



Integrated Science for Our Changing World: Invasive non-native species

Invasive non-native species are one of the top five threats to global biodiversity according to the United Nations Convention on Biological Diversity. These species are major drivers of change in biodiversity, threatening native species, transforming habitats and disrupting ecosystem functions. They can also be responsible for the spread of new diseases. Altogether, they are estimated to cost the UK economy £2 billion a year.

The Centre for Ecology & Hydrology (CEH) plays a key research role in developing solutions to tackle the problems caused by biological invasions. Its work at both the national and European level includes:

- [Monitoring and mapping the distribution of species
- [Determining their habitat requirements
- [Modelling the population dynamics of invasive species and the plant and animal communities they threaten
- [Predicting future trends and advising statutory authorities on control strategies

What is a non-native invasive species?

There is a general perception that our countryside, waterways and coastal areas are a mosaic of habitats made up predominantly of native species, whereas our gardens and parks are dominated by introduced species. In reality the situation is considerably more complex and although both indigenous and non-native species do coexist in many areas, sometimes the balance is disturbed.

In England alone 2,271 non-native species are believed to have established populations (www.nonnativespecies.org) and estimates suggest there are over 11,000 non-native species within Europe (www.europe-aliens.org). The majority exist in our ecosystems alongside native species with little or no impact.

Over the last three decades the climate across much of northern Europe has become warmer and a number of insect species have colonised Britain through natural dispersal and movement northwards without human intervention. The Small Red-eyed Damselfly *Erythromma viridulum* is just one in a succession of the many species that have arrived. The Collared Dove *Streptopelia decaocto* is another good example, not known to have bred in Britain before 1955 but now a familiar garden bird.



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Many other species have established themselves as a result of either accidental or deliberate introductions by humans.

Most of our plants growing alongside arable crops arrived with imported agricultural grain. A notable proportion of the familiar flora of lowland Britain, such as its trees and herbaceous plants, was introduced for ornamental or landscaping purposes.

The non-native Harlequin ladybird was also deliberately introduced – in this case to continental Europe, but notably not to Britain - for pest control reasons. However, Harlequins have flourished and find other native non-pest species an easy target. The Harlequin is an example of how a non-native, or “alien”, species can become invasive.

Such species pose significant risks to biodiversity and ecosystems by:

- [Directly competing with native species and sometimes excluding species occupying a similar ecological niche
- [Changing the genetic character of native species through cross-breeding
- [Carrying new diseases which can spread to native species and even to humans
- [Changing the character and functionality of land by altering habitat structure

It is because of these risks that the UK Government has published an Invasive Non-Native Species Framework Strategy. This sets out requirements for surveillance, monitoring and research requirements – with the aim of informing regulation to minimise risks and advise on mitigation, control or eradication measures.

Biological Records Centre



The Biological Records Centre (BRC) at CEH, co-funded by the Joint Nature Conservation Committee, is the national focus for biological species recording in the UK. The BRC establishes and supports recording schemes that represent experts (usually volunteers) and special interest organisations throughout Britain and Ireland. Most information collected by the BRC network of recording schemes and societies is published via the National Biodiversity Network (NBN), in which CEH is a key partner. The NBN Gateway uses this and other data to provide access to a wealth of species distribution information.

DAISIE

CEH manages a European Commission project called Delivering Alien



Invasive Species Inventories for Europe (DAISIE). The project aims to create an inventory of invasive species that threaten European terrestrial, freshwater and marine environments.

Central to DAISIE is a website, which offers a “one-stop-shop” for information on biological invasions in Europe (www.europe-aliens.org). It documents the invasion of over 11,000 non-native species across the continent. DAISIE assesses the ecological, economic and health risks and impacts of the most widespread and/or harmful invasive species, publishing a list of “100 of the worst” in Europe on the website. The reliable, detailed information DAISIE provides is an essential tool for preventing the spread and impact of invasive non-native species, and for applying effective and appropriate control strategies.



Photograph - Shutterstock

Japanese Knotweed *Fallopia japonica* is on DAISIE's list of “100 of the worst” invasive non-native species in Europe

Almost 40 million records from around 15,000 species are available, including data for more than 2,000 non-native species.

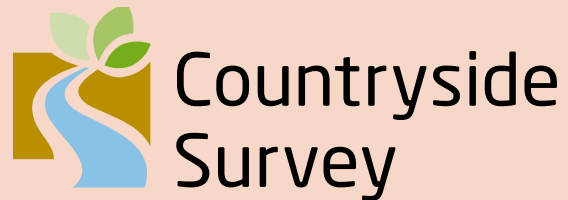
BRC leads a project funded by the Department for Environment, Food and Rural Affairs (Defra) which is developing the online GB Non-Native Species Information Portal (www.nonnativespecies.org). Partners in the project are: the Non-Native Species Secretariat, the British Trust for Ornithology and the Marine Biological Association. The project represents a key element in the UK's strategy for invasive species and enhances the ability to anticipate arrivals, respond rapidly to aggressive invasions and deliver information to stakeholders. Engaging the public in monitoring non-native species is essential to the success of the project. BRC in collaboration with the NBN is helping to develop online recording for a number of the most invasive species to assist with this aim.

Countryside Survey

The Countryside Survey is a unique "audit" of the British countryside's natural resources. Carried out at regular intervals since 1978, the Survey has two main components: the Field Survey and the Land Cover Map. CEH coordinates the Survey on behalf of a partnership of funding bodies led by the Natural Environment Research Council (NERC) and Defra.

By sampling and analysing areas of the countryside using rigorous scientific methods, and comparing results from earlier surveys, CEH can detect gradual and subtle changes that occur over time – including increases in the types, quantity and distribution of non-native plant species.

The Survey enables scientists (many from CEH) to study the causes of these changes and how they may affect the UK's ecosystem functions and services. This research provides vital evidence which enables policy-makers and land managers to address the environmental, social and economic challenges of providing a sustainable countryside.



www.countryside-survey.org.uk



Photograph - © NERC

Surveyors at work, Scotland

Harlequin Ladybird Survey

Britain has 43 native species of ladybird, Coccinellidae, some of which are important natural predators that help control crop and garden pests such as aphids. In 2004, the Harlequin ladybird *Harmonia axyridis* first appeared in south-east England and has spread at a staggering rate, reaching Orkney by 2008. While the Harlequin feeds on pest insects, it has also been observed feeding on insects that are beneficial to our ecosystems including the larvae of native ladybirds. It is predicted to become a serious threat to Britain's biodiversity, possibly threatening over 1,000 native species. In 2005, CEH launched the innovative web-based Harlequin Ladybird Survey (www.harlequin-survey.org), encouraging members of the public to submit sightings with photographic evidence.

The Harlequin survey has received more than 30,000 records, helping scientists to track this biological invasion with great accuracy. Public involvement has been crucial to its success. The Harlequin survey data, together with experimental work at CEH and collaborating organisations, is enabling scientists to explore ways to understand and predict the impact of this invasive species.



Scientists are also exploring natural control measures and the Harlequin survey will be vital to testing the effectiveness of these. The research associated with the Harlequin survey has a leading, international reputation.

This survey is considered a model system for studying invasive species and its success is recognised by Defra, which has commissioned a project led by CEH in partnership with the NBN to develop and launch six new invasive species surveys based on this one. The new project is anticipated to help invigorate biological recording for other species with the aim of attracting a similar public response to the Harlequin Ladybird Survey and the UK Ladybird Survey, which have received more than 70,000 records in total.



Photograph - N Greatorex-Davies

Disease-Carrying Mosquitoes

An area of concern amongst scientists is how the changing climate will affect the range expansion of disease-carrying species such as mosquitoes and biting midges. Although the UK is currently at relatively low risk of mosquito-borne diseases, new research coordinated by CEH will provide vital baseline data to understand the current distribution of mosquitoes and biting midges, which can then be compared to data gathered in the future to understand change. By developing a nationwide infrastructure to monitor these insects and models to predict future trends, CEH science will help the Government and health agencies to prevent outbreaks of disease.



Asian tiger mosquito *Aedes albopictus*, a potential invasive species

Photograph - Shutterstock

Aquatic Weeds

Scientists at CEH are studying non-native aquatic plants that have escaped into the wild from gardens and caused significant economic and environmental damage. Floating Pennywort *Hydrocotyle ranunculoides* is a prime example. Imported from Argentina in 1985, it escaped to the wild in 1987 and has now spread to over 120 sites, including a 55-km stretch of the River Soar in Leicestershire. By studying the Pennywort's ecology and physiology, CEH scientists have discovered that its rate of growth and ability to adapt to changing environmental conditions are at the root of its success in Britain. By determining what causes these non-native species to thrive, it is possible to develop more effective strategies to control them.

CEH also provides expert advice to organisations around the world. In 2008, there were many hundreds of downloads from the CEH website (www.ceh.ac.uk) of guides to best practice for controlling invasive aquatic plants. Together with colleagues in the Netherlands, CEH also coordinates EUPHRESKO (www.euphresco.org), a European project to boost European plant health research.



Photograph - M Duenas

Floating Pennywort *Hydrocotyle ranunculoides* forms a dense mat on the River Soar in Leicestershire

Looking Ahead

Invasive non-native species are a major cause of biodiversity change. Ecological research is essential in helping the Government to tackle the problem. CEH will be focusing on the development of the GB Non-Native Species Information Portal to assist the UK Government in meeting its obligations under the Convention for Biological Diversity. Surveillance and rapid reporting are seen as critical components of strategies dealing with invasive non-native species as they enable new arrivals to be rapidly detected and the risk they pose to be assessed. The volunteer recording community and the public are key to achieving this and CEH will be working to further engage these sectors. CEH will also be continuing to develop ecological models which encompass climate and habitat parameters to assist in predicting distributions and impacts of invasive non-native species.



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