



XIIth International Symposium
on Biological Control of Weeds
22-27 April 2007
La Grande Motte (near Montpellier) France

---- KEYNOTE SPEAKERS ABSTRACTS ----

**Is modelling population dynamics useful for anything
other than keeping a researcher busy?**

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Understanding and modelling the population dynamics of weeds and/or agents can require large investments of time and money, just what are we getting for our modelling efforts? Here I outline some models of weed and biocontrol agent dynamics, from simple generalised strategic models to complex phenomenological and predictive models. The management questions asked in these research programs have included “will this particular biocontrol agent be any good at reducing the population growth rate and spread of this weed?”, “what kind of biocontrol agent should we be looking for?”, “are these biocontrol agents we introduced 40 years ago having any effect?” and “what kind of dynamics should we be aiming for in a biocontrol program and what do we actually get?”. Models as tools in biocontrol research programs are as diverse as the questions they are brought in to answer, but are they worth the effort? I hope to convince you that the right model used for the right question can in fact bring us insights into the biocontrol process that would be even more difficult or impossible to achieve otherwise.

Key words: invasive; prediction; management



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**Return on investment: determining the economic
impact of biocontrol programs**

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In >100 years of weed biocontrol, few economic impact assessments of biocontrol programs have been undertaken, and all were of successful programs. Yet governments, who largely pay for these programs, not unreasonably demand proof of their overall return on investment. Cost-benefit analyses can also be used to rank biocontrol against other management methods. A recent economic impact assessment of the weed biocontrol programs undertaken in Australia since 1903, including both successes and failures, demonstrated annual benefits of \$95.3 million from an average annual investment of \$4.3 million (Australian \$\$, 2005 values), a cost-benefit ratio of 23:1. With the enormous economic impact of the prickly pear program excluded, the cost-benefit ratio was still 12:1. Much of the benefit came from 14 successful programs, but two programs usually considered failures returned strongly positive benefits, because small reductions in the weed problem nevertheless resulted in considerable cost savings.

The scarcity of economic studies has many causes: long period from commencement to full field results; difficulties in assigning monetary values to biodiversity and social impacts; difficulties (real or perceived) in assessing impacts of biocontrol programs. The greatest barrier is perhaps the 'so what?' factor – the belief that results (success or failure) are 'obvious' and that economic assessment is superfluous. The Australian study demonstrated the economic returns from partial successes, where these reduce the costs of other management methods. It has also demonstrated the importance of obtaining baseline economic data before starting a biocontrol program and at intervals during the agent release period. Seeking advice from economists at all stages of a biocontrol program must become as routine as consulting statisticians.

Key words: cost-benefit analyse; biological control of weeds; Australia



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Latin American weed-biocontrol science at the crossroads

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Latin America is the centre of origin of many of the invasive alien weeds threatening natural and agricultural ecosystems throughout the world. As a result, it has been an important destination for expeditions in search of natural enemies for their control. Unfortunately, the role of local scientists has been mainly that of contracted hunter-gatherers, cooperating on projects aimed at the exportation of classical biocontrol agents. This is changing as the need to confront the growing threat from alien weeds in Latin America gathers pace. Nevertheless, with limited funding and a continuing ignorance by both the general public and the decision makers about the scale of the problem, target selection will be critical since this will determine the long term viability of the discipline in the region. In the new role of proactive players, should “easy” targets be selected, for which there has been success on other continents? Or, instead, should these be more challenging, potentially confrontational targets, particularly African grasses which threaten not only the stability of unique ecosystems, such as the Amazon forest and the Cerrado (savannah-like formations) but which could also have global beneficial consequences? These issues will be discussed based on experiences gained from past and present collaborative projects, notably for biocontrol of *Miconia calvescens*, *Psidium cattleianum* and *Tradescantia fluminensis*.

Key words: target selection; agent selection; classical biocontrol.



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**Regulation of biological weed control agents –
results of the EU Policy Support Action REBECA**

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Biological weed control uses invertebrate biocontrol agents (IBCA) as well as plant pathogens or weed control products of natural origin. Classical control programmes are area-wide approaches supported by the public sector. Other than in North America, Australia and New Zealand, Europe has no central agency responsible for an environmental risk assessment prior to the introduction of exotic IBCAs. Many exotic and native insect and mite species are currently used in European horticulture (annual turnover ca. 150 million €) and no major damage was recorded. Nevertheless, since the establishment of the exotic coccinellid *Harmonia axyridis* and concerns about potential displacements of indigenous coccinellids, proposals and guidelines for the regulation of IBCAs have been prepared. Exaggerating regulation requirements can significantly impact the future of biological control. Regulation of IBCAs follow a hierarchical system taking into account establishment, dispersal and direct and indirect effects caused by IBCAs. The methodological and financial problems concerning the assessment of environmental risks are discussed. Microbial weed control agents and products of natural origin have to be registered following the rules of the EU directive 91/414, which treats BCAs almost like synthetic chemicals. REBECA has reviewed current legislation and guidance documents and made proposals for alternative, less bureaucratic and more efficient regulation procedures maintaining the same level of safety for human health and the environment but accelerating market access, increasing the availability of BCAs and lowering registration costs. Information on the progress of the Action is available at www.rebeca-net.de.

Key words: EU policy; biological control; guidelines



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**Biological control meets evolutionary
biology in the South of France**

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Evolutionary biology forms the nucleus for much of the science of biological control. For example, agent selection, agent establishment, agent performance, agent-target interactions, and non-target effects, all have fundamental evolutionary underpinnings. However, the central role of evolution in biological control is seldom recognized, likely because it has been difficult to quantify sufficiently the evolutionary components of biological control in order to make meaningful predictions. Towards this end, new advances in genomics, molecular population genetics, systematic biology, geographic information systems (GIS), and computational science, are providing insights into evolutionary processes. These approaches can be applied to topics in biological control, including the role of genetic variation in the establishment and spread of small populations, the rate of adaptive change in agents and targets, the potential for coevolution of agents and targets, and the use of phylogenetics in agent selection. This is a two-way street. Not only can evolutionary principles inform practices of biological control, but also biological control practices can inform evolutionary biology. Purposeful introductions of pathogens, parasites, predators and herbivores can be considered as replicated semi-natural field experiments, and therefore biological control can be an ideal test bed for theories in evolutionary biology.

Key words: adaptation; selection; microevolution



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**Opportunities and constraints for biological
control of weeds in Europe**

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Although there has been increasing interest in Europe over the last few decades in trying to harness the potential of biological control as a management tool for weeds, securing funding for projects continues to be problematic whilst the successes have been limited. The incentives to use alternative technology are based on a number of inter-related factors, not least the dramatic rise in popularity of organic products linked to increasing environmental awareness, and a powerful anti-GMO lobby. Combine this with new legislation to remove some chemical herbicides from the market or to restrict their usage, as well as soaring development costs for new products, means that the opportunities for biological control have never been better. Here, we analyse the reasons for the limited uptake, and the challenges or constraints facing weed biocontrol from two different approaches: classical and inundative. For classical, Europe has lagged behind other continents (Australasia, North America) to the point that there have been no introductions thus far, whilst those that are in the pipeline still need to clear considerable legislative hurdles. These are highlighted for past and on-going projects. For inundative - in this case, the use of products based on plant pathogens (bioherbicides) - the constraints are largely technological and commercial rather than bureaucratic: stability and efficacy; costs of production and registration; limited markets. Strategies to overcome these constraints - improving production, formulation and application systems; genetic enhancement; synergistic mixtures of agents/metabolites - are discussed.

Key words: bioherbicides; classical biocontrol; legislation



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**Release strategies in weed biocontrol: how well
are we doing and is there room for improvement?**

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Biocontrol offers an ideal opportunity to study the release of new organisms into new environments. Yet it is only recently that an experimental approach has been taken with the release of weed biocontrol agents, for example examining factors such as release size. A plea for more experimental science in weed biocontrol releases is not novel, but more data would be generated, and more understanding achieved, if initial releases in weed biocontrol programmes were treated as opportune experiments. In this way predictions from ecological theory and retrospective studies could be tested. However, a skeptical biocontrol practitioner might argue that, although ecological knowledge would be advanced by using biocontrol releases experimentally, there is little room for marked improvements in agent establishment rates: Reported rates of agent establishment have increased in recent times from around 60% up to the 1980s, to at least 80-90%. These overall analyses do hide frustrating problems in establishing some species: programmes in New Zealand targeting 'recalcitrant' environmental weeds such as *Clematis vitalba* and *Calluna vulgaris*, have been hampered by partial or complete failure to get potentially critical agent species established. For example, very patchy establishment of heather beetle, *Lochmaea suturalis*, in New Zealand is presenting some perplexing but interesting challenges. Rearing in containment may have inadvertently created beetles with body sizes too small to survive New Zealand's variable winter and spring weather conditions. The way that such inadvertent changes in population genetics might reduce biocontrol agent establishment success and effectiveness has been explored theoretically but practical recommendations appear to have been seldom tested or used in practice. In summary, there has been a commendable increase in the establishment success rate for weed biocontrol agents, probably at least in part due to better/more persistent release methodologies. However, it is possible that even better release and rearing/culturing practices might increase the rate of agent success in terms of contributions to weed suppression. In this talk we will review release strategies within biocontrol programmes, outline the key problems facing biocontrol practitioners and suggest areas in which an experimental approach would be particularly profitable.



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Integration of Biological Control into Weed Management Strategies

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In addition to biological control, many other management techniques, including mechanical, cultural and chemical control options can be used to control invasive plants. Integration of these strategies with biological control can provide more effective long-term management of a weed. Herbicides do not generally impact insect populations or pathogens and, therefore, can be used without compromising the effectiveness of biocontrol agents. Perhaps the most widely studied integrated management system includes the combination of biocontrol agents and prescribed burning. Although burning in spring or summer can kill exposed biological control agents, both insects and pathogens are mobile organisms and have the opportunity to readily re-occupy the treated site. This has been shown for agents specific to *Centaurea solstitialis* and *Hypericum perforatum*. The combination of prescribed burning, or other control methods, with biological agents can prevent re-establishment of the invasive plant by reducing subsequent seed set or the weed's competitive ability relative to the surrounding vegetation. Burn timing can also be critical to the survival of biological control agents. For example, because leafy spurge flea beetles (*Aphthona* spp.) are active during the summer, burns in mid-spring or fall do not injure the below ground insects and, in fact, can increase their populations.

Key words: integrated weed management; prescribed burning; herbicide