



Department  
for Environment  
Food & Rural Affairs



Llywodraeth Cymru  
Welsh Government



## Progress with Weed Biocontrol Projects

CABI - UK

November 2022

**Cover image:** Monitoring weevil activity on floating pennywort at Pevensey Levels, E. Sussex

## Introduction

Since April 2011, Defra in partnership with the Welsh Government and Natural England has been funding specialist scientists to investigate the scope for biological control (biocontrol) of invasive, non-native aquatic and riverside weeds. Additional financial support for this research has been provided by the Environment Agency, the Canal & River Trust, private water companies, the Ministry of Defence, and a number of Wildlife Trusts and Local Authorities (\* see also footnote for additional funders). Biocontrol has the potential to play an important role in protecting aquatic and riparian habitats where chemical and mechanical control options are impractical or prove to be prohibitively expensive. This will help to meet statutory and policy commitments, both at a UK government level and within the Devolved Administrations (DAs). This control method is already providing sustained and highly successful management of the invasive non-native water fern *Azolla filiculoides* through *Stenopelmus rufinasus*, a weevil native to the Americas which was introduced into the UK together with the weed.

CABI is targeting **Australian swamp stonecrop** (*Crassula helmsii*), **Himalayan balsam** (*Impatiens glandulifera*), **floating pennywort** (*Hydrocotyle ranunculoides*) and **parrot's feather** (*Myriophyllum aquaticum*), and these projects complement our on-going work on the biocontrol of **Japanese knotweed** (*Reynoutria (Fallopia) japonica*). Following a Natural England-funded stakeholder workshop to prioritise new species for biocontrol research, jointly led with CABI, very early-stage research into possible biocontrol approaches for **Tree of Heaven** (*Ailanthus altissima*), **buddleja** (*Buddleja davidii*) and **rhododendron** (*Rhododendron ponticum*) has begun. Natural England has also funded CABI to undertake a feasibility study for the biocontrol of *Elodea nuttallii* and *E. canadensis*, and to make an assessment of natural enemies for *Carpobrotus edulis* biocontrol. CABI is also mass-rearing and supplying the **water fern** weevil, for early season inoculation of infestations of the weed, to ensure ongoing biocontrol. The release and planting out in the wild of any of these species in the UK is an offence due to their highly invasive nature. This is the 15<sup>th</sup> in a series of annual summary notes on progress made and covers the time frame from May to the end of November 2022. <http://www.invasive-species.org/united-kingdom/>

## Japanese knotweed (*Reynoutria japonica*)



Releases of the Kyushu line of the psyllid *Aphalara itadori* (from 2010 onwards) demonstrated safety, and reproduction was observed on *R. japonica* at several release sites, with some overwintering recorded; however, long-term establishment and persistent overwintering have proved elusive. To tackle these issues, better climatically-matched psyllid cultures, which were observed to cause extensive and severe leaf-curling damage in Japan, were collected from Murakami, further north in Japan. Host-specificity testing showed that the Murakami line is also a specialist on Japanese knotweeds.

Defra approval for release of the Murakami psyllid line was obtained in 2021 and the line was released at one *R. japonica* and *R. x bohemica* site, respectively, during the summer. Field monitoring showed curling damage on plants at both of these sites during the season, being particularly heavy at the *R. x bohemica* site where overwintered adults were found in spring 2022. The psyllid releases were undertaken at the same sites this year and monitoring is currently underway. Studies of the leaf-curling on *R. x bohemica* highlight its role in promoting nymphal survival. The Murakami psyllid was also released in the Netherlands and Canada in 2022, and field results are now being shared between all countries. The Kyushu psyllid line was released at *R. japonica* sites in north-east England for the Tees Rivers Trust in this spring and persistence over the summer will be assessed.

The leaf-spot fungus *Mycosphaerella polygoni-cuspidati* has been under evaluation for use as a mycoherbicide as studies showed that the pathogen can cause restricted disease symptoms on selected non-target plant species under quarantine conditions and is thus not suitable for classical biocontrol. Basing a potential mycoherbicide on a single-mating type isolate would prevent reproduction, persistence and spread of the fungus in the field and allow for targeted applications. A European patent held in the name of the Secretary of State protects the idea with registration in twelve individual countries; further international patent applications are pending. Following Defra approval for release from quarantine, CRD-licensed experimental field trials were conducted with the agent at CABI, Egham from 2019 to 2021. Collated trial data show that the agent can infect Japanese knotweed and, to a lesser extent Bohemian knotweed, under more natural conditions. Higher ambient temperature and lower relative humidity have an adverse effect on disease development. Results also indicate that early season application of the agent leads to better disease development due to higher susceptibility of the plants. Methods to retain agent virulence *in vitro* have been established as a prerequisite to achieve good performance of the agent in the field. Re-newed collaboration with private industry is currently being explored and it is hoped that ultimately a product can be developed to control Japanese knotweed which would be applied in much the same way as a herbicide but without side effects.



## Floating pennywort (*Hydrocotyle ranunculoides*)

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The weevil, *Listronotus elongatus*, was granted Ministerial approval for release into the wild in September 2021. A shipment of weevils was subsequently received from collaborators in Argentina, to build up a culture for preliminary overwintering assessments. The results of these studies have been encouraging, with weevils surviving and new generations developing with the onset of warmer spring temperatures. A second shipment of weevils was received in May 2022 and mass rearing began in earnest to provide for the start of the wider release program across England.

From July to September this year, and with support from a range of sponsors, a total of 2330 weevils were released across 12 sites in England. A comprehensive monitoring program is now underway to assess subsequent weevil activity and impact at all sites, as well as assessing any impacts on neighbouring non-target plants. Whilst the trials are still in their infancy, preliminary results have been very promising. At the earliest release sites, at Pevensy Levels and in the Colne Valley, weevil feeding and larval mining was recorded up to 35 metres from release points, both upstream and downstream. Mats of pennywort with high weevil loads were found to have reduced growth and collapsed stems. At all other sites, consistent evidence of weevil feeding and reproduction was observed beyond the release point, with some initial areas of mat collapse where weevils had had the most suitable conditions and time to establish. Further monitoring will take place in spring 2023 to assess potential establishment and impact across existing sites. Weevil maintenance will continue over the winter months and collaborator and sponsor engagement will be sustained to build momentum for future release opportunities.

## Himalayan balsam (*Impatiens glandulifera*)

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A strain of the Himalayan balsam rust fungus *Puccinia komarovii* var. *glanduliferae* from India, was approved for release into the wild in the UK in July 2014. However, due to the presence of rust-resistant populations, an additional rust strain from Pakistan, which was found to infect a different subset of Himalayan balsam populations, was approved for release in 2017. The rust has been released widely in England and Wales and since 2020, has been released in Scotland.

Pre-release susceptibility testing, to ensure the most virulent and pathogenic strain is released at each site, and an updated release strategy involving working with Local Action Groups across the country, has significantly increased infection levels in the field. The results of the field releases are encouraging; the rust has established at numerous sites, successfully overwintered with the development of good levels of leaf infection during the following growing season and spread naturally by wind more than 100 metres.

The rust continues to be released at compatible sites, however, in order to counter the presence of resistant populations and achieve full control, additional rust strains are required. Key regions in the native range harbouring strains more likely to be fully compatible with UK populations were identified through a molecular analysis. Collaborators in Pakistan surveyed these key areas for new rust strains in 2021 and 2022 and exported rust-infected plant material from three sites to CABI's quarantine laboratories. Once established, the pathogenicity and virulence of the new strains will be assessed towards non-susceptible Himalayan balsam populations under quarantine conditions.

## Water fern (*Azolla filiculoides*)



Water fern again survived the winter well into 2022 and demand for the Azolla weevil, *Stenopelmus rufinasus*, which is mass reared at CABI, was high all season with shipments continuous over the summer. Pre-orders for 2023 are already being received. *Stenopelmus rufinasus* feeds specifically on Azolla and in high densities can cause local eradication of the weed. In addition, Azolla infestations are frequently brought under effective control by naturalised populations of the weevil, particularly in regions that have recently received significant weevil introductions, demonstrating the valuable underlying control exerted by this effective agent. By targeting Azolla outbreaks in a timely manner, it is possible to limit impacts and preserve the biodiversity of freshwater ecosystems. CABI recently published an assessment of the value of Azolla biocontrol by *S. rufinasus*, which was estimated to be worth up to £16.8 million annually in management cost savings (<https://doi.org/10.1186/s43170-022-00136-0>). [www.azollacontrol.com](http://www.azollacontrol.com)

## Australian swamp stonecrop (*Crassula helmsii*)



The gall-forming mite, *Aculus crassulae* (Eriophyidae) was approved as a biocontrol agent against *Crassula helmsii* in August 2018. Field release trials with the mite were initiated in September 2018 with support from water industry and Natural England. The mites have now been released across England and Wales with support of further sponsors.

Mass-rearing for summer release began early in 2022 in CABI's propagation facility and polytunnel. The record-breaking extreme temperatures of summer 2022 affected mass-rearing efforts with *C. helmsii* plants and mites unable to cope with long periods of high temperatures. Despite this, mites were released at 12 sites in England and Wales in 2022, this included supplementary releases at four of the 2021 sites and at seven new sites.

At the release sites, mites have been observed infesting plants within and close to release plots, and the number of mite-infested plants has generally increased over the course of the summer. Mites have also overwintered at several field sites where conditions are suitable. Efforts are now needed to increase the population density of mites at release sites to enable establishment and subsequently, impact. More release sites are being taken on as the understanding of the habitat requirements grows.

## Parrot's feather (*Myriophyllum aquaticum*)



Following an initial feasibility study to assess its potential for biocontrol in 2021, parrot's feather is now under experimental evaluation for biocontrol in the UK. A leaf-feeding beetle, *Lysathia* sp., which has previously been released in South Africa and provides good control of parrot's feather there, was imported from South Africa in September 2021. Safety testing and life-cycle studies with this beetle continue in CABI's quarantine laboratories. The quarantine assessments, conducted in coordination with CABI's Swiss centre who also have a *Lysathia* sp. culture, are being undertaken to establish the beetle's potential host range in the field.

Collaboration has been established with the Fundación para el Estudio de Especies Invasivas (FuEDEI) in Argentina, where parrot's feather originates. Scientists at FuEDEI have recently been investigating the stem-mining weevil *Listronotus marginicollis* which has potential as a biological control agent against parrot's feather and CABI has initiated the permit and import process to obtain a culture of the weevil from FuEDEI.

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