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The regulation of biological control of weeds in Europe – an evolving landscape*

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After a difficult start, classical biological control of weeds is becoming recognized as an option for management of invasive plants in European Union (EU) Member States with intentional releases in three countries over the past 5 years. Many European countries are benefitting from the presence of *Stenopelmus rufinasus*, the azolla weevil, which has been accidentally introduced to the region. However, the UK experience with the official release of the psyllid *Aphalara itadori* against Japanese knotweed (*Fallopia japonica*) and the subsequent release of the rust *Puccinia komarovii* var *glanduliferae* against *Impatiens glandulifera* showed the regulatory framework that could be followed by EU Member States. This process was followed in advance of the subsequent release of *Trichilogaster acaciaelongifoliae*, a specific Australian bud-galling wasp, against the invasive *Acacia longifolia* in Portugal. Soon the case of *Ophraella communa*, another accidental introduction that is severely limiting *Ambrosia artemisiifolia* populations, will influence affected countries, some of which have been uninterested in this technique until now, to consider the advantages and disadvantages of classical biocontrol. The future looks bright for classical weed biocontrol and the EU Regulation on Invasive Species should further aid this situation.

Introduction

All signatories to the Convention on Biological Diversity (CBD) have an obligation to 'prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats and species' (Decision VI/23 in 1992). As part of this, the CBD emphasizes the need to invest in research and assessment of biological control as a control option. In addition, the European Strategy on Invasive Alien Species (ESIAS) was launched in 2003; this supports the CBD and calls for a regional approach to the problem. The ESIAS also highlights the need for cost–benefit analyses of long-term control measures. The European Regulation on Invasive Species subsequently entered into force on 1 January 2015 (Regulation (EU) No. 1143/2014), and this requires that 'management measures shall consist of lethal or non-lethal physical, chemical or biological actions aimed at the eradication, population control or containment of a population of an invasive alien species' (Article 19, 2). Thus, it would seem that conditions have improved for the expansion of classical biocontrol of weeds in Europe: exotic weeds are amongst the most problematic of invasive species but are amenable to biological control (McFadyen, 1998) and biological control has a good history of success (Clewley *et al.*, 2012) and performs well under cost–benefit analyses (Jetter, 2005).

When one considers the scale of classical biocontrol efforts against insect pests around the globe and the world-leading biological pest management strategies implemented in European covered crops (Minks *et al.*, 1998; Eilenberg *et al.*, 2000), it is surprising how little effort has been targeted at European weeds, especially given the long list of potential targets (Sheppard *et al.*, 2006). No officially sanctioned complete classical weed biocontrol programme had been carried out in any EU Member State, although there was a small-scale project conducted against *Cirsium arvense* (L.) Scop. This appeared to be a caged over-wintering study, but as reported by Baker *et al.* (1972), although the initial releases in 1969 of hundreds of adult *Haltica carduorum* Guerin beetles from France were made into field cages, the cages were removed later in the study. The eventual results of this 'field release' were similar to those encountered in Canada, with no successful survival over winter (Peschken *et al.*, 1970).

Pteridium aquilinum

There were efforts made in the late 1980s against bracken, *Pteridium aquilinum* L. (Kuhn), a major problem for

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livestock-based extensive agriculture, conservation, recreation, game management and forestry, which also has direct and indirect impacts on livestock and human health in the UK. A biological control programme was initiated in 1988 (Fowler, 1993), but the target was always going to be a controversial one as it is a native species: the fact that host-specific natural enemies had been found in South Africa that were not present in the UK, coupled with the apparent conservation value of bracken (Pakeman & Marrs, 1993), meant that obtaining authorization for release was always going to be a challenge. After the research phase was completed it was challenging to find out which department would be responsible for the licensing of the agent, the former Ministry of Agriculture Food and Fisheries or the Department of Environment. In the end a decision was made to authorize a large quarantine field cage release that was so prohibitively expensive it was impossible to achieve and the release never took place. Interestingly the loss of registration for Azulox in October 2014 means that there are few tools left for the management of bracken and the results of the biocontrol programme may be of interest again. Nonetheless bracken was not the best first target for biocontrol in the UK or the EU.

Azolla filiculoides

Currently European nations are only benefiting from accidentally introduced agents such as *Stenopelmus rufinasus*, which is cultured over winter for mass production and sale and redistribution in the UK. In this case the agent is considered 'ordinarily resident' as it has been repeatedly recorded in the field since the 1920s (Janson, 1921). It is an interesting example as it is serving as a useful introduction to weed biocontrol for northern European nations including France, Belgium and the Netherlands and was one of the demonstration targets for a recent InterReg RINSE project (see http://www.rinse-europe.eu). A similar situation exists in Spain, where the well-known cochineal insect *Dactylopius opuntiae* is having significant impact on the invasive opuntia in Espadán and Calderona Natural Parks and there is considerable demand for its redistribution (Del Toro La Generalitat Valenciana, ES, 2015, pers. comm.). This situation is not ideal since the lack of a clear licensing process increases the incentive for unauthorized releases. It was therefore crucial that a clear licensing process was established and tested, and the Japanese knotweed project in the UK provided this service.

Fallopia japonica

After many years of research and safety testing against 89 plants selected on a centrifugal phylogenetic basis, the psyllid *Aphalara itadori* Shinji was chosen as the most appropriate agent from the 186 insects and more than 40 fungi considered (Shaw *et al.*, 2009). Discussions began with the various government departments over how licensing would proceed. It was concluded that as an organism likely to be injurious to plants in the country of introduction then it should be considered under plant health legislation (EC Directive 2000/29/EC). Organisms which are potentially harmful to plants and which do not normally occur in Great Britain are regulated by the Plant Health Order (2005) made under the Plant Health Act 1967. This was informed by the completion of a modified version of the European and Mediterranean Plant Protection Organization (EPPO) Pest Risk Assessment scheme. The successful completion of this process, which revealed a low risk, could only free the organism from the Plant Health Quarantine License under which it had been contained since first import. In order to actually release this biological control agent it was necessary to carry out an assessment under the Wildlife and Countryside Act, which effectively bans the release of organisms into the wild and requires licenses for those who wish to do so. There then followed some further peer review and a public consultation prior to ministerial decision and the awarding of a release license.

(1) Production of a pest risk analysis (PRA) under the plant health regime;
(2) Application for a licence under the Wildlife and Countryside Act 1981 (WCA) – review by regulators including standard consultees and departments as well as an independent review by the Advisory Committee on Releases to the Environment (ACRE);
(3) Independent peer review of the PRA and the WCA application by biocontrol experts;
(4) Public consultation on a summary of the PRA (plus ACRE comments and peer review synthesis report) – 3 months;
(5) Licensing decisions;
(6) Ministerial clearance;
(7) Issuing of license with contingency requirements in both England and subsequently in Wales.

In addition, because the release of the pysllid would be the first official intentional release of a non-native biological agent to control an invasive plant in an EU Member State, officials of the Department for Environment, Food and Rural Affairs (Defra) kept EU authorities informed under the EC Plant Health Regime (Directive 2000/29) and EC Habitats Directive, (Directive 92/43/EEC), in accordance with Article 22b. EPPO was also kept informed.

It could be said that the UK experience represents a rather extensive and comprehensive approach, and this is understandable given the novelty of the activity – at least in Europe. It was made clear at the time that some of the additional steps outlined above were not intended to set a precedent for future releases but were seen as useful in reassuring the public and their representatives that a cautious approach was being taken. For example, this is the first weed biocontrol release in the world to have had a contingency plan attached to it.

Impatiens glandulifera

Since the knotweed psyllid there has been another release in the UK, namely a rust fungus, *Puccinia komarovii* var *glanduliferae*, against *Impatiens glandulifera* (Tanner *et al.*, 2015) which followed a similar approach, but with two significant differences. As it was not an animal the Wildlife and Countryside Act did not apply. Secondly, at the point of informing the Standing Committee on Plant Health (SCOPH), the Committee was minded to pass the application to the European Food Safety Authority (EFSA) for further assessment as the PRA only considered the UK as the area of introduction. The team involved was able to rewrite the PRA to cover the whole of the EU, and at their next meeting the SCOPH was happy to accept the proposal for release and this went ahead in 2014.

Acacia longifolia

The third of the trio of official releases occurred in Portugal, where again there is no specific legislation about the introduction of exotic biological control agents for the control of invasive plants. Portuguese law, through Decree-Law No. 565/99, forbids the intentional introduction of alien species into the wild (with exceptions for agriculture, horticulture, etc.). Partially based on this regulation, but with the consultation of the phytosanitary authorities and the European Commission, the first permit to introduce the agent was obtained in July 2015: *Trichilogaster acaciaelongifoliae* (Froggatt), a specific Australian bud-galling wasp, was permitted against the invasive *Acacia longifolia* (Andrews) Willd.

In 2003 an application for introduction into quarantine was submitted to Portuguese national authorities for nature conservation (then ICN). For this, a dossier with biological information (biology, host-specificity tests, etc.) was prepared and a list of species for host-specificity testing including 40 non-target species was used. In 2004 the permit to perform the host-specificity tests in quarantine was granted. Female *T. acaciaelongifoliae* were obtained from South Africa (where the same biocontrol agent has been used for more than 30 years) and tests were performed in September to December each year from 2005 to 2010 (Marchante *et al.*, 2011).

The promising results obtained encouraged an application, back in 2011, to release the biocontrol agent in the wild in Portugal. The Portuguese authorities informed the European Commission and the Standing Committee on Plant Health (December 2013) about the proposal, and the decision was made to send it to EFSA for risk assessment. EFSA advised more testing on *Acacia retinodes* Schlecht. (mistakenly identified as *A. floribunda* Sieber in Italy, and with some ornamental use in that country) and *Cytisus striatus* (Hill) Rothm (because the number of previous testing plants was relatively low), but no galls were formed on either of these species. The technical advice from EFSA was obtained in March 2015 and sent back to the Standing Committee on Plant Health. After analysis, the decision was passed to the Portuguese authorities, and in July 2015 the permit to introduce *T. acaciaelongifoliae* in the wild was granted. The first releases were made in November 2015 and new releases are planned for June/July 2016.

Ambrosia artemisiifolia

An interesting opportunity to determine the attitudes of different countries to classical weed biocontrol is presented by the recent accidental arrival of *Ophraella communa* LeSage, a widely used biocontrol agent against common ragweed, *Ambrosia artemisiifolia* L., in China (Zhou *et al.*, 2014). This North American leaf beetle was first detected in Europe in 2013, in Northern Italy and Southern Switzerland (Müller-Schärer *et al.*, 2014); it performed so well in the field that drops in airborne allergenic pollen were recorded from 2013 onwards (Bonini *et al.*, 2015).

The problem with *O. communa* is that its fundamental host range includes numerous species within the tribe Heliantheae, including sunflower. This relatively broad host range was the reason why this beetle was not introduced into Australia to combat common ragweed and closely related weeds (Palmer & Goeden, 1991). One could have expected that the establishment of *O. communa* in Europe would raise concern among national authorities, sunflower oil producers and other stakeholders about whether the accidental arrival of this species in Europe should be considered as a fortunate coincidence or rather a threat to agriculture or native biodiversity. However, the only immediate response to the establishment of *O. communa* was the creation of the Task Force 'Ophraella' within the EC COST action on the 'Sustainable management of *Ambrosia artemisiifolia* in Europe' (SMARTER). The overall goal of the Task Force is to collect scientific information on the potential negative and positive effects of *O. communa* in Europe and to provide this information to national and European decision-makers.

The countries that finally took action were Switzerland and France. In spring 2014, the Swiss Federal Office for Agriculture agreed to co-finance research done within SMARTER to better understand the risks of non-target effects on sunflower by *O. communa* in Southern Switzerland. In late 2014, the French Agency for Food, Environmental and Occupational Health and Safety (Anses) created a working group with external experts to conduct a PRA of an establishment of *O. communa* in France, with particular emphasis on assessing the risks for crop species, thereby benefiting from the data collected by SMARTER participants. Interestingly, as a follow-up to the risk analysis, the French Ministries of Health, Agriculture and Environment have asked the working group to assess the potential benefits of the establishment of *O. communa* in France. This is

a remarkable development, since French authorities have so far not considered classical biological control as a reasonable management option against invasive weeds in continental France, only in overseas territories (Le Bourgeois *et al.*, 2011).

It is noteworthy that *O. communa* is not the only herbivore that has recently established on ragweed species in EPPO countries and that is used as biological control agent in other parts of the world. In the case of common ragweed, extensive surveys revealed that *Epiblema strenuana* (Walker, 1863), which is considered to keep common ragweed in check in Australia, has accidentally established in Israel (Yaacoby & Seplyarsky, 2011), and the moth *Ponometia candefacta* (Hübner, 1831), which was deliberately released in Russia, has spread to Serbia and Bulgaria (Stojanovic *et al.*, 2011). Moreover, the mite *Aceria artemisiifoliae* n.sp., which was recently described from Serbia (B. Vidović, University of Belgrade, RS, pers. comm.) and which largely prevents seed set of common ragweed, is probably of North American origin. All these herbivores are currently under consideration for use as biological control agents against common ragweed and/or other invasive ragweed species (e.g. *Ambrosia psilostachya* DC) in EPPO countries.

Conclusions

It is clear that the regulation of biocontrol agents for weeds is evolving fast following a very slow start, and that different countries have different laws within which they must operate. It is good that most recognize that biocontrol agents need to be considered under plant health legislation irrespective of taxon and this should ensure an adequate focus on safety, but it is equally important that the benefits of introductions are considered alongside the risks otherwise no releases would ever be made. The future looks bright for weed biocontrol in Europe and it is hoped that the new EU Invasive Species Regulation provides an additional push to countries to consider this potentially cost saving and environmentally friendly approach to the management of some of the worst invasive species in Europe.

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Réglementation de la lutte biologique contre les mauvaises herbes en Europe - un paysage évolutif

Après un début difficile, la lutte biologique classique contre les mauvaises herbes semble de plus en plus reconnue dans les Etats membres de l'Union européenne (UE) comme une option pour la gestion des plantes envahissantes : des lâchers intentionnels ont été réalisés dans trois pays au cours des cinq dernières années. Beaucoup de pays européens bénéficient de la présence du charançon *Stenopelmus rufinasus,* contre *Azolla filiculoides*, introduit accidentellement dans la région. Cependant l'expérience de lâchers officiels du psylle *Aphalara itadori* en Grande-Bretagne contre la renouée du Japon (*Fallopia japonica*) ainsi que les lâchers ultérieurs de la rouille *Puccinia komarovii* var *glanduliferae* contre *Impatiens glandulifera,* ont indiqué aux Etats-membres le cadre réglementaire pouvant être suivi. Ce processus avait été réalisé au Portugal, avant le lâcher de *Trichilogaster acaciaelongifoliae,* une guêpe australienne, contre l'espèce envahissante *Acacia longifolia*. Bientôt, le cas d'*Ophraella communa*, une autre espèce introduite accidentellement et qui permet de fortement limiter les populations d'*Ambrosia artemisiifolia,* poussera les pays touchés, y compris ceux qui n'étaient jusqu'à présent pas intéressés par cette méthode, à considérer les avantages et les inconvénients de la lutte biologique classique. Cela promet un avenir brillant à la lutte biologique classique contre les mauvaises herbes, et la nouvelle Réglementation UE sur les espèces exotiques envahissantes devrait encore améliorer la situation.

Регулирование биологической борьбы с сорняками в Европе: меняющаяся картина

После сложного первоначального внедрения классическая биологическая борьба с сорняками начинает признаваться в качестве варианта управления инвазивными растениями в государствах-членах ЕС, и за последние пять лет были осуществлены преднамеренные выпуски агентов биометода против сорняков в природу в трех странах. Многие европейские страны получают выгоду от присутствия *Stenopelmus rufinasus,* долгоносика азоллы, который был интродуцирован в регион случайно. Опыт Великобритании с официальной интродукцией листоблошки *Aphalara itadori* для борьбы с японским гречишником (*Fallopia japonica*) и последующие выпуски в природу ржавчинного гриба *Puccinia komarovii* var *glanduliferae* против *Impatiens glandulifera* продемонстрировали тот нормативно-правовой механизм, которому могут следовать государства-члены ЕС. По этому пути пошли также и при проведении более поздних выпусков в природу *Trichilogaster acaciaelongifoliae,* специализированной австралийской галлицы, для борьбы с инвазивным видом акации *Acacia longifolia* в Португалии. Вскоре после этого *Ophraella communa*, еще один пример случайной интродукции, позволила существенно сократить популяции *Ambrosia artemisiifolia*, что заставит затронутые страны взвесить все преимущества и недостатки классической биологической борьбы, некоторые из которых до сих пор остаются непонятыми. Будущее биологической борьбы с сорняками представляется блестящим, и Регламентация ЕС в

отношении чужеродных видов в этой ситуации окажет несомненную помощь.

References

Anses (2015) Évaluation des risques pour la santé des végétaux liés à l'introduction accidentelle ou en tant qu'agent de lutte biologique, d'*Ophraella communa*, un insecte ravageur de l'ambroisie à feuilles d'armoise. https://www.anses.fr/fr/system/files/SANTVEG2014SA0199Ra.pdf [accessed on 01 June 2016].

Baker CRB, Blackman RL & Claridge MF (1972) Studies on *Haltica carduorum* Guerin (Coleoptera: Chrysomelidae) an alien beetle released in Britain as a contribution to the biological control of creeping thistle, *Cirsium arvense* (L.) Scop. *Journal of Applied Ecology* **9**, 819–830.

Bonini M, Sikoparija B, Prentovic M, Cislaghi G, Colombo P, Testoni C *et al.* (2015) Is the recent decrease in airborne *Ambrosia* pollen in the Milan area due to the accidental introduction of the ragweed leaf beetle *Ophraella communa*? *Aerobiologia* **31**, 499–513.

Clewley G, Eschen R, Shaw R & Wright D (2012) The effectiveness of classical biological control of invasive plants. *Journal of Applied Ecology* **49**, 1287–1295.

Eilenberg J, Enkegaard A, Vestergaard S & Jensen B (2000) Biocontrol of pests on plant crops in Denmark: present status and future potential. *Biocontrol Science and Technology* **10**, 703–716.

Fowler SV (1993) The potential control of bracken in the UK using introduced herbivorous insects'. *Pesticide Science* **37**, 393–397.

Janson OE (1921) *Stenopelmus rufinasus* Gyll. An addition to the list of British coleoptera'. *Entomologist Monthly Magazine* **57**, 225–226.

Jetter K (2005) Economic framework for decision making in biological control. *Biological Control* **35**, 348–357.

Le Bourgeois T, Baret S & Desmier de Chenon R (2011) Biological control of *Rubus alceifolius* (Rosaceae) in La Réunion Island (Indian Ocean): from investigations on the plant to the release of the biocontrol agent *Cibdela janthina* (Argidae). Proceedings of the XIII International Symposium on the Biocontrol of Weeds, Hawai'i, USA, 11–16 September 2011.

Marchante H, Freitas H & Hoffmann JH (2011) Assessing the suitability and safety of a well-known bud-galling wasp, *Trichilogaster acaciaelongifoliae*, for biological control of *Acacia longifolia* in Portugal. *Biological Control* **56**, 193–201.

McFadyen REC (1998) Biological control of weeds. *Annual Review of Entomology* **43**, 369–393.

Minks AK, Blommers LHM, Ramakers PMJ & Theunissen J (1998) Fifty years of biological and integrated control in Western Europe: accomplishments and future prospects; Proceedings, 50th international symposium on crop protection, Gent, 5 May 1998. Part I, *Mededelingen – Faculteit Landbouwkundige En Toegepaste Biologische Wetenschappen, Universiteit Gent* **63**, 165–181.

Müller-Schärer H, Lommen STE, Rossinelli M, Bonini M, Boriani M, Bosio G *et al.* (2014) *Ophraella communa*, the ragweed leaf beetle, has successfully landed in Europe: fortunate coincidence or threat? *Weed Research* **54**, 109–119.

Pakeman RJ & Marrs RH (1993) Bracken. *Biologist* **40**, 105–109.

Palmer WA & Goeden RD (1991) The host range of *Ophraella communa* Lesage (Coleoptera, Chrysomelidae). *Coleopterists Bulletin* **45**, 115–120.

Peschken D, Friesen HA, Tonks NV & Banham FL (1970) Releases of *Altica carduorum* (Chrysomelidae: Coleoptera) against the weed Canada thistle (*Cirsium arvense*) in Canada. *Canadian Entomologist* **102**, 264–271.

Shaw RH, Bryner S & Tanner R (2009) The life history and host range of the Japanese knotweed psyllid, *Aphalara itadori* Shinji: potentially the first classical biological weed control agent for the European Union. *Biological Control* **49**, 105–113.

Sheppard AW, Shaw RH & Sforza R (2006) Top 20 environmental weeds for classical biological control in Europe: a review of opportunities, regulations and other barriers to adoption'. *Weed Research* **46**, 1–25.

Stojanovic DV, Curcic SB, Orlovic S, Keresi T & Galic Z (2011) The first finding of *Ponometia candefacta* (Hiibner, 1831) (Lepidoptera, Noctuidae) in Serbia. *Biljni Lekar (Plant Doctor)* **39**, 31–36.

Tanner RA, Ellison CA, Seier MK, Kovács GM, Kassai-Jáger E, Berecky Z *et al.* (2015) *Puccinia komarovii* var. *glanduliferae* var. nov.: a fungal agent for the biological control of Himalayan balsam (*Impatiens glandulifera*). *European Journal of Plant Pathology* **141**, 247–266.

Yaacoby T & Seplyarsky V (2011) *Epiblema strenuana* (Walker, 1863) (Lepidoptera: Tortricidae), a new species in Israel. *EPPO Bulletin* **41**, 243–246.

Zhou Z-S, Chen H-S, Zheng X-W, Guo J-Y, Guo W, Li M *et al.* (2014) Control of the invasive weed *Ambrosia artemisiifolia* with *Ophraella communa* and *Epiblema strenuana*. *Biocontrol Science and Technology* **24**, 950–964.