
Reducing badly behaving plants: recent national weeds research

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Summary

Between 2004 and 2008 the Australian Government committed \$44.4 million to the national Defeating the Weed Menace program to identify Australia's most threatening weeds and to implement measures for their control.

A research and development (R&D) component of the program was managed by Land and Water Australia on behalf of the Department of Agriculture, Fisheries and Forestry and the Department of the Environment, Water, Heritage and the Arts. The goal of this three year R&D component was to generate new knowledge to prevent the development of new weed problems, to reduce the impacts of existing weeds of national priority, and to build capacity for their management into the future.

Between June 2006 and November 2008, 27 projects were directed to:

- assessing risks of different pathways of weed ingress;
- impacts of land use change on weed incursion;
- developing 'best practice' early detection, survey and eradication of potential weed species;
- identifying biocontrol agents for priority weed species;
- developing new integrated weed management strategies that incorporate an understanding of landscape scale ecological processes;
- quantifying the impacts of weeds on sustainability and the environment (including the ecological costs of weeds) and the relative benefits and costs of different weed control measures; and
- providing knowledge to support a national information system for weeds.

A key focus of the R&D has been the generation of knowledge products designed to maximise uptake of the information generated. As the program drew to a close in June 2009, key cross-project learnings were highlighted and input relevant to future weeds R&D at the national level identified.

Keywords: weeds R&D, national priorities, key learnings, adoption.

Introduction

In June 2006 the Australian Government Department of Agriculture, Fisheries and

Forestry (DAFF) contracted Land and Water Australia (LWA) to manage, on behalf of both DAFF and the Department of Environment, Water, Heritage and the Arts (DEWHA) the \$5.4 million research and development (R&D) component of the national weeds program 'Defeating the Weed Menace'.

LWA was a national research broker seeking to increase knowledge and to encourage understanding and informed debate which will inspire innovation and action in managing our natural resources sustainably.

In this capacity, LWA sought to ensure that the research projects contracted benefit not just the rural production systems affected by weeds, but also the diversity of species and ecosystems that make up our uniquely Australian landscapes. Weeds are estimated to cost Australian agriculture around \$4 billion per annum. Although less well documented, the costs to nature conservation and landscape amenity are thought to be of a similar magnitude.

The projects

Twenty-five projects addressing a broad sweep of weeds-related issues were contracted through two open calls for proposals. Together these projects (see Table 1) saw an investment of some \$4.54 million of DWM funding, together with \$4.31 million of cash and in-kind contributions from weeds research organisations and interested third parties.

Two additional projects were commissioned later in the program, each directed to addressing gaps in new knowledge about weeds.

A study of the needs of potential end-users of a national information system for weeds indicated clearly that priorities other than biosecurity surveillance loom large as potentially benefiting from a nationally coordinated information system on weeds.

Several jurisdictions also invest heavily in the development of biological control agents for weeds. However, our understanding of how best to select target weeds for which biocontrol will become an important part of management remains limited. Within the DWM R&D program one project was directed to developing a framework to improve the targeting of

weed biocontrol projects within Australia.

Discussion

In addition to the information generated from each of these projects individually, several important themes emerged from across the whole program which will assist in managing invasive plants that impact adversely on agriculture and the environment.

Researching and managing landscape rather than weeds

One of the factors highlighted by many of the DWM R&D projects is the complexity of interactions between landscape processes and the differing components of the landscape. Projects addressing land use and changes in that use, whether through grazing management, changes to our aquatic waterways or peri-urban settlement all draw attention to the need to better understand and integrate holistic landscape management, rather than simply address the particular weed of concern. Colloff *et al.* (2009) provide an integrated framework for managing weeds within a broader natural resource context.

The importance of monitoring and evaluation

Related to this is the importance of longer-term monitoring and evaluation in assessing the effectiveness of weed management. As our knowledge of complex ecological processes and their interactions increases it is becoming increasingly apparent that adaptive management of weeds will rely on longer term monitoring than is usually associated with a 2–3 year funded project. The project completed by Reid *et al.* (2009), in particular highlighted this need as it relates to recovery of natural systems after a Weed of National Significance has been removed.

Facing the challenges of biological control

Also highlighted by the suite of DWM R&D projects are the numerous challenges faced in seeking effective biological control agents. Both a review of biocontrol work in Australia during the past decade (Auld 2009) and a framework to assist in better targeting of plant species for biocontrol (Paynter 2009) are legacies seeking to assist in addressing these research challenges.

Weed behaviour changes in response to climate change

As the impacts of human-induced climate change increase, plants will behave badly in different ways. While only one of the DWM R&D projects (Scott *et al.* 2009) focused directly on the implications of climate change for weed spread, several contained elements relevant to weed

Table 1. DWM R&D themes and projects.

Research theme and sub-themes	Projects	Lead researcher/Lead organisation
Developing 'best practice' early detection, survey and eradication	Managing weeds under future scenarios for environmental flows in the Murray River	Dr Matt Colloff, CSIRO Entomology
Assessing risk of different pathways of weed ingress	Modelling climate change impacts on 'sleeper' and 'alert' weeds	Dr John Scott, CSIRO Entomology
	Pathway risk analysis for weed spread within Australia	Prof. Brian Sindel, University of New England
	Serrated tussock: Managing native pastures to prevent invasion	Dr Aaron Simmons/Prof. David Kemp, Charles Sturt University
Identifying biocontrol agents for priority weed species	Biological control and ecology of alligator weed	Dr Shon Schooler, CSIRO Entomology
	Development of new biocontrol agents for parkinsonia	Dr Tim Heard, CSIRO Entomology
	Improving management of salvinia in temperate aquatic ecosystems	Dr Bertie Hennecke/Assoc. Prof. Kris French, University of Wollongong
	Importation and release of a new biological control agent for Scotch broom	Dr Jean-Louis Sagliocco, DPI Victoria
	Boneseed rust: a highly promising candidate for biological control	Dr Louise Morin, CSIRO Entomology
	Enhancing noogoora burr biocontrol in northern Australia	Dr Louise Morin, CSIRO Entomology
	Importation, rearing and field release of the cape broom psyllid	Mr Ken Henry, SA Research and Development Institute
Land use change impacts on weed incursion	Land use effects on soil nutrient enrichment: Risks for weed invasion	Dr Elizabeth Lindsay/Dr Saul Cunningham, CSIRO Entomology
	Effect of land use and peri-urban development on aquatic weeds	Dr Lauren Quinn/Dr Shon Schooler, CSIRO Entomology
	Understanding and determining mechanisms to prevent weed invasion in coastal vegetation	Dr Tanya Mason/Assoc. Prof. Kris French, University of Wollongong
Developing new integrated weed management strategies at landscape scale	Developing a model for environmental weed management in fragmented landscapes	Mrs Melissa Herpich, Department for Environment and Heritage, SA
	Optimising management of core mesquite infestations across Australia	Dr Rieks van Klinken, CSIRO Entomology
	Elucidating relationships between distribution and invasion in riparian zones	Dr Fiona Ede, DPI Victoria
Developing efficient methods for surveying and eradicating agreed emergent weeds	Best practice on-ground property weed detection	Prof. Brian Sindel, University of New England
	Exploring agents of change to peri-urban weed management	Ms Jo Harding, Upper Murrumbidgee Catchment Coordinating Committee
	Cost-effective surveillance of merging aquatic weeds using robotic aircraft	Dr Salah Sukkarieh, University of Sydney
Quantifying the impacts of weeds on sustainability and the environment...	Quantifying costs and benefits of buffel grass	Dr Margaret Friedel, CSIRO Sustainable Ecosystems
	<i>Pinus radiata</i> in bushland: Assessing the issues in the Green Triangle	Mrs Melissa Herpich/Dr Andrea Lindsay, Department for Environment and Heritage, SA
	Quantification of the environmental and control costs of weeds	Dr Samantha Setterfield, Charles Darwin University
	Evaluating the environmental benefits from managing WoNS in natural ecosystems	Dr Adele Reid/Dr Louise Morin, CSIRO Entomology
	Ecological, economic and social considerations in spray control of hymenachne	Prof. Bob Miles, Central Queensland University

management in a changing physical climate. The projects that focused on weed management in riparian and floodplain areas drew attention to the complex interactions between weed invasion and management and altered water regimes in the face of climate change. Similarly, the project assessing the environmental and control costs of tropical tall grasses drew stark attention to the interactions between climate change, changing fire regimes and the influences of some weed species on fire.

Plants of commercial value also behave badly

Several of the projects completed with the DWM R&D program focused on improving understanding and management of plants of commercial value that also pose considerable threat from invasion of natural areas, waterways and other systems. Miles *et al.* (2009) address policy, institutional and management issues designed to improve the future impacts of plants as diverse as buffel grass (*Cenchrus ciliaris*), gamba grass (*Andropogon gayanus*) and para grass (*Urochloa mutica*), pine wildlings (*Pinus radiata*) and the ponded pasture plant hymenachne (*Hymenachne amplexicaulis*).

Other needs and opportunities highlighted by the DWM R&D program are many and varied (Auricht and Yapp 2009). Cross-disciplinary and interdisciplinary research is increasingly recognised as important in addressing the social, economic and environmental impacts and management of weeds, whether in rural production systems, in natural environments or where the plant species involved has both production value and invasive weed characteristics

By combining spectral data analysis, smart algorithms enabling machine learning and the use of unmanned aircraft in weed detection it is becoming increasingly possible to detect and manage weeds in difficult and inaccessible areas (Sukkarieh 2009).

Weeds are a persistent problem which costs Australia dearly. Only by combining the efforts of a diverse set of technical expertise with on-ground commitment and vigilance are we likely to manage them effectively in a changing world. Even then, effective long-term monitoring not just of the weeds, but of what comes after they have been controlled or removed will be an essential element of effective adaptive management in the medium to longer term.

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