



CONFERENCE/WORKSHOP ORGANISER'S REPORT

“Genetic Biocontrol for Invasive Species”

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Brief Description of what the conference/workshop was about

Invasive species represent an economic threat to agriculture and forestry for all countries that engage in international trade. In order to address this threat, new applications of biotechnology are being developed and deployed that target invasive species in order to reduce their economic impact in the future. This workshop brought academic researchers and biotechnology regulators together to review the status of invasive species genetic biocontrol, contrasting existing invasive species eradication methods, which tend to be labor and resource intensive, to newer approaches such as gene drive, that promise to be more efficient, but may also pose risks to the environment that need to be assessed and managed. Four genetic biocontrol methods were compared with respect to the efficiency that each affords as a genetic biocontrol tool, the practical utility and costs/benefits associated with each approach as well as the regulatory hurdles that each would face in order to be approved for use.

Participation – details of total number of participants, countries they came from, backgrounds (academia, industry, etc.) In total there were 27 registered participants at the workshop including the 9 invited speakers. Among the attendees were 4 participants from academia, 13 from government agencies, 9 from NGOs and 1 biotechnology consultant. Gene drive was a central focus of the meeting, thus several of the NGO participants in attendance were from the Target Malaria group and several were from the GBIRD (Genetic Biocontrol for Invasive Rodents) project, which are developing gene drive technology in insects and rodents, respectively. Additional participants included 2 ILSI Research Foundation staff and 8-10 participants from the concurrent International Society for Biosafety Research Symposium who did not register.

There were nine speakers who gave presentations at the conference, six giving scientific presentations on genetic biocontrol (John Teem/USA, Dan Schill/USA, Neil Gemmell/New Zealand, Tim Harvey-Samuel/UK, Paul Thomas/Australia, Owain Edwards/Australia,) and three giving presentations on the regulatory aspects of genetic biocontrol (Trevor Smith/USA, Detlef Bartsch/Germany, and Heidi Mitchell/Australia). Additionally, one speaker provided a presentation on genetic containment of gene drives via video recording (Toni Piaggio/USA). Presenters giving scientific talks came from a state agency (Idaho Department of Fish and Game, DS) two federal agencies (USDA Wildlife Services, TP, and CSIRO, OE), two NGOs (ILSI Research Foundation, JT, Pirbright Institute, TH)) and two academic institutions (Otago University, NG, and Adelaide University, PT). Invited regulators came from a state agency (Florida Department of Agriculture and Consumer Services, TS) and two federal government agencies (The Office of the Gene Technology Regulator, (HM), and BVL - Federal Office of Consumer Protection and Food Safety, DB).

The speakers giving scientific presentations at the conference are active in genetic biocontrol research, representing a diverse range of relevant disciplines including Molecular Biology, Genetics, Cell Biology, Entomology, Fisheries Biology, and Aquaculture. Speakers on regulatory issues included a state agency regulator, implementing classical biocontrol for invasive species control (USA, Florida Agriculture), a policy director from a federal biosafety agency (BVL, Germany) and a risk assessor of genetically modified plants from a federal biosafety agency (OGTR, Australia). For a list of participants, see attachment.

Major highlights from the presentations

Early in the workshop, a comparison was made between an existing pest control strategy in limited use for more than 50 years (sterile-release) and a new method that has yet to be used (gene drive) that offers many advantages for invasive species control. While the use of gene drive promises to be more efficient because of the ability to



spread genes into wild populations, it also raises questions about how risks will be assessed and managed. Two other genetic biocontrol strategies (YY fish and Trojan Female Technique) were also presented. In comparing the four genetic biocontrol strategies, it was clear that there is a trade-off in terms of the benefits that each offer (efficient control, reliability, practical utility) and also the costs of each in terms of uncertainty with regard to unintended effects, and necessary infrastructure, resources and regulatory burden.

A number of points of general agreement emerged from discussions during the workshop:

- There is no single approach to invasive species genetic biocontrol that is effective, approved for safe use and also useful for controlling a wide range of different invasive species.
- Gene drive is perhaps the one genetic biocontrol method with the greatest potential as a general approach to invasive species control, but there is a high degree of uncertainty associated with the release of gene drive organisms into the environment and the possible unintended effects that could result.
- Extensive research is currently being conducted on methods to reduce the risks associated with gene drive so that this new technology can be applied to invasive species.
- Contained testing of various gene drive designs will be needed in order to assess the effectiveness and biosafety of gene drives and inform risk assessments for gene drive organisms. Although there are some unique considerations for gene drives for invasive species control, current regulatory frameworks for risk assessment will be suitable for this task.
- Because invasive species may potentially cross international boundaries, there remain some future regulatory challenges to be resolved in terms of addressing potential transboundary movement of transgenic organisms used for genetic biocontrol. In this regard, a discussion of classical biological control was informative in providing a context for considering how issues of transboundary movement of classical biological agents have been dealt with in the past.

One of the principal lessons learned in the workshop is that public acceptance will play an important role in the adoption of new genetic biocontrol technologies, and any new genetic biocontrol approach will need the support from the natural resource managers that have the local authority to implement it within the environment. It will take time for natural resource managers (and also the general public) to develop trust in new genetic biocontrol technologies, so the results obtained with field trials will be important in shaping future perceptions of genetic biocontrol. Genetic biocontrol strategies that are predictable and reliable (but not necessarily the most efficient) will be favoured initially by natural resource managers.

This conference was unique in that it brought natural resource managers together with international scientists and regulators; two groups that don't normally have an opportunity to meet and exchange ideas. It was a learning opportunity for both groups, providing each with an opportunity to view genetic biocontrol from a completely different perspective. This kind of exchange is important because it gives both groups a better sense of what works and what doesn't work, both in the field and in the laboratory.

Major outcomes/conclusions in terms of policy relevance

This conference linked into policy issues related to the use of biotechnology for protecting agriculture, but also broader policy goals for protecting the environment and human health from harms caused by invasive species. The same genetic biocontrol strategies that could be used to control agricultural pests can also be used to eradicate invasive mosquitoes that transmit human disease, or invasive fish that threaten fisheries.

Because invasive species can cause harm to human health, agriculture or the environment, it is important for policy makers to be informed regarding the technologies that are available for controlling invasive species and



limiting these harms. Principal among these harms is economic loss due to the effects of invasive species on agriculture or forestry. Currently, biotechnology related to pest control for agriculture has focussed on making plants resistant to insects as means of protecting plants from invasive insects. Genetic biocontrol approaches the problem in a different way, targeting the pest directly using genetics rather than targeting the insects indirectly through insect-resistant plants. Both approaches require that policy be developed on how best to use biotechnology to improve agriculture without harming the environment.

Policy makers can expect to see a range of new technologies being proposed and applied for genetic biocontrol that attempt to deal with otherwise intractable problems related to invasive species. The relative ease of manipulating chromosomes in fish make non-transgenic strategies, such as Trojan Y chromosome, likely. These methods can be effective while avoiding some of the public perception issues associated with transgenic technologies. Similarly, non-transgenic biocontrol methods, in insects are building on the concept of sterile insect technique (SIT) by introducing deleterious mutations that affect fertility (e.g. Trojan Female strategies). Transgenic techniques will be applied for similar purposes, using transgenic sterile releases or introducing gene drive in a variety of strategies to eradicate populations of invasives. These gene drives may also employ a range of genetic containment strategies.

What all of these techniques have in common is that they will need to be considered by policy makers in the context of ongoing control programs. Policy makers will need to be prepared to make decisions (or facilitate decisions by control program managers) that weigh the efficiency and predictability of new genetic approaches as well as the social acceptability of using genetic technologies.

Relevance to CRP theme(s)

This conference addressed CRP research theme II (Theme II. MANAGING RISKS IN A CONNECTED WORLD), *Invasive Species and Biosecurity*), in which it is stated “With increasing global interactions across countries and continents, invasive alien species are increasingly a challenge and the importance of biosecurity preparedness and risk assessment is growing. Invasive pests and diseases threaten both agricultural and forest productivity and biodiversity within countries and constrain the potential for free trade and market access. Biosecurity science is about securing social, environmental and economic wellbeing by minimising the risks of pests and diseases and enhancing the effectiveness of mitigation and eradication responses.”

New biotechnologies are now available to control invasive species that threaten agricultural and forest productivity and biodiversity. By providing an overview of the state-of-the-art methods for genetic biocontrol for invasive species, this conference provides a basis for informing future policy decisions on how genetic biocontrol can be used to protect natural resources that include food, agriculture, forests and fisheries, consistent with the OECD objectives.

Website for further details – please also indicate if the presentations are/will be available on the website
<https://ilsirf.org/event/isbr-invasivespecies/>

Presentations will be available on the website.