Workshop Summary: Is Classical Biological Control a 20th Century "Old Science" Paradigm that is Losing its Way?

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Workshop proposal

For years most countries accepted the benefits of biological control as given, leading to facilitated inside lanes through the regulatory maze. "Successes" led to many passionate disciples over science rationalists. Biocontrol targets continue to be selected on assumptions of good value with little direct evidence. Even when successful, biocontrol has rarely delivered environmental benefits that have been measured. Money flow is still healthy, but is arguably being directed against less impactful targets. Lack of science rigour exposes the field to attacks from an increasing number of critics as values change. A global change driven counter-revolution is underway on the dichotomy of hate between natives and aliens. Will climate change undermine even currently successful biocontrol outcomes? Meanwhile negative direct and indirect impacts of biological continue to fuel dissent. Nowhere is this issue hotter than in Hawaii where "invaders" have massively increased biodiversity, make up nearly all the biomass and create whole new ecosystems. This workshop will entertain a panel discussion around the future for classical biological control of weeds. Does it need to change its paradigm in response to changing societal values, if so can it reinvent itself?

Introduction

Scientists engaged in weed biological control are all advocates of the discipline and so what they say about the benefits of biological control in the public arena can be seen as a value judgement and won't be considered as objective or impartial. Historically, biological control has been, at least implicitly, supported by government agencies, because of the recognised accrued benefits against agricultural pests and weeds. The views of government in developed countries are changing, however, with growing scientific and public concerns about environmental degradation from biological invasions and the increasingly recognised risks from introducing exotic organisms. The recognised historical agricultural benefits compared to the small realised risks (off-target direct and indirect impacts) may be quickly forgotten when biodiversity faces increasing pressures from alien invasive species and as government departments responsible for environmental protection become

increasingly involved in weed biological control implementation. Furthermore, weed biological control is now more a tool for the management of environmental weeds (weeds affecting biodiversity, habitat integrity, ecosystem processes and services) than for agricultural weeds. Use against environmental weeds has grown because the impacts of such weeds are perceived as often even more substantial (e.g. ecosystem "transformers") than simple economic costs from agricultural weeds. The new problem here however is one of perception, because the impacts of environmental weeds cannot be measured in straight economics. Their impacts can be hard to quantify. When biological control is increasingly used against targets where the impacts might be considered qualitative or subjective, then its use can increasingly be questioned too. It is critically important that a target weed for a biological control program has clear and undisputable negative impacts against which the program can be evaluated in the future.

As an applied science, biological control lives and dies based on its acceptance by its stakeholders and society. It requires good government and community support. There are still many countries in both the developed and developing world where the use of weed biological control has not achieved public acceptance and is not being applied (i.e. most of Europe, Asia and South America). In countries where biological control is both practiced and accepted, scientists may be taking their stakeholders for granted (e.g. seen just as funding sources for their science) when they should be engaging and encouraging them as objective public advocates for the discipline. After a long history, it could be argued that to sustain the discipline, weed biological control is also starting to work on more second tier targets as all the "world's worst weeds" have already been tackled. Second tier can mean not just weeds where the impacts are hard to quantify, minor or more doubtful, but also weeds for which some sectors of the community perceive benefits from them. Where potential benefits are less explicit, the argument for introducing an exotic potentially beneficial biological control agent may meet greater resistance. Similarly, even if a control program successfully eliminates the environmental weed target, there may be no measureable biodiversity or ecosystem service benefits, only weed replacement. Biological control may be moving on to targets where the value of the approach will be more vulnerable to criticism, if strong independent advocates are lacking.

Community, government and even scientific perceptions of the harmful impacts of alien invasive plants may also be changing. Firstly, most legislation relating to the importation and release of exotic biological control agents only considers risks not benefits, being largely based on International Plant Protection Convention import risk assessment protocols. Where governments accept the importation and release of biological control agents, this is because of an implicit but not legislative government acceptance of the potential benefits. This allows for a rapid change in attitude in a society that is becoming increasingly risk averse. The rapid decline in recent biological control agent release permit approvals in the USA may be testament to this. Scientific evidence for non-target direct and indirect impacts following the introduction of ineffective agents helps change the risk perception against biological control. Certain scientific and community groups also consider certain elements of an alien flora are beneficial, where, for example they provide habitats or an ecosystem service not provided by the indigenous flora (e.g. forests on islands). These arguments are backed up with the lack of evidence that exotic plants cause extinctions.

Biological control can also be accused of being "an old science paradigm" by science agencies wishing to invest in new state of the art approaches. Biological control can be viewed as a "service from science" discipline and as such should be fully funded by stakeholders. This can lead to declining public investment in infrastructure and programs as public good science. Biological control is also not practiced yet in the context of climate change, in the way other types of natural resource management (NRM) are (e.g. carbon storage). Both target selection and the likely ongoing benefits from successful biological control may change, if future climates are considered in the decision making. Classical biological control won't be considered as "leading edge" if it fails to adopt new techniques and approaches and consider drivers of global change.

Hawaii was a perfect place to hold a workshop to debate the external perceptions of the discipline. Alien species dominate the biota on these islands and generate new ecosystems and services not

present before their arrival. Many of them are valued for this and are used as food sources by the Hawaiian community. In Hawaii the benefits and risks of biological control have always been strongly debated as there have been contentious historical programs against snails and insect pests. Furthermore, recent proposed releases of biological control agents in Hawaii against strawberry guava (*Psidium cattleianum* Sabine) have raised perhaps the highest level of public contention around any biological control program in recent years, with local opposition on one Hawaiian island having attracted some political support, while other islands in the archipelago remain supportive. Debate at the workshop was encouraged around some proposed options for the future for the biological control scientific community:

Focus on the science – as long as the science is of the highest calibre leading to maximised successful weed control, the community will see and accept the benefits and future funding will flow.
Become our own lobbyists – In the policy arena, abandon an independent scientist or "trusted advisor" role and actively stimulate debate around the benefits of biological control.
Engage the community – Enable communities to take ownership of, and advocate for programs by building and supporting local knowledge about the impacts of weeds and the benefits of biological control.
Change our science – continuously seek to apply modern scientific approaches (e.g., genetics, genomics, and bioinformatics) and considerations, like climate change, to the discipline.

It will be a fine line for scientists to present the scientific evidence of the benefits of their discipline without slipping into an advocacy role.

Panel member comments

Simon Fowler (Landcare Research, NZ): Despite some countries showing reduced commitment, New Zealand is in the golden age for weed biological control. Stakeholder and government support of the projects is the highest it has ever been as is the number of programs showing signs of success. There is sufficient funding for the science to develop in a number of new ways that are allowing many ecological questions to be addressed about risk assessment, release strategies, impacts of targets and biodiversity benefits of successful control. Evaluation is also underway for a number of projects and has considered non-target impact assessment. New Zealand also has a highly efficient regulatory process in place for assessing and approving biological control agents for release and so the times between permit submission and approval and the rate of agent approval is faster than in other countries. With regards to the effects of climate change, a recent assessment suggests such impacts on future target status and the ongoing success of existing projects appears likely to be unaffected as changes to the New Zealand climate are not expected to be high relative to other regions.

Martin Hill (Rhodes University, South Africa): South Africa too is bucking any apparent trend in skepticism around classical biological control. The Working for Water Programme and the value the leaders of this put in biological control as a cheap and effective approach to long-term weed management in South Africa is inspirational. This provides the ongoing support and development of the discipline in South Africa. While biological control still competes with other NRM activities for funding it holds its own and attracts its justifiable share. Universities and the Plant Protection Research Institute work in effective collaborations across a number of programs and are as good as ever in terms of delivery of agents and research outputs. The regulatory arrangements for obtaining release permits in South Africa are also not prohibitive at this stage. The regulations are under review at the moment and this affords the South Africa biological control fraternity to have significant inputs. The challenge for South Africa weed biological control is the effective implementation and post-release evaluation that shows the environmental benefits of the science.

Keith Warner (Santa Clara University, USA): Recent issues have arisen in Hawaii around a critical reaction by an individual with a capacity to influence debate to the proposed biological control of strawberry guava. This reflects diverging

perspectives between the practitioners and advocates of biological control and the community at large. If, as a result of such high profile opposition, members of the public become more suspicious of biological control, it risks becoming orphaned as a discipline from other NRM strategies and, as such, losing its public licence to operate in some regions. The budget investment by biological control in public engagement and communication is insignificant relative to its importance to the success of the practice. Public engagement and communication will be important in the US, as in other countries, in the long-term. Programs and their stakeholders need to identify and develop public figures in the community as champions and advocates and be prepared to engage in public debate about both the risks and the benefits of this management approach.

Peter McEvoy (Oregon State University, USA): Biological control programs need to target greater interactions with university scientists to sustain the ongoing science rigour of the discipline to make sure the science outputs are of the highest quality, addressing contemporary science priorities and understanding. University collaborators have the freedom, through funding more targeted to addressing fundamental research questions, to more comprehensively address the mechanistic underpinning of successful and unsuccessful biological control systems. Universities keep the ideas flowing and can test non-target direct and indirect and community level impacts and benefits. Universities, and the generations of young scientists they cultivate, provide the knowledge market that will keep the practice of classical biological control as not only a successful tool for managing weeds, but a recognised manipulative approach to push forward ecological understanding about biological invasions, species interactions and evolutionary processes. Furthermore biological control of weeds, arthropods, and other organisms should be more closely allied, because when disciplines become isolated they are less likely to be successful.

Workshop discussion

The proposed issue for discussion that biological control is potentially "losing its way" as a public supported cutting-edge science discipline, appeared overly pessimistic to the participants based on the response of panel members. Clearly New Zealand and South Africa have 'never had it so good' even if resources or public support for classical biological control are more in abeyance in countries like Australia and the USA. However, it was acknowledged that complacency, and lack of focus on the needs of both the scientific and the wider community could put continuation of that public support at risk. The broader discussion at the workshop addressed the following issues.

Biological control and broader NRM activities. It was suggested that biological control has been poor at integrating its activities into broader NRM efforts and so has failed to gain broad recognition by the wider NRM community. This has become much more significant now biological control is focussed on environmental weeds where the NRM impacts are broader and more complex. For example, purple loosestrife control in the USA was successful, but failed to clearly define a NRM aim beyond weed reduction. There was no clear native community that it had displaced in many areas, and the effects of the changes in loosestrife densities (and increased control agent abundance) on other aspects of the community (e.g. water plants) remains poorly explored. The necessity to more effectively integrate biological control into broader NRM strategies stems from it targeting only one species when many sites suffer from multi-species invasions. Nonetheless the program had been of value for educating the community about biological control (school agent rearing programs), and understanding also has increased around the threats posed by invasive plants.

Community engagement. There was recognition amongst the Hawaiian delegates at the workshop that community acceptance of biological control for recent activities had been assumed, based on historical perceptions, and that the response around the strawberry guava biological control program had been completely unexpected in scale and intensity. This has necessitated a "road show" to try and expose the issues to a wider sector of the community. Future programs will need to be more proactive in investing in public discussions and engagement before programs are initiated and use

historical successes and the benefits obtained from them to attract champions and present convincing arguments. Past successful programs are quickly forgotten in the public psyche. This was particularly true in a state, like Hawaii, where the majority of the biota is exotic and the indigenous community has learnt to adopt and use exotic organisms for the benefit of their community and culture.

Declining relevance of classical biological control of weeds. One of the reasons for the decline of funding for weed biological control in some countries (e.g. Australia), has been that the agencies now responsible for allocating government investments are not agencies that have traditionally managed or understood the historical benefits from, and the need for, sustained investment in weed biological control. As such, weed biological control project proposals, are perhaps judged against less relevant criteria. As funding cycles drop to less than three years, this presents a tighter timeframe for projects to deliver outcomes. Expensive ongoing biological control programs are assessed against a broader array of novel ideas that target a shorter time frame for delivery. It behoves the weed biological control scientific community to work with stakeholder groups to champion the sustainable support of biological control programs. In other jurisdictions (e.g. the USA) problems relate less to investment and more to complex regulatory processes. Decision making for biological control agent releases can become the responsibility of single individuals, who make judgements based on not just the advice of an independent advisory panel, but also their individual perceived levels of risk aversion. A lack of a collective approach leads to less objective decision making and fewer release permits. Again the solution is greater engagement between stakeholders, the public and the regulators to define the value proposition through understanding the likely benefits relative to the risks.

Conclusions

As is often the case, support for biological control projects waxes and wanes and does so quite independently between countries. At the moment some countries are in the trough while others are at the crest. These positions will change in both directions. Certainly in terms of weed control success, biological control of weeds programs are now probably more successful historically (proportion of targets controlled) than they have ever been, so the benefit arguments for sustained funding should be easy to generate. But the world is changing and along with it societal values. The biological control fraternity cannot lock themselves away and assume that attitudes to their work will remain unchanged. In this workshop the issues around the acceptability and support levels for weed biological control were explored and it was certainly widely recognised that investment in public engagement around the discipline, and continually finding ways to ensure the public are supportive, will forever be as critical to its survival as the need to ensure that this science too is the best it can be.