



Department
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Food & Rural Affairs



Llywodraeth Cymru
Welsh Government



Progress with Weed Biocontrol Projects

CABI - UK

March 2023

Cover image: Sonal Varia and representatives from the North Wales Wildlife Trust and Dwr Cymru (Welsh Water) scoping a potential *Crassula helmsii* site near Conwy, North Wales

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 16th in a series of annual summary notes on progress made and covers the time frame from December 2022 to the end of March 2023.

Website: <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 the safety of this agent. 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 proved 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 one *F. x bohemica* site during the summer. The psyllid releases were undertaken at the same sites in 2022 and field monitoring showed characteristic curling damage on plants at the *F. x bohemica* site during the season, where overwintered adults had been found in the spring. Field experiments showed that leaf-curling on *F. x bohemica* promoted nymphal survival and predation did not cause significant psyllid mortality. The Murakami psyllid was also released in the Netherlands and Canada, and field results are now being shared between all countries.

The leaf-spot fungus *Mycosphaerella polygoni-cuspidati* has been under evaluation for use as a mycoherbicide as studies showed that under quarantine conditions the pathogen can cause restricted disease symptoms on selected non-target plant species; the agent is thus currently not considered 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. 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. Early season application of the agent tends to lead 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 to control Japanese knotweed can be developed which would be applied in much the same way as a herbicide but without the non-target species side effects.

Floating pennywort (*Hydrocotyle ranunculoides*)



The first field trials with the weevil, *Listronotus elongatus*, began in late 2021 following ministerial approval for release into the wild. With support from a range of sponsors, including the Environment Agency, Canal and River Trust and Yorkshire Water, weevils were mass reared throughout spring and early summer of 2022 allowing releases to be made at 13 sites across England, from Sussex to Yorkshire.

Monitoring at all sites has provided an excellent insight into the weevil's potential to impact floating pennywort. Where early season releases were made and in the warmer more southerly release sites in particular, several generations of weevils were achieved. This was associated with significant local impact, mat collapse and weevil spread up and downstream over a distance of 20-35 metres.

Visits to almost all sites have been carried out in March 2023 to assess the overwintered floating pennywort populations and many have been found to be significantly reduced, if not absent. Plant populations have undoubtedly been affected by the cold weather this winter, but the weevil impact over the summer and autumn may have further compromised their survival.

It may take a few years for weevils to establish self-perpetuating populations that can bring the plant under control year on year but even after one season of releases, the weevil's potential to mitigate pennywort growth is encouraging. The release programme will continue in 2023/24, with new sites identified in different geographic regions. Further monitoring will take place across all existing sites in summer 2023, with potential to top up numbers and crucially, to determine if the weevils have persisted and can continue to impact the plant.

Himalayan balsam (*Impatiens glandulifera*)



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 areas in 2021 and 2022 and exported rust-infected plant material from three sites to CABI. One strain of the rust collected from the Astore District, Gilgit-Baltistan, Pakistan has since been established under quarantine conditions. Work is underway to determine the pathogenicity and virulence of this new strain towards UK Himalayan balsam populations. If found to infect a different cohort of populations, host-range testing against a number of closely related *Impatiens* species will be conducted. Subsequently, approval to release the strain from quarantine will be sought and, where possible, the rust released at field sites in the UK.

Water fern (*Azolla filiculoides*)



Water fern was widespread in 2022, with a significant number of weevil shipments completed. Despite a relatively cold winter, pre-orders for 2023 are being received at a steady rate as new or persistent *Azolla* infestations are observed. *Stenopelmus rufinusus* 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. rufinusus*, 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>).

Website: 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.

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. At sites where the mites have been present for longer, mites have started to spread up to 35m beyond the release plots. Mites have been recorded overwintering 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. Further releases will take place in summer 2023 at new and existing sites.

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 with this beetle continues 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. The UK research is focused on biocontrol potential for the UK, while the Swiss research is for North America.

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 in 2023.

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*Footnote: Prior to 2011, funding for this research has also been provided by the Scottish Government, predecessor bodies of the Welsh Government, Network Rail, Cornwall Council, the Regional Development Agency of South West England