Biological control of *Crassula helmsii*

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Classical Biological Control

- Use of co-evolved, highly specific natural enemies (e.g. insects, mites, pathogens) from the area of origin of the pest, to provide self-sustaining control, often after a single release

- Some spectacular successes, returns on investment in research can be phenomenal

- International code of conduct, rigorous safety testing

- 2000 releases globally, 224 weeds & 552 agents
- Only 4 intentional releases in Europe to date
The theoretical process

Graph courtesy of APHIS
• Water Framework Directive funding kick-started control programme in 2011
• Surveys carried out in Australia – eriophyid mite, *Aculus crassulae* had the most potential as a biocontrol agent
Australian natural enemy surveys
**Aculus crassulae**

- Distribution: Victoria, Australia
- Mites colonise shoot tips forming big bud galls
- Short life cycle -14 days at 22°C
- Feeding causes abnormal growth – studies show infected plants are 50% smaller than control plants
- Shoot tips of terrestrial and emergent plants affected.
- Host range: very narrow
Plants exposed to mites for 42 days

Plants exposed to mites are significantly shorter and have less and shorter side shoots.
Safety testing

- Test plant list consists of 40 species
- 31 species in the Saxifragales order
- 10 species that share the same habitat as *C. helmsii*
- 6 *Crassula* species, including 2 natives
- Reviewed by expert botanist (NHM)
- Many rare/vulnerable/scarce plants
- Plants are exposed to mites and monitored for symptoms over a 6 week period

*Crassula tillaea*  
*Crassula aquatica*
Pest Risk Analysis - PRA

- 4th BCA under consideration in Europe
- Used EPPO template for assessing pest risk
- Includes host range testing, establishment potential, biology, impact of Crassula
- Overseen by Defra plant health officials
- Reviewed by numerous groups
- Ministerial approval June 2018
- Licence August 2018
Release sites

- Mite released at 3 sites in autumn 2018
- Releases sponsored by SWW, YW & NE
- 2 reservoirs & 1 wetland
- More sites for 2019
- Require emergent/terrestrial Crassula growth

**Licence requirements:**
- Defra releaser’s licence for biocontrol agent
- NE release of non-native species licence
- Site specific documentation (HRA, SSSI notice)
- Release and monitoring plan
Mass rearing *A. crassulae*
Release technique

- Transplant infected material directly into Crassula population
- Take note of water levels/ Crassula condition
- Overwintering assessment in spring
- Monitor infection and spread of mite
- Continual release over growing season
- Assess changes in Crassula and neighbouring vegetation
Overwintering study

- Investigation into mite survival through winter period
- 2 treatments – exposed and sheltered
- Regular assessments to assess mites and plant survival
Impatiens glandulifera - Himalayan balsam

- Biocontrol project was initiated in 2006.
- Extensive natural enemy surveys in the native range (India & Pakistan) revealed a rust fungus (*Puccinia komarovii* var. *glanduliferae*) as best candidate.
- Rust was approved for release into the wild by UK gov. (after extensive safety testing) in 2014.
- Good rust infection with some spread within the field plant populations observed; although infection inconsistent between sites and overwintering at a few sites.
- Molecular analysis of UK and native range populations found plant introduced at least 3 times to UK: multiple rust isolates required: currently 2 released (India and Pakistan).
- Aiming to source a third isolate in 2019.
HYDROCOTYLE RANUNCULOIDES – floating pennywort

- Part of WFD suite of projects funded by UK government (2011-2020)
- The weevil, *Listronotus elongatus* prioritised.
- Safety testing nearly complete, some non-target feeding, more experimentation to be carried out
- Pest Risk Assessment submitted to Non-native biocontrol licensing group (Defra) in 2017 for the weevil
- Funding extended to address specificity and establishment questions before resuming peer review process. Research on thermal threshold of weevils and realised risk to rare natives ongoing in Argentina and UK respectively (weevils permitting)
**AGENT:** *Aphalara itadori* (psyllid ex. Japan)

**TARGET:** *Fallopia japonica*

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**Fallopia japonica - Japanese knotweed - psyllid**

- **Safety:** host range testing (87 European plants). Highly specific to JK. No effects on native invertebrates in cage and field
- **Impact:** sap-sucking insect. Reduce height and rhizome weight in lab and field cages (Clewley 2014)
- Successful overwintering 2016-17 at sites in Swansea, Surrey, Cornwall, County Durham
- Still working for consistent field establishment
- Linked with EU RAPID LIFE project 2017-20
**Fallopia japonica** - Japanese knotweed – leaf spot pathogen (*M. polygoni-cuspidati*)

- Not considered as a classical agent due to potential non-target impact
- Potential as a mycoherbicide due to pathogen’s genetics and biology
- UK and International patents in the name of the Secretary of State/Defra
- Proof of concept research for mycelial inoculum under way
- Looking for partnership with industry/ SMEs
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