

The Invasive Animals CRC: a new research initiative for managing some old problems

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ABSTRACT

Invasive animals include introduced and native animals that have or may become overabundant and pose threats to agriculture, the environment or human health and safety. Following its successful bid to the Australian Government's Cooperative Research Centres Program, a new Invasive Animals CRC commenced its operations in 2006 specifically to deal with these threats. The IA CRC will focus on helping to solve invasive animal (vertebrate) pest problems through the development of commercial outputs, integrated strategies and business partnerships that bring together national and international skills in science, management, commerce and industry. Comprising a large number of members (41), the IA CRC will assemble critical mass to address an Australasian problem and it will bring together private and public land managers to integrate approaches to invasive animal management. This unique partnership will deliver the means to deal with existing high profile invasive animal pests as well as those that have the potential to cause catastrophic impacts in the future. Outcomes will help solve the prominent and costly impacts of invasive species on agricultural, environmental and social values.

Key words: invasive animal, vertebrate pest, research management, impact

Why invasive animals?

Invasive animals include introduced and native animals that have or may become overabundant and pose threats to agriculture, the environment or human health and safety. At least 80 species of non-indigenous vertebrates have established wild populations in Australia and more than 30 of these species have become pests (Bomford and Hart 2005). Precisely costing the impacts of invasive animals on the Australian economy is difficult, particularly when trying to include environmental and social losses. Estimates of the different costs are incomplete and those that have been made need refinement and further justification if they are to be used to prioritise and stimulate further action on invasive species (Agrtrans Research 2005).

A recent conservative estimate for Australia was \$720 million p.a. (McLeod 2004) although this only included data for 10 terrestrial and one freshwater species. Feral pigs, rabbits, foxes and feral cats were estimated to account for 83% of losses and agricultural productivity loss accounts for about half of total costs estimated. Most agricultural sectors suffer significant economic losses from invasive animals. Notably, these losses occur through predation of livestock, crop damage, competition for feed and costs of control. Invasive animals have also markedly altered our landscapes, reduced our biodiversity and through events such as mouse plagues, disrupted communities.

Invasive animals have been a major factor in Australia's unenviable record of having nearly half the known mammalian extinctions worldwide in the past 200 years (Short and Smith 1994). They are strongly implicated in the serious decline of Australia's native freshwater fish populations and degradation of aquatic ecosystems (Lintermans 2004). Invasive animals are also identified as threatening 14 of Australia's 15 World Heritage Listed areas and 13 of 15 "Biodiversity Hotspots", the latter

identified by the Australian Government's Threatened Species Scientific Committee, with input from recognised experts in the field of biodiversity conservation from each Australian State and Territory (<http://www.deh.gov.au/biodiversity/hotspots/national.html>). The devastation inflicted by invasive animals on Australia's indigenous animals and fish has been massive and despite the population's general support for wildlife protection, the threat is unabated. Australia is listed as having the sixth highest number of threatened and vulnerable combined mammal, bird and fish species, out of 245 countries and territories (IUCN 2004).

Historically, management activities and much supporting Government legislation have sought eradication of invasive animals, as demanded by their pest status. Some efforts (public and privately funded) to combat invasive animals have met with nation building success, such as the establishment of dingo fences and the release of myxomatosis (Rolls 1969). Despite these occasional successes and ongoing control efforts, many invasive animal pests continue to survive at densities sufficient to cause significant, ongoing damage to our agricultural production and conservation values. This reflects the inherent difficulties of dealing with such pests, the often poor cooperation and coordination among key stakeholders, and significant impediments to innovation and effective application of technology that still exists. Australian markets for invasive animal solutions are often restricted and the barriers to entry, particularly regulatory compliance, are prohibitively costly in relation to market scale. The cost of registering a new toxin, for example, is beyond the capacity of small to medium enterprises to deliver, yet the benefit to national industries such as grain or wool might be measured in the tens of millions

of dollars annually. Further, despite the objectives of developing controls which are more humane and target-specific, regulations governing animal ethics and welfare can restrict the research required for new product registration of lethal control agents.

The Invasive Animal CRC Ltd (IA CRC) will address these issues, by bringing together for the first time, a national collaboration of skills in research, extension, training and market development, industry providers and key end-users to combat the most damaging of Australasia's invasive animal pests. It will also liaise with and inform important policy makers such as the Vertebrate Pests Committee; a national advisory group sanctioned by the Natural Resources Management Standing Committee (NRMSC). The partnership will concentrate its efforts on developing and putting the necessary tools and strategies in the hands of people who will utilise them for economic, environmental and social gain. The IA CRC will seek to empower local and regional groups to make a difference. This will bring about less reliance on government support i.e. acceptance of ownership (regardless of land tenure) with appropriate tools and training to deal with invasive pest management issues at the local level.

Reducing the impact of invasive animal pests can only be achieved by a partnership between the public and private sectors. No individual land manager or agency carries the whole invasive pest animal problem but all are responsible for making a contribution and a commitment to the solution. Invasive pests do not recognise land tenure, and roam freely across the 23% of Australia under public control, the 14% in Aboriginal and Torres Strait Islander custody, and the 63% in private hands. Most research into controlling invasive animals is undertaken in public R&D institutions. State and Federal agriculture and natural resource management agencies have played a significant role in managing public land and in supporting farmers, graziers, conservation managers and foresters in their efforts to control terrestrial invasive animals. Individual land managers often work to reduce on-site impacts, but the mobility and stealthy nature of these animals can make their local eradication difficult, if not impossible. Similarly, river systems inter-connect as do their fish populations. Management of a pest fish in one catchment is meaningless if the pest quickly recolonises from adjacent, unmanaged catchments. Australia is particularly vulnerable to many exotic (and endemic) livestock diseases for which widespread populations of invasive animals are important potential sylvatic hosts. Our ability to develop appropriate contingency plans for exotic disease emergencies is directly influenced by the ongoing effectiveness of pest management strategies and knowledge of current distribution and abundance: key issues to be addressed by the IA CRC.

IA CRC structure

A total of 41 organisations are giving their support to the IA CRC. The total comprises 35 Australian government agencies, industry bodies and small-medium enterprises, as well as six international organisations from New Zealand, Britain and the USA.

IA CRC will be run through five Research and Development Programs including Education and a sixth Business Services Program which includes the communication strategy. Projects have been developed in thematic areas under the Programs. Each project must demonstrate direct contribution to one of 13 Operational Targets or Outcomes:

1. Reduce impact of foxes and wild dogs by 10% (\$27 million p.a.).
2. Reduce feral pig damage by 15% (\$16 million p.a.).
3. Reduce rodent damage by 20% (\$7 million p.a.).
4. Reduce spread and impacts of carp and other pest fish leading to improved water quality.
5. Reduce impacts of feral cats over 5 million hectares.
6. Improve integration of existing and new rabbit control options, increasing agricultural profitability.
7. Develop at least one new tool for control of cane toads.
8. Reduce risk of disease transfer from invasive animals to humans and livestock.
9. Reduce the risk of economic losses, and environmental and social damage by forecasting and responding to new and emerging invasive animal problems.
10. Growth in the Australian invasive animal control industry through support of partners in addressing their problem species, registration, marketing, export and uptake of products.
11. Increase skills base in invasive animal management through education and training.
12. Establish national and local benchmarks for invasive animal impact, density and distribution from which performance can be assessed.
13. Effectively manage resources to achieve the CRC's research, education and technical transfer outcomes.

IA CRC Ltd will be governed by a skills-based Board of seven and will be constituted as an Australian not-for-profit company, limited by guarantee. This form of company provides an ongoing vehicle for the CRC beyond the anticipated seven-year funding period and suits the participants' objectives most closely. It is not expected that the company will build significant capital in its own right, existing to service the common needs of participant organisations, despite their widely varying organisational objectives.

Research and development programs

The national impact of invasive animals is clearly demonstrable as is the need for new and more effective control tools and management strategies. The variety of species which cause damage nationally is large. Although focussing on primary invasive animal pest problems (rabbit, fox, wild dog, carp, feral cat, feral pig, house mouse), IA CRC will explore additional significant problem species including feral goats, birds, feral deer, feral horses, feral camels, tilapia, rats and over-abundant macropods. Programs will also consider the detection and prevention of new or emerging invasive species from

becoming significant economic and/or environmental pests, or existing problem species further expanding their range into previously non-impacted regions of Australia. IA CRC activities will also develop contingencies for protecting Australia's agricultural industries from suffering catastrophic losses by enhancing our capability to rapidly respond to outbreaks of exotic diseases where invasive animals are potential vectors.

Successful biological control methods deliver outstanding returns. More than half a century after its release, myxoma virus still kills half the rabbits born in Australia annually, for zero expenditure. We aim to deliver biocontrol solutions for the house mouse and carp based on new generation biotechnologies, and improve the effectiveness of Rabbit Haemorrhagic Disease (RHD), already estimated to have provided \$4 billion in benefits. Currently, bait-based control technologies for invasive animals require registered toxicants. Most are dispensed by authorised agents, commonly State government agencies or via rural merchants. Where commercially feasible, new projects in the IA CRC will include members from all parts of the delivery path and will establish clearly defined routes to market application thus increasing the commercial viability and adoption of new products. New target-specific baits and toxins, national approaches to policy development and delivery to larger markets will help reduce long-term control costs and increase ease of management by providing more effective means for individuals and agencies to take cost-effective action.

Optimising control efforts will lead to improved outcomes at local and regional levels. IA CRC's research programs will focus on enhanced delivery through better information systems, development of 'best practice' pest management strategies, policy and socio-economic analysis, removing impediments to adoption (policy, regulatory, legislative, social) and the use of large-scale demonstration sites that showcase practical solutions to pest control. Many of the programs in the IA CRC are also designed to assist in the development of a more viable pest animal control industry in Australia.

The decision to make the IA CRC an "Australasian" effort rather than solely Australian reflects the scale of the pest problems shared by Australia and New Zealand. As well, the differing systems of landscape management in the two countries will stimulate an active exchange of ideas. Similarly, a strategy for engagement of researchers outside of Australia has been undertaken with great care. International partners have been selected because of the specific skills they can contribute and only where a clear mutual benefit exists. International cooperation will be a very strong part of the IA CRC and will operate at an active research level. Moreover, the opportunity to export products and services from Australia to other countries in the region will be encouraged. This will build on export potential for both technology and skills in the field that have been developed by the private and public sectors over many years.

The IA CRC activities will span vertebrate invasive animal species occupying terrestrial or freshwater habitats. There are four Research and Development Programs as well as an Education Program. Key activities within these programs are described below:

Terrestrial Products and Strategies

This program covers a wide range of species management issues and represents a continuation of some work begun in the Pest Animal Control CRC, along with a considerable amount of new work.

National Control Strategies:

- Develop new control techniques and delivery methods for over-abundant fox, wild dog, herbivore (including native species), bird and feral pig populations.
- Virally vectored mouse immunocontraception (VVIC) work will be inherited from the previous Pest Animal Control (PAC) CRC.
- Field demonstration of the effectiveness of feral cat baits in relation to wildlife conservation through sound ecological underpinning of control programs.
- Prolong and improve the success of RHD which has already been extremely successful in particular regions of Australia and New Zealand. Substantial benefits to the agricultural economy could be produced if we can understand why the virus has not been successful in the more temperate and high production agricultural areas. Improved integration of existing biological and conventional control options is vital to ensuring a long-term reduction in the impacts of rabbits.

Tactical Options:

- Provide R&D support to register target-specific, welfare-improved, lethal toxicants and disseminating biocontrol technologies.
- Species specific bait and toxin developments are required by land managers. Completely new toxins are likely to be very expensive to register and modification of existing products may be preferable.
- Investigate commercial harvesting option as a means of reducing the impact of species such as feral pigs, feral goats and kangaroos with associated economic gain.

Emerging Issues:

- Examine the potential of novel strategies and techniques to control pest impacts. These might include repellents, attractants, vaccines and new techniques for studying / understanding invasive animals.
- Welfare-based solutions to address a growing public expectation that animal suffering associated with pest management be minimised. There are both ethical and commercial opportunities available in the development of new, or modification of existing control strategies.

Freshwater Products and Strategies

The overarching objective for this Program is the preparation of an integrated pest fish management strategy for Australia containing the latest available methods and options for pest fish control.

National Biocontrol:

- A key component will be development of "Daughterless" technology. This revolutionary technique uses recombinant technology to convert female fish into

fully functional males, thereby distorting population sex ratios and leading to the decline in pest populations. This approach will be developed for carp (*Cyprinus carpio*) in Australian inland waters, while also testing its potential for other pest fish species. The approach is relatively high-risk and requires long-term support. However, if successful, it could revolutionise pest management strategies and be applicable to a range of pests.

- Koi carp herpesvirus feasibility (KHV) - CSIRO Livestock Industries, through the Australian Animal Health Laboratory, will conduct a feasibility study of KHV as a possible biological control for carp.

Tactical Options:

- Development of specific response plans and early warning strategies, in conjunction with State agencies, to respond rapidly and effectively to newly invasive fish species.
- Containment technologies. For species whose range is still spreading, it is imperative that methods be developed to slow or stop spreads at minimum costs to, for example, irrigators and water industries.
- Biocides. Toxins represent a potentially highly effective control option for aquatic species, but R&D on the field has been limited and no toxins are currently registered in Australia for use against even the major pest fish species. Biocides that show promise will be fast-tracked for further development and, with industry partners, progressed to the registration stage.
- Pheromone trapping. Many fish species have extremely highly developed olfactory senses, which might provide options for attracting fish to areas where they can be successfully trapped or where the use of toxins can be more effective.

Vulnerability analysis:

- A coordinated multi-State and Commonwealth initiative will be undertaken to assess the ecological, behavioural and physiological weaknesses of invasive fish species, starting with carp and *Tilapia*, in order to evaluate and then trial innovative approaches to integrated pest control.

Uptake of Products and Strategies

Management of invasive pests is complex because it exists in a social context. Any bio-physical solutions to invasive pests must be grounded in a solid science-based understanding of the problem. It must, however, also address the problem in its practical, social, ethical, and legislative context.

Demonstration Sites:

- Major demonstration sites will be established to research the practical management of invasive animals in different social (e.g. land tenure, ethical challenges) and technical (e.g. pest species, ecosystems) environments across Australia (figure 1). Demonstration projects will be the focus for participatory action research programs to discover how to manage complex invasive pest control.
- Demonstration sites will be the first 'port-of-call' for new IA CRC products and strategies. Biocontrol methods (carp), baits (fox, wild dog, feral pig, rabbit), viruses (house mouse, carp, rabbit), and lures (fox, wild dog, carp, feral pig) and innovative strategies that move beyond simplistic single-species / single-solution concepts will be ground proofed through exhaustive and publicly critiqued ecological experimentation.

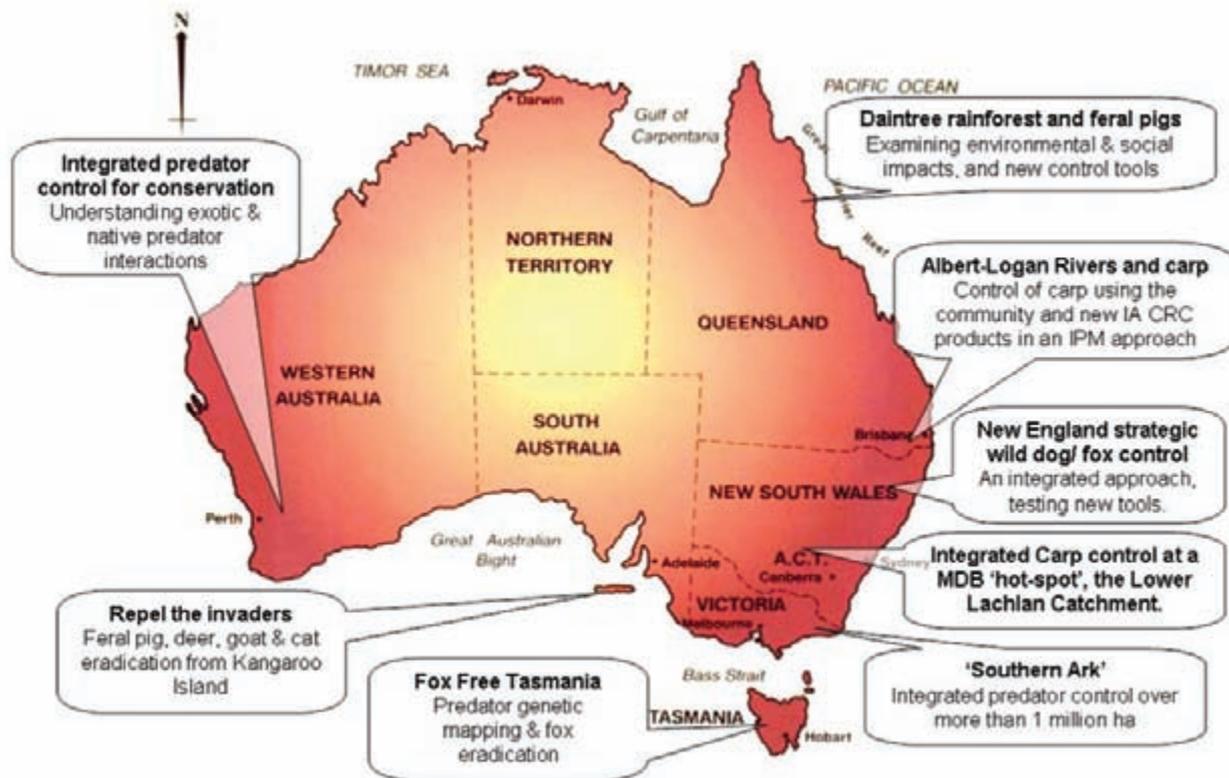


Figure 1. Location of demonstration sites

Community dialogue:

- A series of initiatives will be established to actively engage the community in the process of invasive animal product and practice development.
- The IA CRC will build on the 'Feral.org.au' project undertaken by PAC CRC. This project will provide an online resource for all professionals and community interests, allowing dissemination of much inaccessible information.
- To ensure a timely uptake of IA CRC products, practices and strategies, industry and environmental lines of communication will be used to initiate the 'bush telegraph' and land manager endorsement. This will be particularly relevant at demonstration sites. This will only be achieved through open lines of communication between land managers and the IA CRC in regards to outcome and output success.

Commercialisation:

- The Uptake program will be responsible for managing the Intellectual Property generated by the IA CRC. Commercialisation activities will be geared towards maximising the financial, environmental and social return on the Commonwealth and IA CRC-partner investment in the organisation. The fiscal and in-kind human capital invested by the IA CRC's 41 partners means that product development overheads can be kept to a minimum. Furthermore, substantial industry investment and a solid sociological understanding of what is required by land managers means that rapid uptake of novel products is anticipated. *AIA Offshore* further strives to assist international partners within the United Kingdom, United States and New Zealand with appropriate and humane non-lethal and lethal wildlife management tools, so the necessary scales of production can be achieved, and the maximum economic return accrued.

Detection and Prevention*Information Systems:*

- Develop and implement an information system that will improve coordination and evaluation of effort on a national, regional and local level.
- National survey and inventory procedures for pest animal populations incorporating property management information systems; will also help serve as benchmarks for ongoing performance assessment.
- Develop decision support systems to assist in the management of invasive animals. These will be appropriate for conventional control of existing invasive pest populations and for emergency situations such as exotic disease in feral pigs.

Early Warning:

- Develop and implement improved, cost-effective risk management strategies and response options to restrict introductions or the range of invasive animals.
- Early warning strategies based on risk analysis and identification of hazards i.e. expansion of range of existing pests, exotic/endemic disease risks.

- Forecasts of outbreaks of pest species based on ecological studies, habitat and population modelling in response to climate and land use change.
- Development of tools for pest monitoring, particularly at low densities (early stages of invasion).

Policy, Socio-economics and Ecological solutions:

- A better understanding of the social and economic impacts of animal invasions will improve priority setting, design of control programs and remove constraints to innovation or control.
- Bio-economic modelling will provide informed decisions about managing invasive species and allocating resources. This requires an understanding of the economic and ecological impacts and economic benefits associated with new control tools and strategies.
- An international Consensus Group on Economics of Invasive Species will also be created to generate new, internationally benchmarked, methodologies for assessing the non-agricultural impacts of invasive animals.

Preparedness through Education*Postgraduate Training:*

- IA CRC will fund 24 scholars.
- Student cohorts to commence in 2006, 2007 and 2008. By organising postgraduates into cohorts we will build a team spirit that will benefit individuals as well as having long-term national benefits.
- Commitment by IA CRC to a comprehensive four-year program for each PhD student; which will include the potential for students to participate in a Research Leadership and Management short-course based program leading to a Certificate of Achievement.
- The placement of students within industry to better prepare graduates for the work place, aid in the development of industry networks before graduation, improve the job prospects of our students, and better match the research effort being conducted with the requirements of our industry partners.
- An Honours research program comprising up to 30 scholars and focussed on projects which support the major research outcomes of the CRC and which will feed the 2nd and 3rd rounds of the PhD program.

Stakeholder Training:

- IA CRC will conduct stakeholder training and on-site workshops providing land managers and communities with the capacity to take greater and more effective action against invasive animal species.
- Training of trainers to deliver consistent national approaches to manage invasive species, facilitate a rapid uptake of new technologies, and provide the opportunity for two-way information flow.

Conclusions

These IA CRC outcomes will help solve the prominent and costly impacts of invasive species and will benefit a range of Australian sectors and deliver these services at a continental scale. Key sectors include the grains, horticultural and viticultural industries (rodents and/or birds), extensive grazing industries (wild dogs, foxes,

rabbits, feral pigs and disease risk), water use in agriculture, tourism and fisheries (carp) and the environment (all species). The IA CRC will create a continuum of stakeholders from perception of a problem, through R&D and marketing, distribution and on-ground application. It will also train scientists to continue the effort against invasive pests beyond the life of the CRC.

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