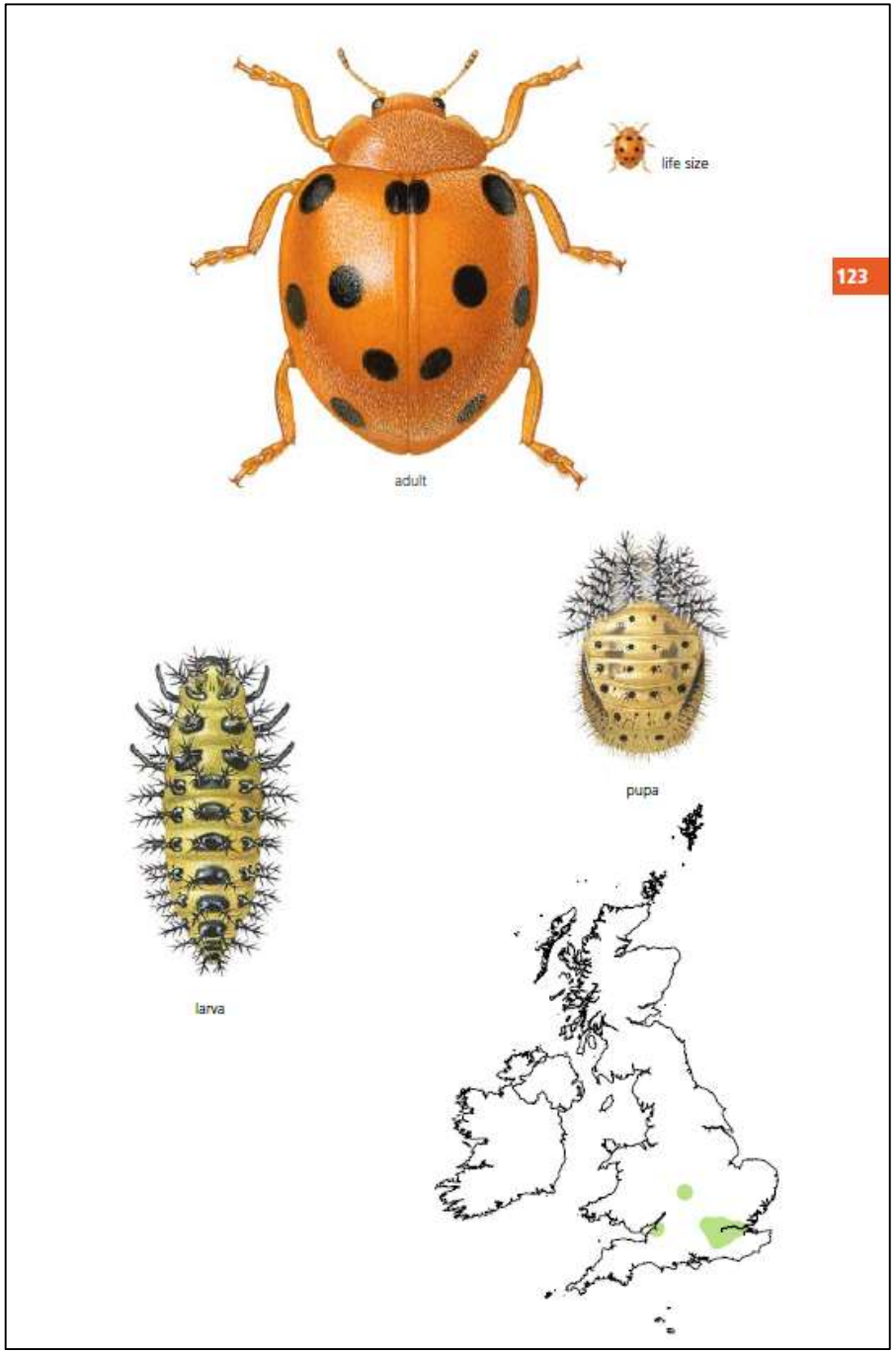


Images: Richard Lewington

Bryony Ladybird *Henosepilachna argus*

- White bryony

Image: Gilles San Martin



Images: Richard Lewington

Larvae

2-spot ladybird
© Gilles San Martin

Harlequin ladybird
© Gilles San Martin

7-spot ladybird
© Gilles San Martin

Orange ladybird
© Gilles San Martin

Kidney-spot ladybird
© Gilles San Martin

THE Sun

2011

INVASION OF THE CANNIBAL LADYBIRDS

AN invasion of CANNIBAL ladybirds is sweeping across Britain.

Larvae of the giant Harlequins munch native species.

Scientists fear that 27 of Britain's 47 own ladybird types are under threat. Harlequins from east Asia arrived in Kent eight years ago – probably on a ship.

The insects, up to 8mm long, spread across the rest of the country at the rate of 60 miles a year.

Researchers found that in three years they went from 0.1 per cent of the ladybird population in Cambridgeshire to **40** per cent.

Harlequins can be red, black, orange or yellow and have between zero and 22 spots. Dr Peter Brown, of Cambridge's Anglia Ruskin University, said: "They could have a drastic effect on native five-spot ladybirds." *t.spanton@the-sun.co.uk*

By TIM SPANTON

Threat . . . the Harlequin

Peril . . . British ladybird

Not only the tabloids… Guardian 2015

The Guardian, Kings Place, 90 York Way, London N1 9GU 020 3353 2000

Harlequin ladybird is fastest invader of UK on record

From Essex to Shetland Islands in just one decade

Threat to native species with 2-spot declining 44%

Lewis Smith

Harlequin ladybirds have been declared the UK's fastest invading species after reaching almost every corner of the country in just a decade.

The cannibalistic ladybird was first seen in Essex in 2004 and has since spread as far as Cornwall and the Shetland Islands, in the fastest alien invasion of the UK on record. Grey squirrels, American mink, ring-necked parakeets and muntjac deer are advancing at a rate far behind them.

Scientists monitoring the spread of the voracious harlequin, which can prey on native ladybirds, said the warnings when the species first arrived that it would colonise rapidly and was the world's "most invasive ladybird" have proved correct.

Dr Helen Roy, of the Centre for Ecology and Hydrology, said a decade of sightings recorded by the public for the UK Ladybird Survey have revealed just how far and fast the harlequin has spread.

"The harlequin is the fastest-spreading alien species on record that I can think of," she said, adding that it is now consolidating its presence in the UK.

While sightings of harlequins (*Harmonia axyridis*) in Scotland are much less common than in England and Wales, it has colonised much of the south and has been spotted – though probably hasn't established over-wintering populations – on the north coast and Shetland Islands.

The species is believed to be responsible for the decline of at least seven native ladybirds, including the two-spot, which when last assessed in 2012 had slumped 44%. Roy said there had been no sign of a recovery among two-spots.

PHOTOGRAPH: STEVE HOPSON

The impact of the harlequin has, however, been less costly than other invasive species, such as Japanese knotweed which in 2010 was estimated to cost the UK economy £166m annually. Overall, invasive species are estimated to cost £1.7bn each year.

Harlequins might even have some benefits as they prey on smaller insects, especially aphids which can damage crops and flowers, but the extent to which they protect plants is undetermined. There is also evidence to suggest that native insects may have adapted to prey on harlequins, helping to keep numbers in check.

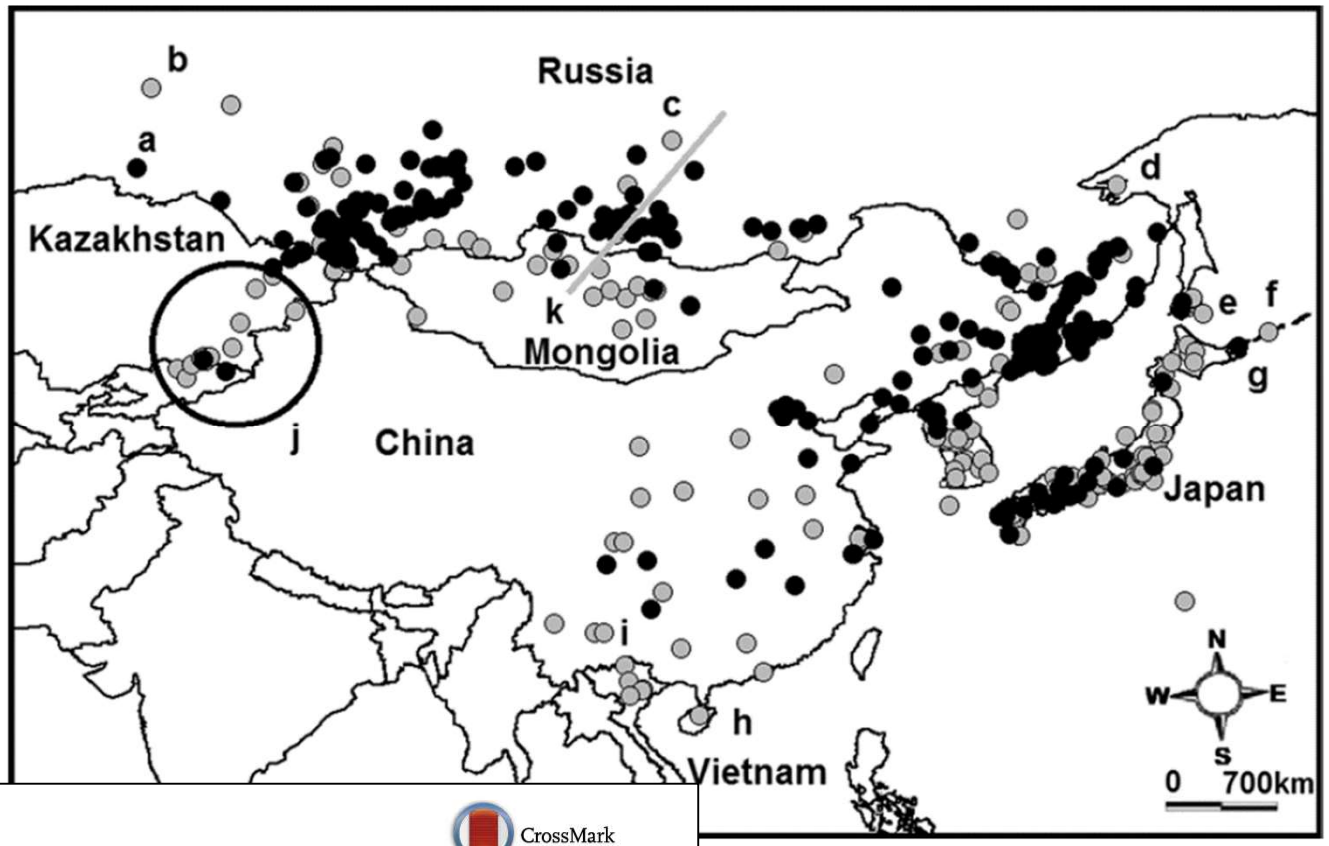
Harlequin ladybirds, main image, are cannibalistic and a threat to seven UK ladybird species including the seven-spot, right

One silver lining, said Roy, is that the monitoring scheme has helped scientists better understand the routes alien species use to invade and how it might be possible to reduce the threat.

Most non-native species have little impact but a handful are considered harmful. Among those that are unwanted but likely to arrive imminently are bee-eating Asian hornets – they have already reached France – and Roy said the lessons learnt from the harlequin invasion could prove vital to preventing the hornet establishing itself as a ubiquitous species.

In a paper in the journal Ecological Entomology, Roy and co-author Peter Brown, of Anglia Ruskin University, said the harlequin "has provided unique and detailed insights into invasion biology".

Native distribution of the harlequin



Biol Invasions (2015) 17:1941–1948
DOI 10.1007/s10530-015-0848-9

CrossMark

ORIGINAL PAPER

Harmonia axyridis (Coleoptera: Coccinellidae) in Asia: a re-examination of the native range and invasion to southeastern Kazakhstan and Kyrgyzstan

Marina J. Orlova-Bienkowskaja · Andrey S. Ukrainsky · Peter M. J. Brown

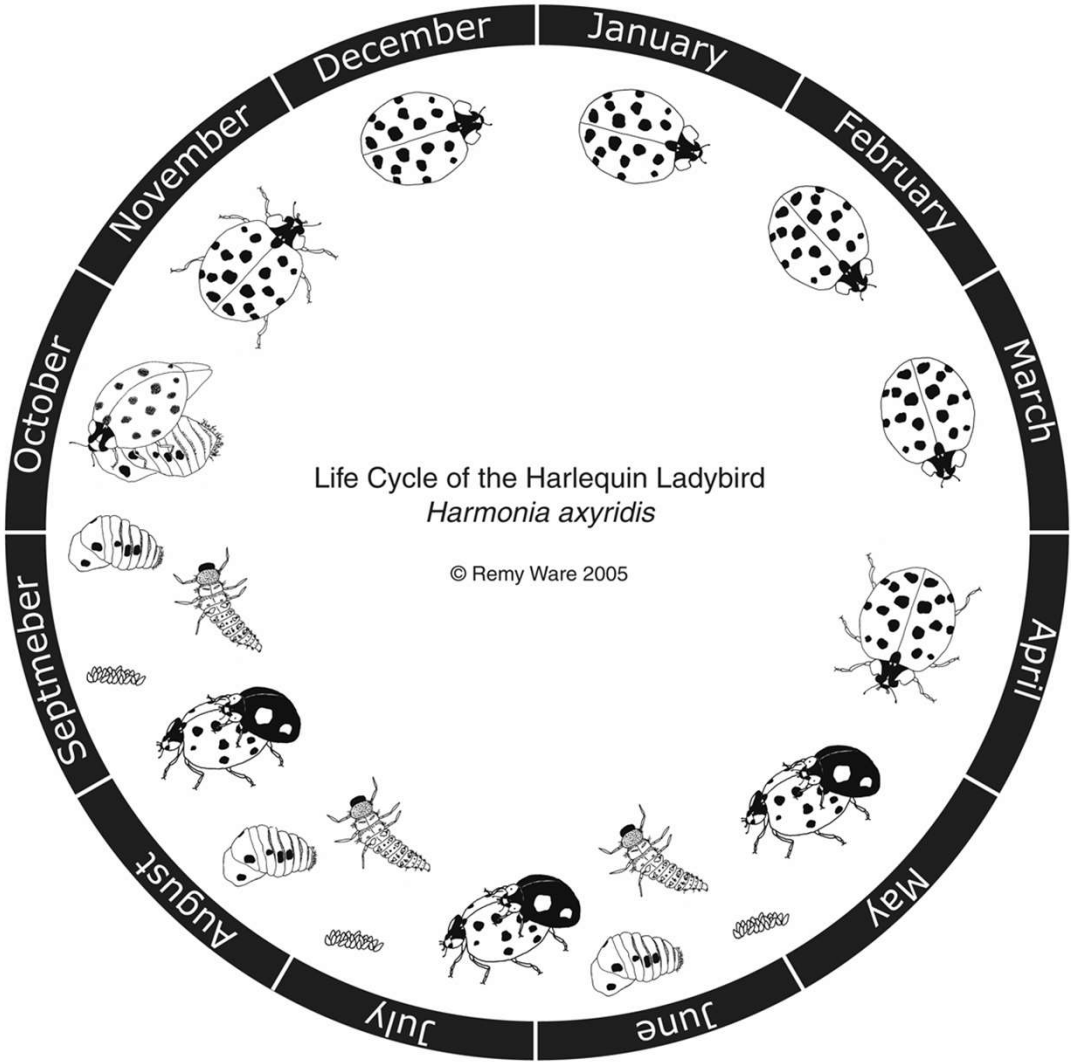
Ecology of the harlequin ladybird

- Generalist (food and habitat)
- Biological control agent (Europe & Americas)

How did harlequins get here?

- Established in France, Belgium, Germany, Netherlands around 2000
- Flown / blown across Channel
- Flowers and vegetables
- Not deliberately introduced

Fast breeding species

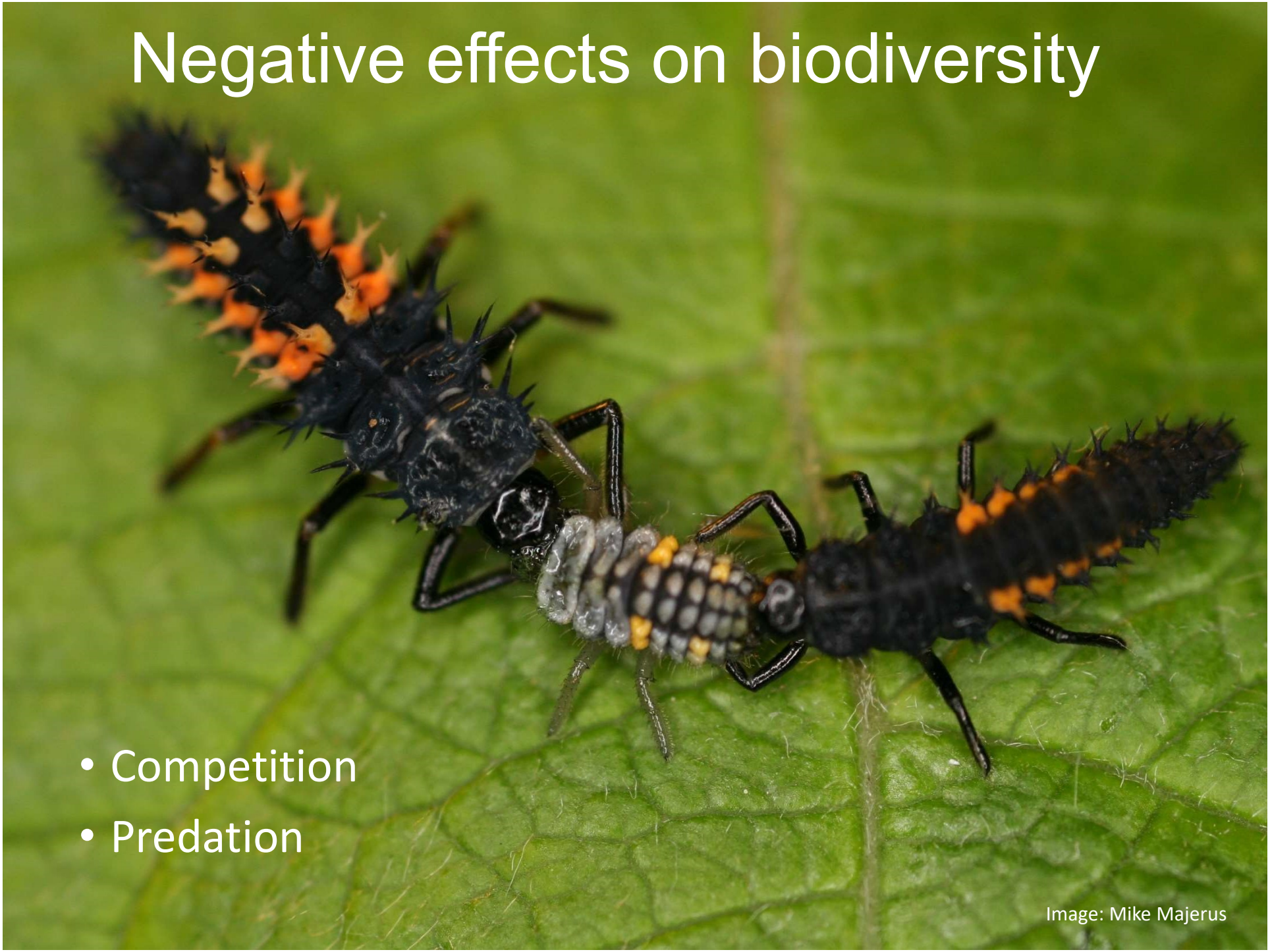


Harlequin eggs hatching

Image: Ashlea Jarvis

Cannibalism

Negative effects on biodiversity



- Competition
- Predation

Image: Mike Majerus

Polymorphism

- Numerous colour forms (three in Britain)
- Large variation, even within forms

H. axyridis f. *succinea*

H. axyridis f. *conspicua*

H. axyridis f. *spectabilis*


Image: Nick Greatorex Davies

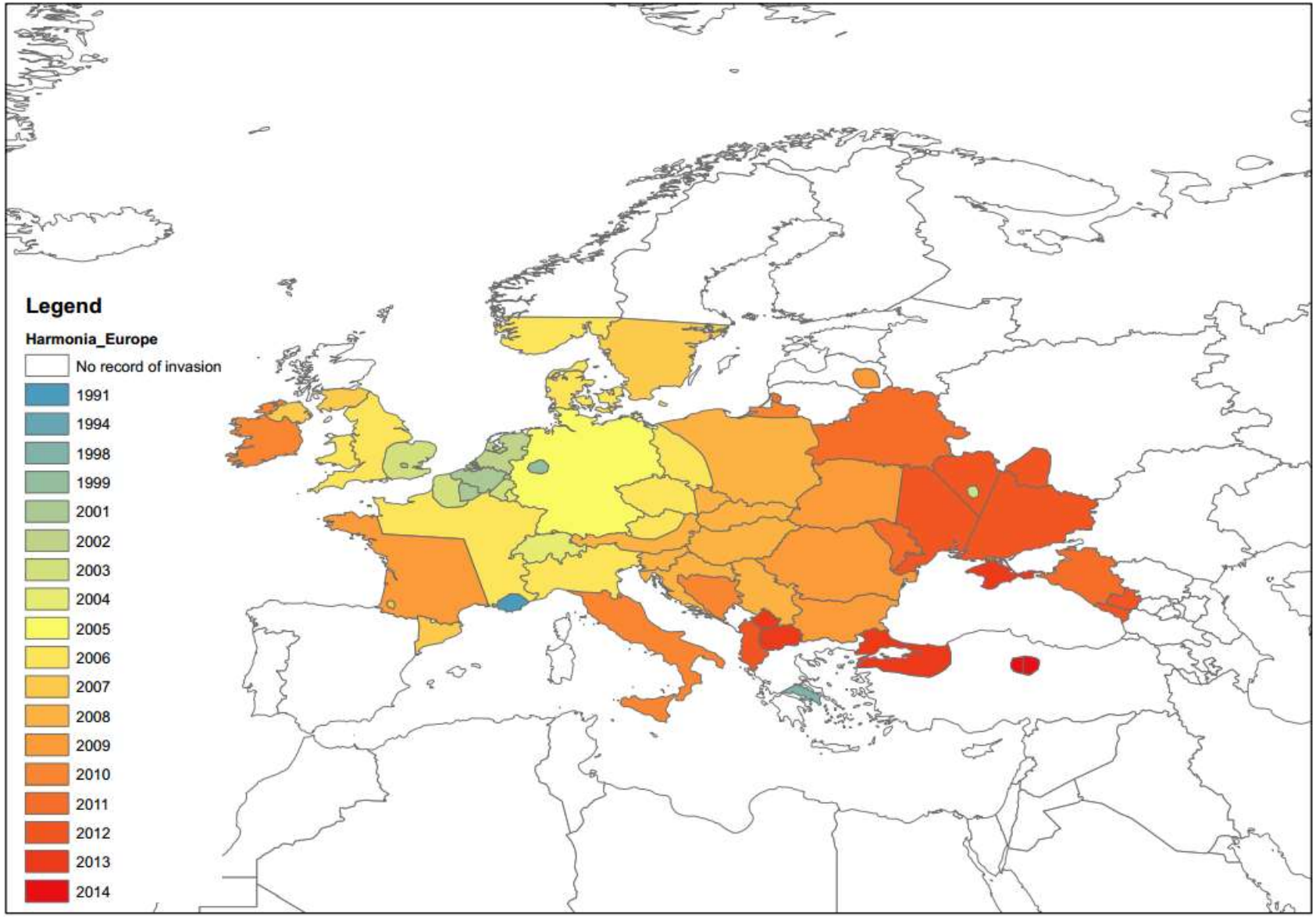


Fig. 2 European distribution of *H. axyridis*

Roy, Brown et al (2016) *Biological Invasions* 18: 997-1044

Citizen science approach

Image:
David
Moorman

Website 2005 / Smartphone app 2013

- Identification key
- GPS
- Photo submission

UK Ladybird Survey

Spread of harlequin ladybird (UK)

UK Ladybird Survey

BioControl (2008) 53:55–67
DOI 10.1007/s10526-007-9124-y

Harmonia axyridis in Great Britain: analysis of the spread and distribution of a non-native coccinellid

Peter Michael James Brown · Helen E. Roy · Peter Rothery · David B. Roy · Remy L. Ware · Michael E. N. Majerus

Verified harlequin ladybird records

Negative effects on other ladybirds (UK) (Brown & Roy, 2017)

Insect Conservation and Diversity (2017) doi: 10.1111/icad.12266

Native ladybird decline caused by the invasive harlequin ladybird *Harmonia axyridis*: evidence from a long-term field study

PETER M. J. BROWN[1] and HELEN E. ROY[2] [1]Department of Biology, Anglia Ruskin University, Cambridge, UK and [2]Biological Records Centre, NERC Centre for Ecology and Hydrology, Wallingford, UK

Abstract. 1. *Harmonia axyridis* (Pallas) (Coleoptera: Coccinellidae) is regarded as an invasive non-native species in Europe, where it has been spreading rapidly since the early years of the 21st century.

2. This study examines changes in ladybird communities at four sites (two lime tree sites, one pine tree site and one nettle site) in East Anglia, England, over an 11-year period (2006–2016) following invasion by *H. axyridis*.

3. Overall, *H. axyridis* represented 41.5% of all ladybirds sampled [varying

Negative effects on other ladybirds (Europe) (Roy et al., 2012)

A Journal of Conservation Biogeography

Diversity and Distributions, (Diversity Distrib.) (2012) 1–9

BIODIVERSITY RESEARCH

Invasive alien predator causes rapid declines of native European ladybirds

Helen E. Roy[1]*, Tim Adriaens[2], Nick J. B. Isaac[1], Marc Kenis[3], Thierry Onkelinx[2], Gilles San Martin[4], Peter M. J. Brown[5], Louis Hautier[6,7], Remy Poland[8], David B. Roy[1], Richard Comont[1], René Eschen[3], Robert Frost, Renate Zindel[3,9], Johan Van Vlaenderen[3], Oldřich Nedvěd[10], Hans Peter Ravn[11], Jean-Claude Grégoire[7], Jean-Christophe de Biseau[12], Dirk Maes[2]

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ABSTRACT

Aim Invasive alien species (IAS) are recognized as major drivers of biodiversity loss, but few causal relationships between IAS and species declines have been documented. In this study, we compare the distribution (Belgium and Britain) and abundance (Belgium, Britain and Switzerland) of formerly common and widespread native ladybirds before and after the arrival of *Harmonia axyridis*, a globally rapidly expanding IAS.

Location Europe

Methods We used generalized linear mixed-effects models (GLMMs) to assess

Calculating long term trends

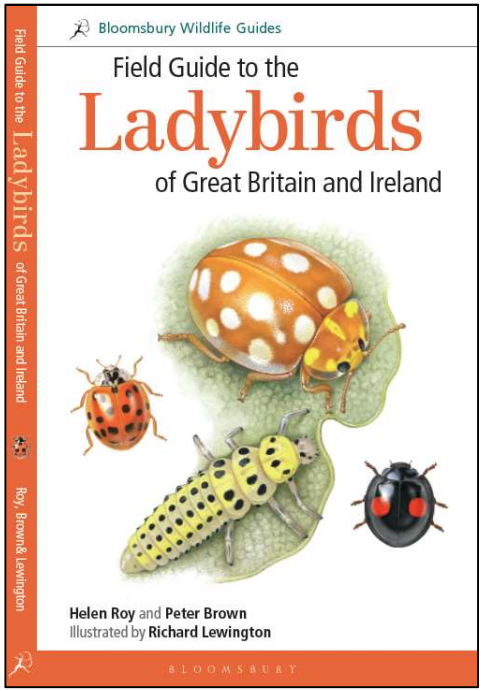
(UK ladybirds, 1995-2015)

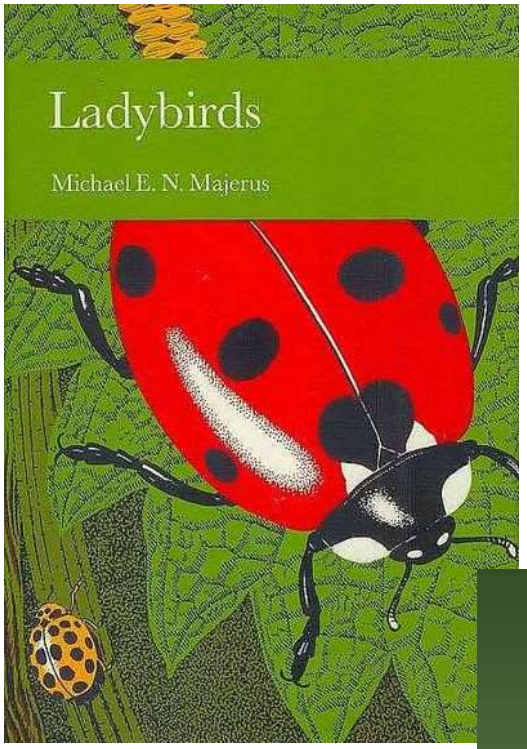
- Eight species declining
  - ***Adalia 2-punctata***
  - *Coccinella 7-punctata, Coccinella 11-punctata, Coccinella hieroglyphica, Psyllobora 22-punctata, Anisosticta 19-punctata, Aphidecta obliterata, Anatis ocellata*
- Two species increasing
  - ***Harmonia axyridis***
  - *Halyzia 16-guttata*

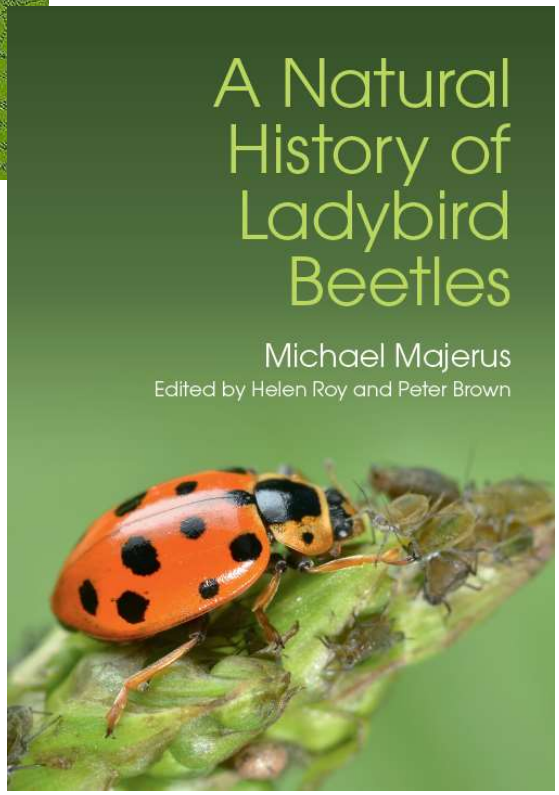
Orange ladybird © Nigel Downer

JNCC

Joint Nature Conservation Committee







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