

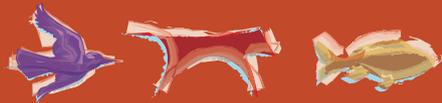
Invasive Animals Cooperative Research Centre

# ANNUAL REPORT

2012-2013 IA CRC



An Australian Government Initiative



Invasive Animals Cooperative Research Centre

# OUR PURPOSE

To counteract the impact of invasive animals through the application of new technologies and by integrating approaches across agencies and jurisdictions.



Invasive Animals Cooperative Research Centre Annual Report 2012-13 for the period 1 July 2012 to 30 June 2013 as per the Department of Industry (the Department) annual reporting requirements.

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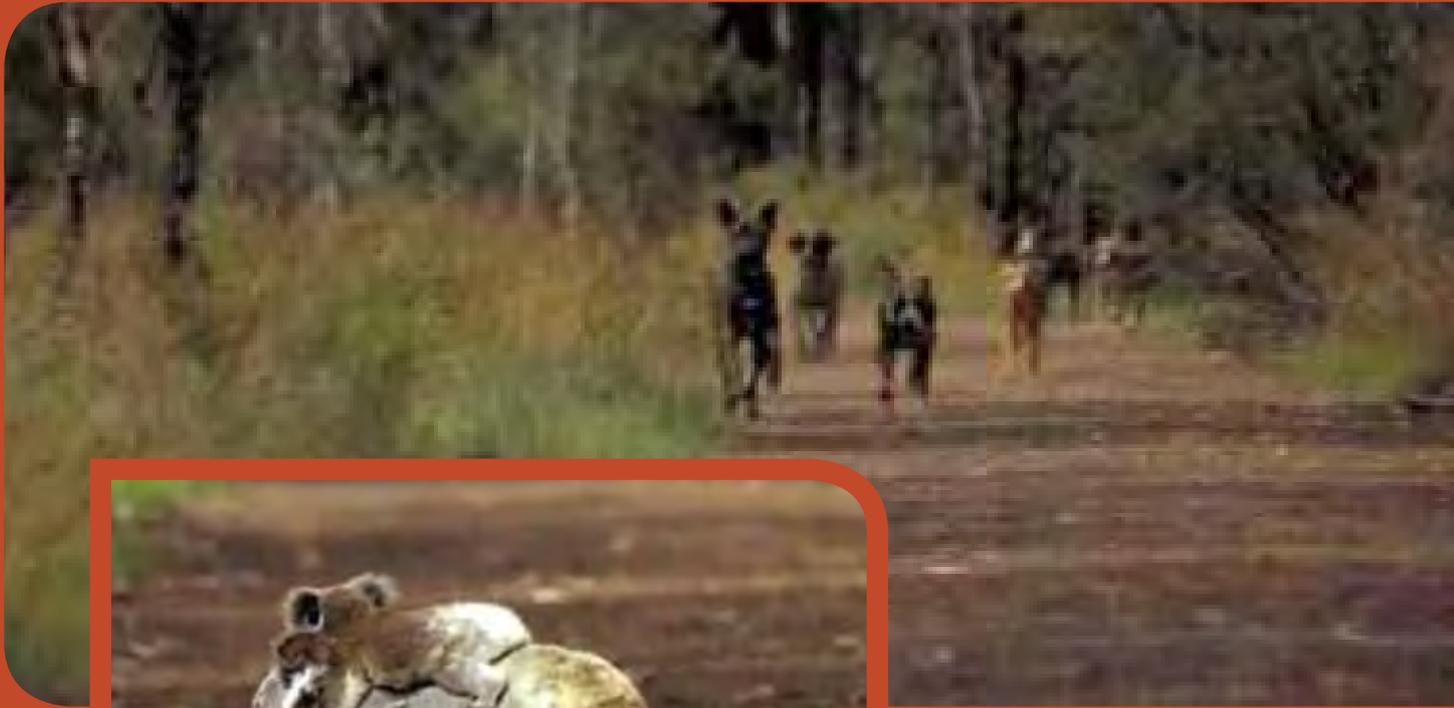
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Two rabbit biocontrols – myxoma virus and RHDV – have delivered agricultural benefits of \$70 billion over 60 years. Through its partners, the Invasive Animals CRC is building Australia’s vertebrate pest biocontrol research capability by investing in the largest strategic rabbit biocontrol research program in almost two decades.

# OUR PARTICIPANTS





A koala mother and her joey flee wild dogs at Koala Beach, near the town of Kingscliff, south of Queensland's Gold Coast.

With wild dog impacts rapidly increasing, a focus of the IA CRC's wild dog research program is analysing the policy, regulatory and institutional settings that best enable effective community-led wild dog control.

# NATIONAL CHALLENGE

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Rabbits, foxes, wild dogs, carp, feral pigs and other invasive animals are a serious threat to Australia's food and fibre security, our globally significant biodiversity and social wellbeing. Around the turn of this century, in the midst of a severe prolonged drought, invasive animals cost Australia at least \$740 million per year in lost agricultural production and control costs.

Invasive animals are also among the biggest threats to the conservation of Australia's wildlife and the environment. Foxes, feral cats, rabbits and rats have contributed to numerous mammal and bird extinctions and impact on hundreds of threatened plant and animal species. The rabbit, for example, impacts 75 threatened species and native vegetation over two-thirds of Australia.

New and emerging pests, combined with new challenges posed by established pests, have created a dynamic and constantly changing situation. This is all compounded by the nature of the challenge. It is chronic and diffuse, and it lacks clear ownership and responsibilities, factors that have often led to market failure of commercial efforts to control invasive animals. The situation has stymied innovation in many areas of invasive animal management, particularly in the development of new control technologies.

Furthermore, the reduced effectiveness of rabbit biocontrol technologies, societal demand for more humane controls and the global trend to restrict or withdraw available control products underscores the imperative for ongoing innovation. The response to this national challenge: industry and government collaboration through the Invasive Animals Cooperative Research Centre (IA CRC).

# CHAIR'S REPORT

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Helen Cathles

Globally we live in challenging times and in Australia external pressures impact our production and natural wealth. Asia continues to grow in trade importance and focus, as the global economy becomes more Asian-centric. While this creates market opportunities and competition, it also adds a higher potential risk for pest incursions with an increase in commerce and tourism traffic. Our vital communications are virtually instantaneous, nationally and internationally, but universally they are not always reliable.

The increasing climate change-induced stress on our landscape has been further complicated by a structural change in rural demographics, creating a loss of expertise in both land care and pest management. The most recent census reports an 11% drop in the number of farmers in the last five years down to 157,000, a far cry from the 263,200 just 30 years ago. Another compounding factor is the shrinking investment in extension services and NRM, with NRM moving into a more land-service model. This highlights the value of approaches such as the Invasive Animals Cooperative Research Centre's (IA CRC's) wild rabbit biocontrol research project.

Coinciding with these declines across the nation is the increase in wild dogs, wild rabbits and feral pigs, to name a few. And in the case of wild dogs, their expansion is forcing rangeland sheep production to a tipping point where, unless efforts are boosted and better coordinated, some scientists suggest that wild dogs may eliminate rangeland sheep production within 40 years.

In temperate areas, the cost is also high. My personal experience as a superfine wool producer is that in addition to killed and mauled sheep, wild dog trauma to sheep can create a 'break in the wool' that reduces the value at auction by up to 60%. And the health of the sheep never returns to full bloom.

Food security, fibre and animal production and native fauna and flora are all at risk from pest animals. Additionally, recent natural phenomena of droughts and floods have encouraged mouse plagues and an explosion of carp throughout the Murray-Darling Basin.

There are no 'still waters' in the Australian landscape. These are the high stakes that are the drivers, bringing 27 Participants together across four countries, to form one of the world's largest integrated pest animal research and development initiatives – the Invasive Animals CRC.

Public sentiment demands that we focus on predicting and preventing problems rather than just responding to them. In our society we have the luxury of affluence giving us the opportunity to demand forward thinking and proactive approaches with good animal welfare, targeting humane control methods.

In the midst of all these factors we are managing a complex CRC extension that addresses some of these issues, ensuring that the considerable investment in innovation over the past seven years delivers on new products and services for land managers.

The past year has focused on two key strategic issues. The first has been the establishment of our extension as a CRC with all the head and critical third-party agreements in place and finalising, and commencing over 80% of the research portfolio in the first year worth more than \$50 million. This accelerated start-up was extremely ambitious and required the support of the entire IA CRC team. It is the result of Participants being engaged in both the design of the research, development and extension program, and its early implementation. Plus the determination and a 'can do' culture in this CRC's management and research teams.



The second key strategic issue has been working our way through the first phase of our strategic thinking to shape an enduring organisation ready to address future challenges relating to invasive animals in the four key areas – production, biodiversity, conservation and human health. It was essential to start this process early to ensure a successful outcome ready for an orchestrated implementation in a favourable timeframe.

Over the past eight years, the IA CRC has played an important and unique role forging an independent and trusted international collaboration organised around some of the big pest challenges facing Australia, New Zealand, the United States and the United Kingdom.

The Board has a clear philosophy and commitment to continue this collaborative approach and started a collaborative process last December to build our future organisation. As we have been exploring the options, we have been delighted with the positive ‘buy in’ to the process by existing partners and potential investors. The Board anticipates that from the Participants meeting this November, the process will yield a substantive outcome that the Invasive Animals Ltd (IAL) Board can take forward.

We are all stakeholders in the bigger invasive animal impact picture and we are in a privileged position of having an extraordinary opportunity to establish an ongoing visionary organisation by leveraging all that

the current and previous CRCs have achieved. We need a bold, energetic and focused approach to the future and to the development of a self-sufficient organisation.

Last November, Professor Dave Choquenot was elected a Director to the IAL Board and his input throughout this year has been welcomed. We now have the difficult scenario of four Directors and the Chair all standing for re-election. The dedication, diverse experience and skill depth in the current Board have served IAL and the IA CRC well.

My sincere thanks to the Board who have passionately and diligently governed the IAL and the IA CRC extension start-up, particularly my Deputy Chair Dr Dedee Woodside who has contributed many additional hours and given valuable counsel.

And to our Participants whose continued support and ongoing input is highly valued, the Board sincerely thanks you. The willingness to collaborate and respect for diversity that we all share is the key to our current and future success.

To the entire management and research teams led by our CEO Andreas Glanznig, the Board recognises and sincerely thanks you for your tenacity, outstanding commitment and achievement at the close of year one. This achievement is a reflection on the CRC’s people and our four core qualities – skill, experience, collaboration and a generosity of spirit.

Helen Cathles  
Chair

# CEO'S REPORT & EXECUTIVE SUMMARY



Andreas Glanznig

The launch of the Invasive Animals (IA) CRC extension in October 2012 heralds the delivery of a high impact research and development program to reduce pest animal impacts. With only five years to make a difference, CRC management and researchers have worked hard to get over 80% of our research, development and extension portfolio – worth over \$50 million – in place in our first year.

This platform puts the CRC on track to deliver a range of new technologies to help protect our food and fibre security, globally important biodiversity, and to build research capability at a time when many scientists working in this area are nearing retirement age.

## RESEARCH HIGHLIGHTS

### *Environmental DNA as a pest fish detection tool gains momentum*

New and emerging invasive fish pose a major risk to aquatic biodiversity. Early detection greatly improves the chance of successfully preventing any new incursion, however, to date, this is hampered by the

cost and efficiency of current methods. Two projects led by the Queensland Government's Department of Agriculture, Fisheries and Forestry and the University of Canberra are addressing this challenge by developing new surveillance techniques based on environmental DNA technology. These projects are evaluating this technique in the detection of tilapia – a major pest fish spreading in Queensland – and a multi-species surveillance technique that if successful will provide a very cost-efficient way of finding new pest fish incursions.

### *New carp biocontrol agent evaluation on track*

Overseas, up to 80% of European carp have been killed by the introduction of the Cyprinid herpes virus-3. This naturally occurring virus is found on most continents, including Indonesia and Japan, where it has proven to act only on carp and carp-goldfish hybrids. To ensure this potential biocontrol agent for carp is effective and safe in Australia, the scientific evaluation of Cyprinid herpes virus-3 continues to make

## IA CRC 2 officially launched

Chair of the CRC Committee, Neville Stephens AO, officially launched the IA CRC extension at Parliament House in Canberra on 15 October 2012. In his speech, Neville Stephens highlighted the recent study into the impact of the CRC Program and cited the Invasive Animals CRC as a high-achieving CRC.

*Photo courtesy of Geoff Comfort*



solid strides. Research undertaken at CSIRO's Australian Animal Health Laboratories (AAHL) near Geelong has now shown that carp found in Australia are highly susceptible to the virus, and that it has no effect on 10 native fish species nor trout. Chickens and mice (being representative birds and mammals respectively) were also shown to show no clinical signs of disease.

### *Evaluation of new RHDV strains to boost rabbit biocontrol reaches final stage*

Since 1995, the Rabbit Haemorrhagic Disease Virus (RHDV) has reduced rabbit impacts and consequently boosted agricultural productivity by \$16 billion. To ensure these benefits are not eroded by increasing rabbit resistance, the RHD Boost project, led by NSW Department of Primary Industries' scientists, has evaluated a variety of naturally evolved RHDV strains now found in Europe and Asia. They are identifying new strains that can overcome this resistance, and ideally work more effectively in wetter, cooler parts of Australia than the existing RHDV strain already here. The field of potentially effective new RHDV strains has been narrowed down to one European and two Asian strains with the evaluation expected to finish by the end 2013. In tandem, the new Invasive Animals CRC RHD Boost roll-out has developed a robust release and monitoring framework, and monitored RHDV prevalence at selected sites.

### *Review of vertebrate pest eradication efforts to identify success factors*

One of the most cost-effective ways to avoid ongoing pest animal impacts is to eradicate them when feasible. This approach is generally used on islands and the mainland when pest numbers are very low. This approach has great promise for Australia by securing many of our wildlife-rich islands from threats such as black rats, which account for half of Australia's bird extinctions. University of Adelaide researchers have analysed and modelled existing eradication attempts to find why they succeeded or failed.

### *Research on horse fertility control agent starts*

Wild horses can have major environmental impacts, and fertility control has the potential to manage wild horse populations in areas where lethal control is not socially acceptable. A research team led by NSW Scientist of the Year – Professor John Aitken – has started its research to study horse ovaries and tissue with the aim of developing a reagent that can sterilise wild horses without surgery. This platform technology can potentially be applied to any mammal.

## EDUCATION HIGHLIGHTS

The Invasive Animals CRC has an exceptional PhD student completion rate. The previous CRC's 29 PhD students are on track for an overall completion rate of 96% by the end of 2013, which is well above the national average rate of 60%, average CRC completion rate of 64% and the Group of Eight completion rate of 68%. This outstanding result has been underpinned by our *Balanced Researcher* Program, which has taken a hands-on approach to supporting and mentoring our students as well as providing 80 days of additional training in leadership, management, commercialisation and communication. Our ongoing longitudinal study has confirmed that most PhD graduates have moved into government or university research roles to build Australia's research capability.

This high performance is continuing with the selection of 13 PhD students and four Professional Doctorate students. Of these, nine PhD students and four Professional Doctorate students were enrolled in the 2012-2013 financial year – a result one year ahead of schedule.

## APPOINTMENT OF KEY STAFF

### *New Chief Operating Officer*

The transition to the IA CRC extension was accompanied by the departure of the Chief Operating Officer – Dr Steve Lapidge – and his replacement by Tim Blackman. Dr Lapidge made a major contribution to this and our former CRCs, headed up our Adelaide office, and leaves a legacy of strong international collaborations, particularly with the USA. The Board and senior management thank him for his many accomplishments over nine years.

## PUBLICATIONS SUMMARY

During 2012-13, 89 publications were published by Invasive Animals CRC researchers and extension staff. These publications were produced under both the former IA CRC (2005-2012) and the IA CRC Extension (2012-2017). The split of publications between the two CRCs is detailed in Appendix B and summarised below.

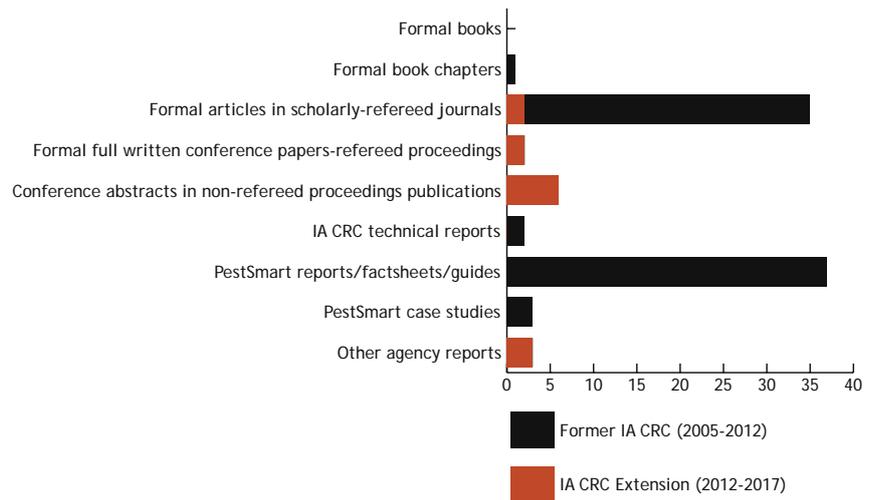
During 2012-13, the Invasive Animals CRC Extension (2012-2017) published:

- Two formal articles in scholarly-refereed journals
- Two formal full written conference papers-refereed proceedings
- Six conference abstracts in a non-refereed proceedings publication
- Two Invasive Animals CRC technical reports
- Three other agency reports

During 2012-13, the Invasive Animals CRC (2005-2012) published:

- One formal book chapter
- 32 formal articles in scholarly-refereed journals
- 41 PestSmart publications
  - » Five factsheets
  - » Two technical reports
  - » Four A5 guides
  - » 27 standard operating procedures (SOP)
  - » Three case studies

## 2012-13 IA CRC Publications



### NSW Scientist of the Year

Professor John Aitken – who is researching ‘Feasibility of humane non-surgical sterilisation of female mammals’ for the IA CRC was named NSW Scientist of the Year in November 2012. Based at the University of Newcastle, Laureate Professor John Aitken is a world-leading biologist whose work not only addresses animal reproduction but also human reproduction. John said “I am pleased to be working alongside an excellent team of researchers to address reproductive issues and pleased that the work has been recognised in the 2012 NSW Science and Engineering Awards”.



### Life membership award

Dr Mike Braysher (left) was awarded Life Membership of the Australasian Wildlife Management Society for outstanding service to the Society. Dr Braysher was presented with the award in December 2012 by Peter Fleming, who is President of the Australasian Wildlife Management Society, IA CRC canid research theme leader and Principal Research Scientist at the Vertebrate Pest Research Unit Biosecurity NSW, NSW Department of Primary Industries.



## Former Minister visited IA CRC

Australia's former Minister for Science and Research, Senator Don Farrell, visited the IA CRC and the University of Canberra in April 2013. First stop was a briefing from IA CRC Chair Helen Cathles and CEO Andreas Glanznig on their five-year research program to 2017, which is concentrating on biocontrol for wild rabbits and European carp, plus toxins for wild dog, foxes and feral pigs. The Minister then went on to see the University's DNA labs in action, which are working on IA CRC research projects including the detection of foxes in Tasmania from fox DNA in scats to using eDNA to detect pest fish such as tilapia.

Professor Stephen Sarre (left) and Anna MacDonald from the University's Institute for Applied Ecology briefed the then Minister Senator Farrell on the identification of multiple species using DNA sequencing. Photo: Michelle McAulay, University of Canberra.

## REVIEWS

The IA CRC six-month visit by the CRC Program Governance team on 6 March 2013 highlighted pleasing progress. The Department of Industry found that sound progress had been made with implementing appropriate governance and management arrangements, commencing research activities and participant engagement in the work of the CRC.

## TRANSITION PLANNING

The Governing Board has started a major process for strategy transition towards a sustainable national institute for pest animal control research and development with more diversified sources of income. The process is collaborative with current CRC participants and a wide range of potential investors and stakeholders. It commenced in December 2012 with a strategic workshop to exchange ideas and views on our way forward. This has been followed by quarterly Board and executive workshops to further develop these views.

The future organisation will continue to capitalise on the unique role that Invasive Animals Ltd plays in facilitating research collaboration and deploying solutions across jurisdictions. The future business model will take into account the public sentiment that demands the consideration of predictive and preventive management, good animal welfare, a strong reliance on innovative science to improve land and waterway management, and engagement with the community to promote community-led action.

## RISKS AND IMPEDIMENTS

The major risk to achieving uptake and impact of outputs relates to government approval and/or registration of key outputs, including new biocontrol agents and new toxins. This risk will continue to be mitigated to every extent possible through regular consultation with key regulatory bodies in project design to ascertain their information requirements. Invasive Animals Ltd will work closely with the government proponent – NSW Department of Primary Industries – to facilitate governance arrangements that enable coordinated government policy and regulatory assessment of the potential rabbit and carp biocontrol agents.



Signing the two partnership agreements between USDA and Invasive Animals Limited are IA CRC Director Dr Dedee Woodside (left) and IA CRC Chair, Helen Cathles.

## USDA partnership with IA CRC strengthened

Two agreements were signed in August 2013 to establish the IA CRC's partnership with the US Department of Agriculture (USDA), under IA CRC's mission to strengthen international collaborations. The agreements signed were the IA CRC Other Participants Agreement (OPA) that sits under the Invasive Animals Participants Agreement and the IA CRC Cooperative Research and Development Agreement. The signing of these agreements has the strong support of the IA CRC's Essential Participants, particularly those that will be integrally involved in the research program such as Animal Control Technologies Pty Ltd, Grains Research and Development Corporation and CSIRO. Much of the US side of the research will be undertaken at the USDA National Wildlife Research Center located at Fort Collins, Colorado.

These two agreements cover an important body of research and development for the IA CRC: investigating potential new toxins for starling management in Australia; investigating potential new rodenticides based on humane active ingredients; conducting field and environmental trials to enable registration of a feral pig toxicant in the USA; and investigating fertility control formulations for wildlife.

In addition to IA CRC's partnerships with USDA and Pennsylvania State University in the USA, the IA CRC also has strong New Zealand collaborations with NZ Landcare Research, NZ Department of Conservation, and Connovation (a NZ SME). The IA CRC also enjoys a strong ongoing partnership with the United Kingdom Food and Environment Research Agency (FERA).



The award was presented to Andreas Glanznig and Keryn Lapidge (IA CRC) and Steven Lapidge (formerly Invasive Animals CRC Uptake Program Leader) at the CRCA's Collaborate Innovate 2013 Conference in Melbourne, May 2013 (pictured with Rose Stellino who presented the award on behalf of Westpac).

## National award for PestSmart Toolkit and Roadshow

The IA CRC's PestSmart Toolkit and Roadshow project was awarded a 2013 Excellence in Innovation Award (Outreach Category) by the Cooperative Research Centres Association in May 2013. Using sound research by the IA CRC, the PestSmart Toolkit delivers the latest information on pest animal control to land managers all around Australia.

The Excellence in Innovation Award is valued recognition that the IA CRC is on the right path to deliver innovative technology to landholders to better control and manage pest animals. The PestSmart Toolkit is the result of the hard work of IA CRC researchers, field staff, writers, organisers and presenters and the funding of supporters of our research, which is continuing to 2017.

Industry and partner agency collaboration is critical to the success of the ongoing PestSmart project with funding, planning and delivery support provided by Meat and Livestock Australia, Australian Wool Innovation, ABARES, Murray-Darling Basin Authority and Animal Control Technologies Australia.

The PestSmart Toolkit presents best-practice management, practical planning and control information for key pest animal species in a range of formats including DVDs, fact sheets and glovebox guides. The National PestSmart Roadshow in early 2012 comprised a series of 20 face-to-face and interactive regional events held in every state and territory. Together, these events served to equip Australian land managers with the latest strategies and information to successfully tackle pest animal issues head-on. A further 41 PestSmart publications were produced during 2012-13.

# END-USER ENVIRONMENT

Australia as a whole experienced winter rainfall only 5% below the long-term average, however, there were large differences between states. Queensland and the Northern Territory recorded rainfalls two-thirds and a half less than their respective averages, while Victoria, Tasmania and South Australia rainfalls were about a quarter above the average.

Despite the dry in Queensland and the Northern Territory, wild dog and feral pig impacts have markedly increased. Rabbit impacts on productivity and native plant biodiversity are noticeably increasing in many areas of Australia. While there have been no significant mouse plagues over the past year there has been some mouse activity in Queensland.

In the longer term, a recent IA CRC study has highlighted that without a boost in coordinated regional wild dog control, the sustainability of the rangeland sheep industry is at risk. The strategic risk of wild dog impacts to the wool and sheep meat industries is real and the wool industry has responded by seeking to promote joint action on the wild dog problem through a National Wild Dog Action Plan. A positive move was the plan's development through an industry-government group, which signals joint interest and responsibility for this national challenge.

This action will happen with far fewer Australians living in rural Australia. Farmer numbers continue to fall, with the 2011 Census showing that farmer numbers fell by another 11% over five years. Of the remaining 157,000 farmers, the 2013 National Landcare Survey found that 80-90% of those surveyed were motivated by the economic impact of pests and weeds on their farms.

These structural changes – fewer farmers and less available labour to manage pest impacts, smaller governments that are reducing their agricultural extension

## OUTCOMES

The Invasive Animals CRC has five Outcomes:

**Outcome 1:** No new vertebrate pests established in Australia.

**Outcome 2:** Improved prediction and control of emerging outbreaks.

**Outcome 3:** Recovery of key land and water regions from rabbit, wild dog and carp impacts.

**Outcome 4:** Strengthened social networks and institutions around pest animal control.

**Outcome 5:** An enduring organisation dedicated to innovative pest animal control research and training.

services, increasing climatic variability and risk, and increasing urban demand for 'greener' food and fibre produce – highlight the challenge for Australia to develop a strategic response to these trends.

Indeed the IA CRC research, development and extension program was developed to position Australia ahead of this structural curve by developing and validating improved strategies, proposing policies and regulations that enable community-led action, and developing new efficient technologies that can be deployed to deliver regional and in some cases landscape scale results.

## IMPACT

The IA CRC's risk-adjusted expected economic impact from only the five potential outputs (RHD Boost, RHD Accelerator, HOGGONE®, a new rodenticide, and a new avicide) is more than \$1.2 billion, with a benefit-cost ratio of 14.27 to 1.

The very large economic return on investment and benefit-cost ratio is primarily due to the development of strengthened biocontrol agents for Australia's most economically costly pest animal – the rabbit. Independent economic analysis by AgTrans Research calculated that the RHD Boost project had a net present value (NPV) of \$987.4 million, a benefit-cost ratio (BCR) of 123.2 and an internal rate of return (IRR) of 191%, while RHD Accelerator had a NPV of \$78.9M, a BCR of 48.1 and an IRR of 38% (AgTrans 2011).

The cost effectiveness of invasive animal biocontrol agents has long been recognised. This is exemplified by the myxoma virus – 55 years since its release, myxomatosis still kills 40-50% of rabbits born and to date has delivered agricultural productivity benefits of \$54 billion to the nation.

The economic benefit of improved rabbit biocontrol was calculated based on both the agricultural productivity as well as carbon storage through native vegetation regeneration based on a cost of \$20/tonne of carbon equivalent. Any change in the cost of carbon above or below this value will change the overall economic impact delivered through any successful release of a new strain of Rabbit Haemorrhagic Disease Virus (RHDV) through the RHD Boost or RHD Accelerator projects.

The challenge of formulating an effective HOGGONE<sup>tv</sup> bait will delay the previously anticipated time to market, however, the IA CRC partnership between Animal Control Technologies, US Department of Agriculture, and other partners, has focussed effort on resolving the outstanding technical issues in a timely fashion.



Cameron Martin (Masters student, Sul Ross State University), Justin Foster (Research Coordinator Region II, TPWD), Mike Bodenchuck (State Director - Wildlife Services, Texas, USDA), Linton Staples (Animal Control Technologies Australia), Kurt Verauteren (Research Wildlife Biologist USDA-APHIS-National Wildlife Research Center), Bruce Leland (USDA-APHIS-Texas Wildlife Services) and Greg Phillips (Wildlife Biologist, USDA-APHIS-National Wildlife Research Center). Photo: John Eisemann (USDA Registration Manager, APHIS-National Wildlife Research Center).

## HOGGONE<sup>®</sup> baits and HOGHOPPER<sup>®</sup> trialled in Texas

Feral pigs may have been a problem in Australia for a while, but they are also a growing problem in the United States. The problem has grown from less than two million pigs in 20 states in 1990 to an estimated six million pigs in 47 states today. They are also heading north with feral pig problems being experienced in Michigan, New Hampshire, New York, North Dakota, Ohio, Oregon and Pennsylvania.

While the US shares feral pig impacts with Australia such as damage to pasture and wetlands and the killing of livestock, feral pigs in the US also spread diseases like pseudo-rabies. Texas Parks and Wildlife has been trialling IA CRC-developed HOGGONE<sup>®</sup> baits and the HOGHOPPER<sup>®</sup> bait delivery device.



Juvenile carp aggregating at the Menindee dam wall, Darling River, NSW in September 2011.

# NATIONAL RESEARCH PRIORITIES

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The IA CRC aims to create new tools and strategies to assist partners and the Australian community at large to manage invasive animals. However, the development of tools is not sufficient. The IA CRC must ensure that any outcomes are:

- socially acceptable
- ecologically effective
- commercially viable.

Most of our activities address the National Research Priority ‘Safeguarding Australia’. Under this Priority, the IA CRC works directly towards the outcome of ‘Protecting Australia

from invasive diseases and pests’. About 20% of our activities also contribute to the outcome of achieving ‘Sustainable use of Australia’s biodiversity’.

The IA CRC’s broad membership comprises a unique partnership, creating critical mass to address this national priority – it brings together private and public land managers to integrate approaches to invasive animal management. The IA CRC is committed to delivering 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.

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## National Research Priorities

## IA CRC Research 2012-13

An Environmentally Sustainable Australia - Transforming the way we use our land, water, mineral and energy resources through a better understanding of environmental systems and using new technologies.

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Sustainable use of Australia’s biodiversity.

20%

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Safeguarding Australia – Safeguarding Australia from terrorism, crime, invasive diseases and pests, and securing our infrastructure, particularly with respect to our digital systems.

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Protecting Australia from invasive diseases and pests.

80%

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# STRUCTURE AND GOVERNANCE

## STRUCTURE

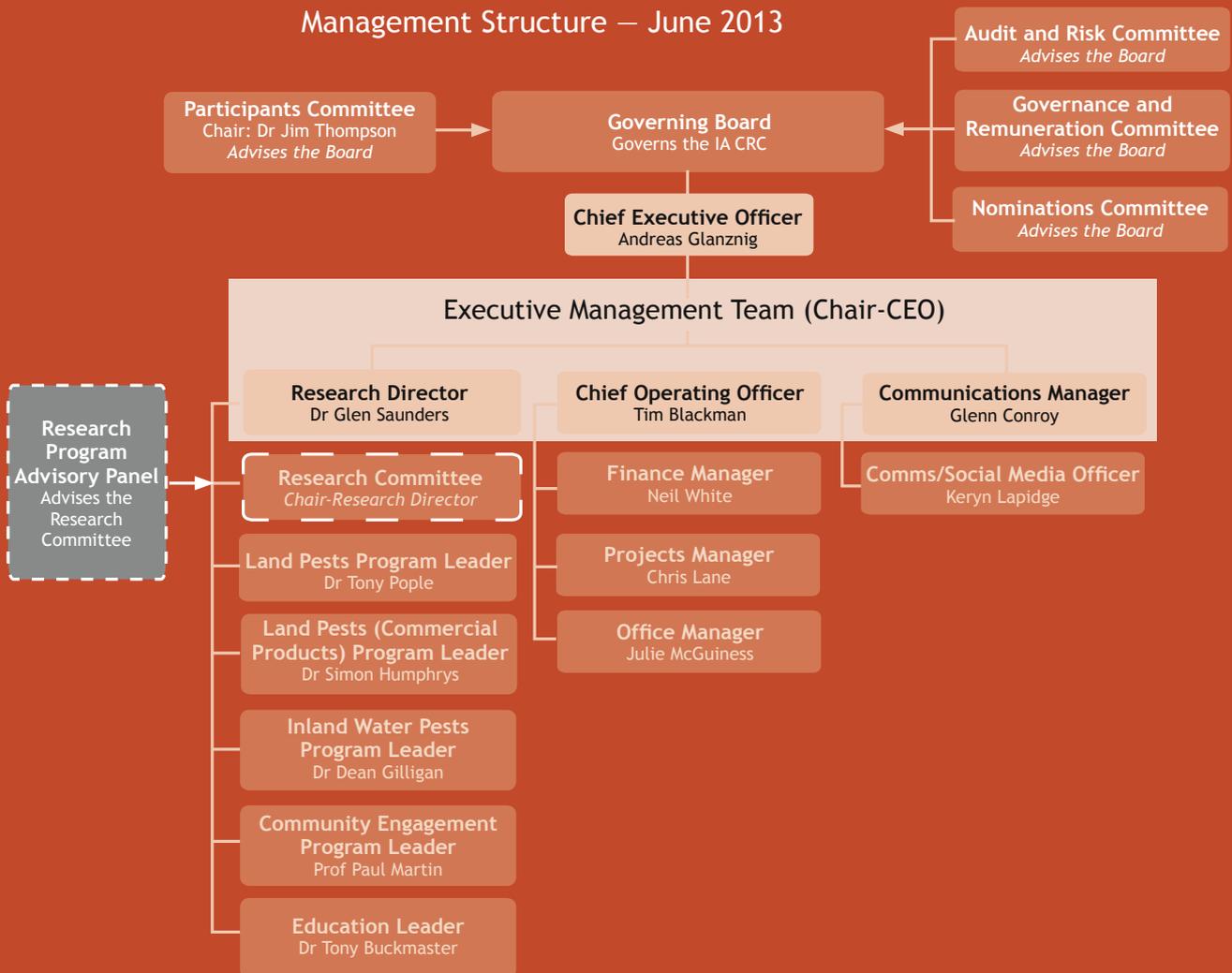
The Invasive Animals CRC is a joint venture arrangement between the Participants, which includes the managing company, Invasive Animals Ltd. Invasive Animals Ltd is a public company limited by guarantee. It has been endorsed by the Australian Taxation Office as a tax concession charity and is exempt from income tax.

The structure and governance of the Invasive Animals CRC provides strong support to its operations. The CRC is led by a Board of skills-based Directors, the majority of whom

are independent from the participants of the CRC. The Governing Board meets at least four times a year and is committed to compliance with the Australian Securities Exchange (ASX) Corporate Governance Principles and Recommendations.

In carrying out its governance role, the main task of the Board is to drive the CRC strategy, to develop policies and monitor and review performance to ensure that the CRC achieves its research and adoption/utilisation goals. The Board also approves the CRC budget and ensures the Company complies with its contractual, statutory and other obligations.

Invasive Animals CRC Governance and Management Structure – June 2013



## Board Members



**Helen Cathles**  
Chair  
Independent  
Corporate  
Governance,  
Primary Production,  
Pest Animal Control



**Dr Dedee Woodside**  
Deputy Chair  
Independent  
Conservation,  
Social Sciences,  
Business &  
Commercial



**Dr Helen Scott-Orr**  
Director  
Independent  
Primary  
Production, Pest  
Animal Control,  
R&D Management



**Prof Dave Choquenot**  
Director  
Director  
Institute of Applied  
Ecology, University  
of Canberra  
Corporate  
Governance,  
R&D Management



**Manfred Claasz**  
Director  
Independent  
Communication,  
Business and  
Commercial,  
Risk Analysis



**Dr Phil Cowan**  
Director  
Landcare Research  
NZ  
Corporate  
Governance, Pest  
Animal Control,  
R&D Management

## COMMITTEE MEMBERS

The Audit & Risk Committee has a documented charter approved by the Board. The Audit & Risk Committee has responsibility for the oversight of fiscal and legal matters to ensure appropriate procedures and internal controls are in place. The Committee is responsible for the independence of the external auditors and also manages the internal audit program.

The Governance and Remuneration Committee has responsibility for IAL governance policy and procedures and remuneration policy.

Responsibility for the Board Directors nomination process has been moved to the new Board Directors Nomination Committee. This Committee's Terms of Reference were approved by the Board on 9 August 2013.

In the 2013 financial year, Invasive Animals Limited paid \$1,070 for Director-related training, education and capacity building activities.

### Audit & Risk Committee Members

Name	Role	Key Skills	Independent/ Organisation
Dr Dedee Woodside	Chair	Conservation, Social Sciences, Business & Commercial	Independent
Dr Helen Scott-Orr	Director	Primary Production, Pest Animal Control, R&D Management	Independent
Manfred Claasz	Director	Communication, Business and Commercial, Risk Analysis	Independent

### Governance & Remuneration Committee Members

Name	Role	Key Skills	Independent/ Organisation
Dr Helen Scott-Orr	Committee Chair	Primary Production, Pest Animal Control, R&D Management	Independent
Helen Cathles	Chair	Corporate governance, Primary Production, Pest Animal Control	Independent
Dr Phil Cowan	Director	Corporate Governance, Pest Animal Control, R&D Management	Landcare Research NZ

## DIRECTOR'S MEETINGS

The number of Director's meetings and number of meetings attended by each of the Directors of the Company during the financial year are presented in the table opposite.

## KEY STAFF

Key staff\* sit on the Executive Management Team. This committee continually assesses the activities and performance of the CRC and provides management information to support the decision making of the Governing Board.

Director's Meetings						
Director	Board Meetings		Audit and Risk Committee		Governance & Remuneration Committee	
	A	B	A	B	A	B
Helen Cathles	4	4	—	—	4	4
Manfred Claasz	4	4	4	4	—	—
Dr Phil Cowan	4	4	—	—	4	4
Prof David Choquenot	2	2	1	1	—	—
Dr Helen Scott-Orr	4	4	3	3	4	4
Dr Dedee Woodside	4	4	4	4	—	—

A: Number of meetings held during the time the Director held office during 2012-13

B: Number of meetings attended.

—: Not applicable

## Invasive Animals CRC Management and Invasive Animals Ltd Staff

Name	Organisation	CRC Position/Role	Time Committed
Mr Andreas Glanznig*	Invasive Animals Ltd	CEO	100%
Mr Tim Blackman*	Invasive Animals Ltd	COO	100%
Mr Glenn Conroy*	Invasive Animals Ltd	Communications Manager	100%
Dr Glen Saunders*	NSW Primary Industries	Research Director	60%
Dr Tony Pople	Qld Agriculture, Forestry and Fisheries	Program Leader, Land Pests	75%
Dr Simon Humphrys	Invasive Animals Ltd	Program Leader Land Pests (Commercial Products)	100%
Dr Dean Gilligan	NSW Primary Industries	Program Leader, Inland Water Pests	50%
Prof Paul Martin	University of New England	Program Leader, Community Engagement	51%
Dr Tony Buckmaster	Invasive Animals Ltd	Education Leader	40%
Mr Chris Lane	NSW Primary Industries	Project Manager	100%
Ms Keryn Lapidge	Invasive Animals Ltd	Communications/Social Media Officer	60%
Ms Julie McGuinness	Invasive Animals Ltd	Office Manager	100%

## STAFF CHANGES

Dr Steven Lapidge, Chief Operating Officer – resigned on 31 August 2012.

Tim Blackman, Chief Operating Officer – appointed on 3 October 2012.

## Invasive Animals CRC Participants

NAME	TYPE	ABN/ACN*
Commonwealth of Australia through the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES)	Australian Government	ABN 24 113 085 695
Commonwealth of Australia represented by the Murray-Darling Basin Authority (MDBA)	Australian Government	ABN 13 679 821 382
Commonwealth Scientific and Industrial Research Organisation (CSIRO)	Australian Government	ABN 41 687 119 230
ACT Environment and Sustainable Development Directorate	State Government	ABN 31 432 729 493
ACT Territory and Municipal Services Directorate	State Government	ABN 37 307 569 373
Livestock Health and Pest Authority State Management Council, NSW	State Government	ABN 89 149 106 100
State of Queensland acting through its Department of Agriculture, Fisheries and Forestry; and Biosecurity Queensland	State Government	ABN 28 830 236 406
State of South Australia through the Department of Primary Industries and Regions (SARDI and Biosecurity SA)	State Government	ABN 53 763 159 658
State of Tasmania acting through its Department of Primary Industries, Parks, Water and Environment	State Government	ABN 568 259 330 901
State of Victoria through its Department of Environment and Primary Industries; and Biosecurity Victoria	State Government	ABN 42 579 412 233
State of Western Australia as represented by the Director-General of the Department of Agriculture and Food	State Government	ABN 18 951 343 745
The Crown in Right of the State of New South Wales acting through the Department of Primary Industries, an office of the Department of Trade and Investment	State Government	ABN 72 189 919 072
Animal Control Technologies (Australia) Pty Ltd	Industry/ private sector, SME	ABN 25 137 868 449 ACN 137 868 449
Australian Wool Innovation Ltd	Industry/ private sector	ABN 12 095 165 558 ACN 095 165 558
Grains Research and Development Corporation (GRDC)	Industry/Private Sector	ABN 55 611 223 291
Meat and Livestock Australia Limited	Industry/Private Sector	ABN 39 081 678 364 ACN 081 678 364
The University of Adelaide	University	ABN 61 249 878 937
The University of Newcastle	University	ABN 15 736 576 735
University of Canberra	University	ABN 81 633 873 422
The University of Queensland	University	ABN 63 942 912 684
University of New England	University	ABN 75 792 454 315
Connovation Ltd	International	NZ 831 417
Department of Conservation, New Zealand	International	Not Applicable
Landcare Research New Zealand Limited	International	Not Applicable
United States Department of Agriculture	International	Not Applicable
<b>Third party project participants</b>		
Braysher Consulting	Industry/private sector	ABN 35 078 050 718
Brisbane City Council	Local Council Agreement Pending	ABN 72 002 765 795
Gold Coast City Council	Local Council	ABN 84 858 548 460
Griffith University	University	ABN 78 106 094 461
Logan City Council	Local Council	ABN 21 627 796 435
Moreton Bay Regional Council	Local Council Agreement Pending	ABN 92 967 232 136
Somerset Regional Council	Local Council	ABN 77 195 375 530
Sunshine Coast Regional Council	Local Council Agreement Pending	ABN 37 876 973 913

## CHANGES TO PARTICIPANTS

Nil

\*Sources for ACN / ABN are Participants' Agreement with IA CRC, the ASIC website [www.asic.gov.au](http://www.asic.gov.au) and/or the organisation's website.

# RESEARCH ACHIEVEMENTS

The following is a summary of the research achievements obtained during the reporting year under relevant activity outcomes. Activity outcomes that relate to commercialisation and utilisation, and education and training are detailed under their own sections.

For further information on the IA CRC's research activities, refer to the *Invasive Animals CRC Research Portfolio Summary* (November 2013), which provides more detailed information on project progress aligning with the CRC's goals and milestones.

Download the full research portfolio from: [www.invasiveanimals.com/publications/research/](http://www.invasiveanimals.com/publications/research/)



## Mobile apps and web-mapping

Australia's first mobile field guide to pest animals titled *Field Guide to Pest Animals of Australia* (version 1.0) iOS App was launched by IA CRC in April 2013. The app received 5,000 downloads in its first 12 weeks. This new mobile platform is one of many planned by the IA CRC to support farmers and communities to tackle the problems caused by pest animals. The popular national pest mapping website FeralScan has also gone mobile allowing farmers and communities to use their mobile phones to map pest animals and note the damage they cause in their local area. The data entered in FeralScan is helping people to identify priority areas for pest animal control and is assisting land managers to work together to target pest animal hotspots.

Pictured: Peter West and Bec Crawford, from NSW DPI at Orange, who worked together to produce for the IA CRC the app 'Field Guide to Pest Animals of Australia'.

## OUTCOME 1: NO NEW VERTEBRATE PESTS ESTABLISHED IN AUSTRALIA

### National incursions response system and enabling technologies

The strategy to achieve this outcome is based on:

- Developing an incursion response decision support system and tools (including pathway analysis and risk modelling) for a nationally coordinated, efficient and effective response to new invasive animal incursions.
- Creating new phone and web mapping technology for pest management that will build stronger community involvement in citizen science mapping such as FeralScan.

#### 2012-2013 Highlights

- Community pest mapping website FeralScan ([www.FeralScan.org.au](http://www.FeralScan.org.au)) has attracted more than 22,000 community records and is now partnering with local councils and community groups Australia-wide.
- FeralScan Mark II (suitable for use on mobile smartphones) was released for greater community engagement, data sharing and targeted pest control. It includes community group settings and community action group logins.
- Data sharing with Atlas of Living Australia and state/regional pest management groups (such as NSW LHPA) commenced.
- Datasets compiled and entered into IA CRC database AusErad to record 650 feral vertebrate pest population eradication attempts.
- IA CRC report *Australian feral vertebrate pest eradications: A review and guidelines for future best practice* circulated to IA CRC stakeholders and end-user groups.

### Technologies and strategies for long-term Tasmanian fox incursion response

The strategy to achieve this outcome is based on:

- Developing an optimal strategy to eradicate foxes from Tasmania through the development of next-generation invasive carnivore detection tools, techniques and strategies using DNA and other detection techniques and thresholds through telemetry and detection probability analysis.

- Risk and long-term strategic planning to minimise impact to 76 native species and the Tasmanian sheep industry.

#### 2012-2013 Highlights

- Literature review, risk analysis report and reports on toxicant delivery mechanisms field trials are underway.
- Manuscript modelling probability of eradication of foxes from Tasmania submitted to the scientific journal *Biological Invasions*.
- Next-generation sequencing analysis of DNA from scats of known fox and non-fox origins and scats collected from the field in Tasmania.
- Project team completed an analysis of the data collected from a project undertaken by staff from Tasmania DPI/PWE to estimate the degradation rates of fox scats.

### Forecasting and adaptive management and planning

The strategy to achieve this outcome is based on:

- Strategic forecasting and planning to enable pre-emptive invasive animal management in priority regions using macro-ecological modelling to assess potential patterns of biological invasion under extreme weather events and climate change and determine the most cost-effective pest management strategies.

#### 2012-2013 Highlights

- Pest Information Hub (Pest iHub) workshop held in October 2012 to plan how to increase adoption of efficient pest management practices.
- Modelling results from Pest iHub were used to help inform a recommendation by the New Zealand Department of Conservation's Island Eradications Advisory Group to boost funding to the Resolution Island eradication team. This case study will serve as a model for other island eradications in NZ and Australia.

#### *Pest fish incursion detection technologies*

The strategy to achieve this outcome is based on:

- Developing pest fish detection tools to support a national incursions response system, including an efficient and accurate field surveillance technique to detect national and state priority pest fish at low densities.

- Assisting government agencies to better contain tilapia spread and prevent invasion of both Gulf catchments and the Murray-Darling Basin.

### 2012-2013 Highlights

- Environmental-DNA (eDNA) detection technology successfully transferred and running at James Cook University laboratories.
- Development and testing of new tilapia specific primers.
- Tested technology on known infestations in the Townsville region.

## OUTCOME 2: IMPROVED PREDICTION AND CONTROL OF EMERGING OUTBREAKS

The strategy to achieve this outcome is based on:

- Developing more efficient and sustained control of mouse outbreaks by enabling local preparation of grain-based baits and resulting in reduced impact of mice to grain producers.
- Research and development of a new humane rat and mouse toxin (and mouse outbreak response system).
- Advancing a new pest bird toxin to reduce the impact of starlings on intensive agriculture, particularly piggeries that currently lose up to 20% of their stock feed.
- Reducing social issues and controversy associated with kangaroo management through developing better managed peri-urban and urban kangaroo and wallaby populations through registration of a long-lasting injectable fertility control GonaCon™.

### Fighting mouse plagues

Australian cereal croppers have been affected by mouse plagues for more than 100 years. A plague occurs when the mouse population density increases from one mouse per hectare to 1,000 mice per hectare over a 12-18 month period. IA CRC research work has focused on understanding the mechanisms that lead to population increases and developing predictive models. Having accurate models gives farmers some warning that high mouse population numbers are expected and alerts authorities to the need to implement a range of control options to successfully manage high mouse population densities before the plague numbers peak. IA CRC researchers are also developing more efficient and sustained control of mouse outbreaks by enabling local preparation of grain-based baits and developing new humane rat and mouse toxins.

- Developing species-specific fertility control that can be applied to better and humanely manage those species where lethal control is not socially acceptable.
- Research and development of oral delivery of fertility control, which is a more efficient delivery of fertility control agents than darting or injectable methods.

### 2012-2013 Highlights

- Three levels of monitoring for mice have been established across all the major grain-growing areas of Australia (northern, southern and western regions).
- CSIRO staff and contractors have completed two rounds of monitoring, using the rapid-assessment and benchmark sites, in spring and in early winter as planned.
- Historical data on mouse outbreaks has been collated by Landcare Research New Zealand and converted to a spatial format (wherever possible) for use in predictive models. Possible predictive parameters (eg rainfall, index of vegetation greenness (Normalised Difference Vegetation Index (NDVI) from satellite imagery) have been identified to explain outbreaks of mice at a regional scale.
- Data collated; predictions made and report delivered to the Grains Research & Development Corporation (GRDC) for dissemination to producers and industry groups; including best current rodenticide practices.



## OUTCOME 3: RECOVERY OF KEY LAND AND WATER REGIONS FROM WILD RABBIT, WILD DOG AND EUROPEAN CARP IMPACTS

### Landscape control - Rabbits

The strategy to achieve this outcome is based on:

- Gaining regulatory approval for the release and monitoring of any new effective RHD Boost strains as part of a government-agreed integrated rabbit control implementation plan with the goal of reducing rabbit impacts for over two-thirds of Australia – 5.3 million square kilometres between 2015-2024.
- Creating a comprehensive RHD resistance model and strategic knowledge to maintain RHD as an effective biocontrol agent in Australia.
- Undertaking strategic, efficient and effective implementation of new and existing rabbit control methods through the Rabbit Decision Support System and National Rabbit Facilitator.

#### 2012-2013 Highlights

- Final report on the RHD-Boost research project was submitted to the Australian Government Caring for Our Country program. The report included an overview of the research work undertaken, a decision framework for the release of a new strain of RHDV and a monitoring and release strategy for a new strain of RHDV.
- Full serological RHDV antibody analysis of rabbit sera samples collected at sites across Australia - 166 samples from six sites across Australia collected and analysed for antibody status.

### Landscape control – Wild dogs

The strategy to achieve this outcome is based on:

- Researching the impacts of wild dogs on agri-ecosystems and determination if the regional control of wild dogs influences populations of quolls, foxes, feral cats, threatened native prey species and other non-threatened native prey species. This will enable improved strategic wild dog management in sheep and cattle regions of Australia.
- Determining the legislative and policy incentives for and barriers to effective strategic co-management of wild dogs with the goal to improve policy formulation for wild dog management across Australia.

### Rabbit biocontrol boost

The effectiveness of rabbit haemorrhagic disease virus (RHDV) as a biocontrol for rabbits is slowly waning. Some early indications are that significant changes are occurring in the virulence of the circulating field strains of RHDV, accompanied by the development of genetic resistance to the disease in rabbits. Studies undertaken by IA CRC researchers will provide a better understanding of the biology of pathogenic RHDV strains and how to maintain RHD as an effective biological control agent in Australia into the foreseeable future. They are also working towards gaining regulatory approval for the release and monitoring of new RHD Boost strains as part of a government agreed integrated rabbit control implementation plan. Epidemiological studies have begun, genetic sequences of RHDV have been obtained and the genetic evolution of RHDV has been analysed. Biological control of wild rabbits in Australia over the last 60 years has produced a benefit of AU\$70 billion (2011 terms) for agricultural industries.



- Improving understanding of the ecology of peri-urban wild dogs in coastal eastern Australia and the most appropriate and effective management strategies and product mix to reduce wild dog impacts in peri-urban areas.
- Increasing adoption of regional nil-tenure wild dog management and integrated use of existing and new wild dog products and techniques.

#### 2012-2013 Highlights

- Stakeholder advisory committee established.
- Research laboratory set-up and functioning at University of New England – NSW Department of Primary Industries.

## Wild dogs at your doorstep

Four study sites have been established in coastal north-east NSW and south-east QLD as part of the integrated package of research on dingoes and peri-urban wild dogs that the Invasive Animals CRC has underway. Wild dogs have been collared and are being monitored at these sites. Preliminary data on the ecology of dingoes in urban areas shows that dingoes are present in most cities and towns and regularly traverse backyards and parkland. The research being undertaken by IA CRC over the next four years is vital as dingoes and wild dogs present significant social, economic and environmental impacts and may risk human health and safety in urban areas.

An urban dingo wanders across a street in Burpengary, Queensland.



- Field work commenced with ecological field study undertaken (wild dogs, foxes, feral cats and spotted-tail quolls fitted with GPS/ radio collars) for study of temporal and spatial interactions in two mesic agri-ecosystems.
- A PhD student commenced study of the ecology of spotted tailed quolls under wild canid control.
- Expert workshop on trophic responses to lethal control of predators and interim report submitted to the Commonwealth Department of Agriculture.
- Convened two National Wild Dog Management Advisory Group meetings where members and local stakeholders met and visited the IA CRC Wild Canid Management Demonstration site and discussed research and management issues.
- Reviewed state regulations pertaining to wild dog management to facilitate the development of regional wild dog management programs in the Northern Territory. This resulted in changes to Territory government policy regarding the injection of baits, application of aerial and ground baiting and the delivery of cooperative and coordinated regional baiting programs based on national best practice.
- Conducted wild dog management meetings with stakeholders in Western NSW and the Northern Territory.
- Continued input into National Wild Dog Management Advisory Group, including secretariat role and liaison with industry and government stakeholders at national and state levels and expert input into WoolProducers' coordinated National Wild Dog Action Plan, contributed to by many parties including the IA CRC.
- Four study sites established in coastal north-east NSW and south-east QLD. Wild dogs collared and being monitored in these sites.
- Impacts and issues data obtained or pledged from six local governments.
- Convened two National Wild Dog Management Advisory Group meetings.
- Conducted numerous presentations on best practice and national approach at various meeting and field days to a range of stakeholders including peak industry councils, state farming bodies and wild dog management committees across the country.
- Major increases in participation in wild dog baiting programs in most regions as a result of working with stakeholders and NSW Farmers' Association.
- A coordinated and strategic wild dog plan was produced for the Flinders Shire Wild Dog Advisory Group (FSWDAG) in Queensland with assistance from the National NRM Facilitator. The plan has been finalised in conjunction with Wild Dog Coordinator Brett Carlsson to allow the group to assess their current program and identify possible improvements, and to increase their effectiveness with management activities.

## Catchment recovery after carp control

The strategy to achieve this outcome is based on:

- Evaluating Cyprinid herpesvirus-3 as a potential biological control agent for carp in Australia with the goal to reduce the carp population by up to 80% over most of the Murray-Darling Basin.

### 2012-2013 Highlights

- Eleven species of fish (10 native and one introduced) have now been shown to be insusceptible to Cyprinid herpesvirus-3.
- Protocol prepared for the removal of Cyprinid herpesvirus-3 from the secure area at the Australian Animal Health Laboratory (AAHL) in order to do in vitro work with the virus in the non-secure area at AAHL. This protocol has received informal approval by the Australian Government Department of Agriculture, Fisheries and Forestry.
- An ecological niche model for the current, and potential, distribution of carp in Victoria is being developed.

## OUTCOME 4: NEW SOCIAL NETWORKS AND INSTITUTIONAL 'ARCHITECTURE' ENHANCED AROUND PEST ANIMAL CONTROL

The strategy to achieve this outcome is based on:

- Improving agricultural productivity from accelerated adoption of pest animal control strategies and technologies, including facilitation of collective action and triggers for effective action, and education of legal and institutional impediments.

### 2012-2013 Highlights

- Research has commenced into the use of communications to trigger action by private

citizens. Effective community action is fundamental to most forms of invasive animal control and this research is focused on addressing the management of domestic and feral cats (Tasmania) and wild dogs (northern NSW and southern Queensland).

- Research has commenced into the institutional dimensions of invasive animals management, including laws and policies, program design and implementation and coordination. The outcomes from the research will assist with reducing the impact of impediments to effective community action. This research is addressing the institutional issues associated with managing/controlling foxes (Tasmania) and wild dogs (northern NSW and southern Queensland), with an emphasis on peri-urban issues.
- The IA CRC research team successfully completed complementary in-depth research of 50 Caring for Our Country-funded projects, which provided a substantial empirical basis for the research in order to develop and ground-truth hypotheses about issues and means to improve the effectiveness of front-line invasive animals' control.
- The first 'Community of Practice' event by the research team was held in Melbourne (27 February 2013 to 1 March 2013) where 50 participants from both public and private invasive animal control bodies have begun the ongoing task to focus on developing and testing best management practices in the human dimensions of invasive animal control.



### Building NRM capacity

Community capacity building and institutional reform are the primary objectives for the National Natural Resource Management (NRM) Facilitator, Jessica Marsh. As a step towards obtaining this goal, Jessica coordinated the 2013 NRM Survey during May-June 2013. The survey provided a snapshot of NRM/CMA employees working in invasive species control and management roles and their organisation's capacity to carry out best-practice pest animal management.

This is the second survey that the NRM Facilitator has coordinated and collects views and feedback from staff who deal directly with pest animals within the 54 regional NRM agencies across Australia. The results are helping to shape the way the National NRM Facilitator and the broader IA CRC engages with pest and land managers across Australia.

During 2012-13 Jessica and her IA CRC colleagues also worked to establish the Northern Inland Pest Animal Committee (NIPAC); assisted the University of Canberra and the University of New England with their respective vertebrate pest training and research programs; helped set-up and run the NSW Vertebrate Pest Management course offered through the NSW Department of Primary Industries; and provided training and educational materials to many training institutions, schools and government agencies operating pest animal control courses for public and private land managers government agency employees, field rangers, school teachers and school students.

NRM Facilitator, Jessica Marsh, is building community capacity and bringing about institutional reform.

# RESEARCH COLLABORATIONS

Collaborative links across the IA CRC are a major focus of activities given the very large number of parties involved. More than 80 Australian and overseas industry, research, natural resource management (NRM) and catchment management authority (CMA) groups and government departments collaborate on research with IA CRC.

A compulsory investment criterion for every project funded is that at least two IA CRC participants are involved in the project and at least one of these participants must be a technology end-user. Even when projects have a relatively long timeframe and are close to the 'research' end of the 'research and development' spectrum, the IA CRC's approach is that the direct involvement of end-users is invaluable to achieving outcomes.

More than half the participants in the IA CRC are end users of research. In setting up the IA CRC, the Board took the view that the IA CRC would have low entry requirements (for example no entry fees) to encourage participation. Thus, our end-users are generally directly involved in many of the projects of interest to them, in an attempt to have a technology transfer process that is as seamless as possible.

We believe the end-users improve the research process as well, so that technology or processes developed are more likely to be adopted. Key national and international collaborators beyond the collaboration between IA CRC partners are outlined in this section.

Australian collaborations	Research Project
Adelaide and Mt Lofty Ranges NRM, SA	National NRM Facilitator
Agforce Queensland	National NRM Facilitator; and Facilitating strategic management of wild dogs throughout Australia
AgriFood Skills Australia	VET training packages on strategic pest management
Arthur Rylah Institute for Environmental Research (Victoria Department of Environment and Primary Industries)	Pest-Information Hub (Pest iHub)
Atlas of Living Australia	Mobile devices and web-mapping tools for pest species
Australian Wildlife Health Network	New potential wild rabbit biocontrol agent prospecting and assessment
Border Rivers-Gwydir CMA, NSW	National NRM Facilitator
Braysher Consulting Pty Ltd	VET training packages on strategic pest management
Brisbane City Council, QLD	Peri-urban wild dog control
Canberra Indian Myna Action Group, ACT	Mobile devices and web-mapping tools for pest species
Tablelands Livestock Health and Pest Authority, NSW	National NRM Facilitator
Clarence Valley Conservation In Action Landcare Group, NSW	Mobile devices and web-mapping tools for pest species
Far North Queensland Regional Organisation of Councils	Prioritising adaptation actions for managing invasive animals under climate change
Gold Coast City Council, QLD	Peri-urban wild dog control
Granite Borders Landcare, NSW and QLD	Facilitating strategic management of wild dogs throughout Australia

Griffith University, QLD	Reduction of legal and institutional impediments on effective invasive species control
Gulf Rivers Landcare Group, NT	Facilitating strategic management of wild dogs throughout Australia
Hume Livestock Health and Pest Authority, NSW	National NRM Facilitator
James Cook University, QLD	Utility of eDNA as a tilapia surveillance tool
Lachlan CMA, NSW	National NRM Facilitator
Murrumbidgee CMA, NSW	National NRM Facilitator
Murrumbidgee Landcare Group, NSW and ACT	National NRM Facilitator
Newton Green Technologies	Mobile devices and web-mapping tools for pest species
Northern New England Landcare, NSW	Facilitating strategic management of wild dogs throughout Australia
Northern Territory Cattlemen's Association	Facilitating strategic management of wild dogs throughout Australia
Northern Territory Government	Facilitating strategic management of wild dogs throughout Australia
Northern Territory NRM	National NRM Facilitator
Northern and Yorke NRM, SA	National NRM Facilitator
NSW Farmers' Association	Facilitating strategic management of wild dogs throughout Australia
Plant Biosecurity CRC	Balanced researcher program
Queensland Murray-Darling Committee	National NRM Facilitator
Rangelands NRM, WA	Facilitating strategic management of wild dogs throughout Australia
Somerset Regional Council, QLD	Peri-urban wild dog control
South Coast NRM, WA	National NRM Facilitator
South-East Queensland Council of Mayors, QLD	Mobile devices and web-mapping tools for pest species
South-West NRM, QLD	National NRM Facilitator

Sunshine Coast Regional Council, QLD	Peri-urban wild dog control
Terrain NRM, QLD	Prioritising adaptation actions for managing invasive animals under climate change
Tilpa Progress Association, NSW	Facilitating strategic management of wild dogs throughout Australia
University of Sydney, NSW	RHD Boost Roll-out of new RHDV strains against wild rabbits
Victoria River District Conservation Association, NT	Facilitating strategic management of wild dogs throughout Australia
Vertebrate Pests Committee National Indicators Working Group	Exotic vertebrate risk analysis and complex Invasion Pathway Framework
Western CMA, NSW	Facilitating strategic management of wild dogs throughout Australia
Western Livestock and Pest Authority, NSW	National NRM Facilitator
West Gippsland CMA, VIC	National NRM Facilitator
Wollongong City Council, NSW	Mobile devices and web-mapping tools for pest species
WoolProducers Australia	Facilitating strategic management of wild dogs throughout Australia

### International collaborations

AgResearch, New Zealand	Non-pathogenic wild rabbit caliciviruses
Cawthron Institute, New Zealand	New eDNA surveillance for multiple high-risk invasive aquatic species
CIBIO, Universidade do Porto, Portugal	Comprehensive RHD resistance model for wild rabbits
Istituto Zooprofilattico Sperimentale della Lombardia e dell'Emilia Romagna (IZS), Italy	RHD accelerator against wild rabbits
Pennsylvania State University, USA	Community engagement - facilitate collective action to manage invasive animals
USA: Texas Parks and Wildlife	HOGGONE® feral pig bait - USA field trials and US registration
University of Otago, New Zealand	Non-pathogenic wild rabbit caliciviruses
University of Waikato, New Zealand	New eDNA surveillance for multiple high-risk invasive aquatic species

### Outcome 1: No New Vertebrate Pests Established In Australia

Atlas of Living Australia
Cawthron Institute, New Zealand
Canberra Indian Myna Action Group, ACT
Clarence Valley Conservation In Action Landcare Group, NSW
Far North Queensland Regional Organisation of Councils
James Cook University
Murrumbidgee Landcare Group, NSW and ACT
NewtonGreen Technologies
South-East Queensland Council of Mayors
Terrain NRM, Qld
University of Waikato, New Zealand
Various CMAs in NSW and NRM regional groups in other jurisdictions
Vertebrate Pests Committee National Indicators Working Group
Wollongong City Council, NSW

### Outcome 2: Prediction And Control Of Emerging Outbreaks

Animal Control Technologies
Connovation
CSIRO
Grains Research & Development Corporation
Landcare Research New Zealand
Texas Parks and Wildlife Department
US Department of Agriculture

### Outcome 3: Recovery Of Key Land And Water Regions After Humane Control Of Rabbits, Wild Dogs And Carp

AgForce Queensland
AgResearch, News Zealand
Australian Wildlife Health Network
Brisbane City Council, QLD
CIBIO, Universidade do Porto, Portugal
Gold Coast City Council, QLD
Granite Borders Landcare, NSW and QLD
Gulf Rivers Landcare, NT
Istituto Zooprofilattico Sperimentale della Lombardia e dell'Emilia Romagna (IZS), Italy
Northern New England Landcare, NSW
Northern Territory Government
Northern Territory NRM
NSW Farmer's Association
Northern Territory Cattlemen's Association
Rangelands NRM WA
Somerset Regional Council, QLD
Sunshine Coast Regional Council, QLD
The University of Sydney
Tilpa Progress Association, NSW
University of Otago
University of Sydney
Victoria River District Conservation Association, NT
Western CMA, VIC
WoolProducers Australia

### Outcome 4: New Social Networks And Institutional 'Architecture' Enhanced Around Pest Animal Control

Adelaide and Mt Lofty Ranges NRM, SA
Agforce Queensland
AgriFood Skills Australia
Border Rivers-Gwydir CMA, NSW
Braysher Consulting
Griffith University
Hume Livestock Health and Pest Authority, NSW
Lachlan CMA, NSW
Murrumbidgee CMA, NSW
Northern and Yorke NRM, SA
Northern Territory NRM
Pennsylvania State University, USA
Plant Biosecurity CRC
Queensland Murray-Darling Committee
South Coast NRM WA
South-West NRM, QLD
Tablelands Livestock Health and Pest Authority, NSW
University of Canberra
University of New England
West Gippsland CMA, VIC
Western CMA, NSW
Western Livestock Health and Pest Authority, NSW

# EDUCATION AND TRAINING

- Balanced Researcher Program
- VET training packages on strategic pest management

This segment of the annual report focuses on key areas of research and vocational education and training during 2012-13 as they relate to Outcome 4. The IA CRC's education initiatives focus on the Balanced Researcher Program and Vocational Education and Training (VET) qualifications specialising in pest management



IA CRC graduate Dr Tom Newsome was awarded a Fulbright Scholarship to study in the United States. Dr Newsome will collaborate with researchers from Oregon State University and the University of Washington to undertake research on the reintroduction of wolves into Yellowstone National Park. His focus will be to explore potential applications of the wolf research to Australian environments where reintroducing dingoes has also been suggested.

## Australia-US collaborate on education

A contingent of IA CRC staff and postdoctoral students spent three-weeks attending and reviewing an invasive animals-focused 'Leadership in Community Engagement' course at the Pennsylvania State University (Penn State) in the US. The intensive course, which explored the cutting-edge of community engagement theories and practice, was run jointly by the IA CRC, Penn State and the University of New England (UNE) and led by Professor Paul Martin (UNE) and Professor Ted Alter (Pen State). Penn State is a world leader in community engagement using digital media as well as usual communication channels and its invasive animals community engagement course will be offered to Australian students through the IA CRC in 2014. The Aussie contingent, which will provide expert comments to "Aussify" the community engagement course into a revised format for use back in Australia, included: Patty Please (Postdoctoral Fellow), Bernadette York (Professional Doctorate student), Katrina Dickson (IA CRC PhD student), Lisa Adams (National Rabbit Facilitator), Jessica Marsh (National NRM Facilitator) and Lynette McLeod (IA CRC PhD student).



## POSTGRADUATE EDUCATION

The *Balanced Researcher* program is a hands-on approach supporting the IA CRC's PhD students and their continued development in key areas of leadership, management, communication and stakeholder and community engagement through additional training that would not normally be received through standard courses.

The program provides 80 days of additional training, including at least 20 days placement within industry. The program includes a fully-funded eighth semester to ensure that the training does not impact on the student's research project.

Education objectives include:

- better prepare PhD students to contribute effectively to industry outcomes on completion of their research project
- train PhD students to become future leaders in science, industry and research innovation.
- widen the choice of careers for PhD students and enhance potential for employment on graduation.

To monitor the effectiveness of the IA CRC's PhD program, a longitudinal study is being undertaken of graduating PhD students and their employers from the 2006 and subsequent student intakes. The program will be adapted and improved if necessary based on the outcomes of this study.

The longitudinal study confirms that most PhD graduates have secured employment in government or university research roles that build Australia's research capability.

## STUDENT RECRUITMENT

The IA CRC's postgraduate student program outcomes have been achieved one year ahead of schedule.

The 20 identified IA CRC PhD projects that align with ongoing IA CRC projects were advertised extensively from April 2012 to September 2012. More than 350 expressions of interest were received for the 20 projects. There were 13 research PhD students and four Professional Doctorate students selected for projects and from this nine research PhD students and four Professional Doctorate students enrolled in partner universities for first semester 2013 – this is one year ahead of the project's schedule.

Six student PhD projects that were not filled in the initial round of advertising were re-advertised during April – June 2013.

### Breakdown of advertised PhD projects per Research Theme

Theme	PhD projects
Incursion response	5
Wild rabbits	3
Wild dog	4
Fertility control	2
Pest fish	2
Community engagement	4
Total	20

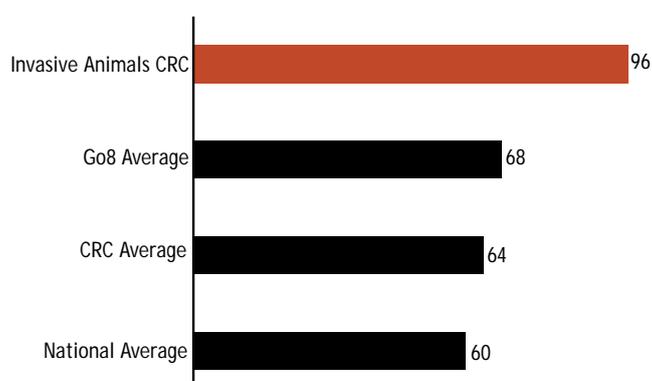
## STUDENT PROGRESS 2005-2012

The IA CRC has an enviable completion rate for PhD students. Of the 29 PhD students that commenced over the 2006-2008 period, 27 have submitted theses for marking. This gives a current submission rate of 93%. Of the remaining two students, one has delayed submission until December 2013 due to new family responsibilities and the second student has withdrawn due to chronic illness.

With 24 students having had their doctorate conferred, the current completion rate is 83%. This is expected to rise to an overall completion rate of 96% following the marking of the three theses still being examined and marking of the remaining thesis to be submitted in December.

This exceptional completion rate is well above the national average for PhD completion of 60%. The average PhD completion rate of CRCs is 64% and the average completion rate for the Go8 universities is 68%.

Average PhD Completion Rates (%)



Commencing Invasive Animals CRC students (2013-2017)  
 PhD students are expected to complete during 2017. Students are included under the Balanced Researcher Program

Name	Award	IA CRC research project	Commonwealth Agreement Output	Prospective Title of Thesis	University and Invasive Animals CRC program
Jonas Bylemans	PhD	New eDNA Surveillance for Multiple High Risk Invasive Aquatic Species	3.1	eDNA surveillance for multiple high-risk invasive fish	University of Canberra
Catriona Campbell	PhD	Mechanised Extraction and Next Generation Sequencing for the Analysis of Trace DNA in Predator Scats	1.2	DNA detection of wildlife in Tasmania from trace samples	University of Canberra
Katrina Dickson	PhD	Facilitate Collective Action	4.1	Facilitating community action	University of New England
Pablo Garcia Diaz	PhD	Exotic Vertebrate Risk Analysis and complex Invasion Pathway Framework	1.1	Exotic vertebrate risk analysis and invasion pathway analysis	University of Adelaide
Sally Hall	PhD	Development of Reagents for the Sterilisation of Pest Animal Species	2.4	Development of novel reagents for the non-surgical sterilisation of male and female mice	University of Newcastle
Rheyda Hinlo	PhD	New eDNA Surveillance for Multiple High Risk Invasive Aquatic Species	3.1	eDNA surveillance for multiple high risk invasive fish	University of Canberra
Amy Iannella	PhD	Comprehensive RHD Resistance Model	1.3	The role of rabbit and virus genetics in the development of resistance to rabbit haemorrhagic disease virus (RHDV)	University of Adelaide
Lynette McLeod	PhD	Triggers for Effective Action	4.2	Improving the behavioural effectiveness of feral cat management programs	University of New England
Elodie Modave	PhD	Mechanised Extraction and Next Generation Sequencing for the Analysis of Trace DNA in Predator Scats	1.2	DNA detection of wildlife in Tasmania from trace samples	University of Canberra
Helen Morgan	PhD	Wild Dogs in Agri-Ecosystems: Predators, Prey, Plants and the Triple Bottom Line	1.5	How is vegetation influenced by top-order predators? Dingo management and trophic cascades	University of New England
Aleona Swegen	PhD	Development of Reagents for the Sterilisation of Pest Animal Species	2.4	Development of novel reagents for the non-surgical sterilisation of male and female rats	University of Newcastle
Nadya Urakova	PhD	RHD Accelerator	1.4	Identifying virulence factors of Rabbit Haemorrhagic Disease Virus	University of Canberra
Alireza Zahed	PhD	RHD Boost roll-out of new RHDV strains	1.3	RHDV: Mechanisms of transmission	University of Adelaide

Completed Invasive Animals CRC PhD students during 2012-13  
(from the 2005-2012 previous completed CRC)

Name	Cohort and year conferred	Award	Activity Output	Title of Thesis	Employment on graduation	
John Abramyan	Cohort 1 Conferred 2010	PhD	5.1	Biology of sex determination and sexual development in the cane toad ( <i>Bufo marinus</i> )	University of California Riverside	International research
Megan Barney	Cohort 1 Conferred 2010	PhD	4.2	Sex determination and differentiation in carp, ( <i>Cyprinus carpio</i> )	CSIRO, Hobart	Australian research
Andrew Bengsen	Cohort 1 Conferred 2010	PhD	2.1	Target-specific vertebrate pest control in complex faunal communities: feral pig baiting in the wet tropics of Queensland, Australia	Kangaroo Island Natural Resources Management Board	Australian industry
Tony Buckmaster	Cohort 1 Conferred 2011	PhD	7.2	Development of genetic resistance to Rabbit haemorrhagic disease in wild rabbits ( <i>Oryctolagus cuniculus</i> )	Invasive Animals Ltd	Australian research
Jennyfer Cruz-Bernal	Cohort 1 Conferred 2012	PhD	1.1	Ecology of the koomal ( <i>Trichosurus vulpecular hypoleucus</i> ) in the northern jarrah forest in relation to predation and resource availability	Landcare New Zealand	International research
Tarnya Cox	Cohort 1 Conferred 2010	PhD	8.4	Predator faecal odours as repellents to manage feral goats and kangaroos	NSW Department of Primary Industries, Orange	Australian industry
Paul de Tores	Cohort 2 Conferred 2012	PhD	1.1	Native fauna response to large scale fox control in the northern Jarrah forest of south-west Western Australia: Operation Foxglove	Department of Environment and Conservation Western Australia	Australian industry
Alex Diment	Cohort 1 Conferred 2010	PhD	1.1	Monitoring the ecological impacts of invasive predator control	Flora and Fauna International, Cambridge UK	International industry
Katie Doyle	Cohort 2 Conferred 2013	PhD	4.1	Impact of increased predator presence through stocking on carp populations and the implications for management	River Escapes	Australian small business
Amanda Elledge	Cohort 1 Conferred 2011	PhD	2.1	Habitat preferences and environmental impacts of feral pigs ( <i>Sus scrofa</i> ) in lowland tropical rainforests of north-eastern Australia	Department of Environment and Resource Management Queensland	Australian industry
Peter Elsworth	Cohort 2 Conferred 2013	PhD	7.2	Development of genetic resistance to Rabbit haemorrhagic disease in wild rabbits ( <i>Oryctolagus cuniculus</i> )	Queensland Department of Agriculture, Fisheries and Forestry	Australian research
Adriana Ford-Thompson	Cohort 3 Conferred 2012	PhD	8.2	People, pests and conflict: community participation in invasive deer management in Australia	University of York, UK	International research
Kate Grarock	Cohort 3 Submitted 2013	PhD	8.3	Removal of the pest bird - Indian Myna ( <i>Acridotheres tristis</i> ) and its impacts and implications for native Australian birds	ACT Territory and Municipal Services	Australian industry
Gwilym Haynes	Cohort 1 Conferred 2009	PhD	4.1	Population genetics of common carp ( <i>Cyprinus carpio</i> L.) in the Murray-Darling Basin	University of Wisconsin, USA	International research
Crystal Kelehear	Cohort 3 Conferred 2012	PhD	5.1	Host-parasite interactions during a biological invasion: the potential of a lungworm <i>Rhabdias</i> as a biocontrol against cane toads	University of Sydney	Australian research
Jessica King	Cohort 2 Conferred 2011	PhD	9.4	Investigating the life cycle and transmission of <i>Neospora caninum</i> in Australia	University of Sydney	Australian research
Maija Marsh	Cohort 1 Conferred 2010	PhD	7.2	Transmission and effectiveness of RHDV infections in rabbit populations at different spatial scales	Natural England, UK	International industry

Penelope Marshall	Cohort 2 Submitted 2013	PhD	8.2	The social impacts on Australian farm families of wild dog predation on agricultural stock	Australian and New Zealand Schools of Government	Australian research
Ian McDonald	Cohort 3 Conferred 2013	PhD	2.1	GnRH constructs for oral delivery: effects on immune responses and reproductive function	Alzheimer's Australia	Australian industry
Eve McDonald-Madden	Cohort 1 Conferred 2009	PhD	9.1	Optimal decision-making in conservation: management, uncertainty and monitoring	University of Queensland	Australian research
Lindsey McFarlane	Cohort 2 Conferred 2012	PhD	4.2	Characterisation of RNA silencing pathways in the common carp ( <i>Cyprinus carpio</i> L.)		
Carla Meurk	Cohort 1 Conferred 2011	PhD	2.6	Loving nature, killing nature, and the crises of caring: An anthropological investigation of conflicts affecting feral pig management in Queensland, Australia	University of Queensland	Australian research
Tom Newsome	Cohort 2 Conferred 2011	PhD	1.1	Ecology of the dingo ( <i>Canis lupus dingo</i> ) in the Tanami Desert in relation to human-resource subsidies	Low Ecological Services Pty Ltd, Alice Springs	Australian industry
Hayley Pearson	Cohort 2 Conferred 2012	PhD	9.4	Understanding and mitigating domestic pig and wildlife interactions	University of Sydney	Australian research
Melissa Snape	Cohort 3 Conferred 2013	PhD	8.4	Effects of vaccination against gonadotrophin releasing hormone (GnRH) on the behaviour and fertility of macropods	ACT Environment and Sustainable Development Directorate	Australian research
Danielle Stephens	Cohort 2 Conferred 2012	PhD	1.1	Developing DNA-based monitoring techniques for improved management of wild dog	Helix Genetics Solutions, Western Australia	Australian research
John Tracey	Cohort 3 Submitted 2012	PhD	8.3	Evaluating management strategies for pest birds of horticulture	NSW Department of Primary Industries and Director of Research, IA CRC	Australian research
Scott van Barneveld	Cohort 2 Conferred 2012	PhD	9.2	Invasive Species, endemic species and geographic distributions	Mining & Energy Technical Services Pty Ltd (MET Serve), Brisbane	Australian industry
Jason Wishart	Submitted 2013	Masters	Projects 2.U.1, 2.U.2e, 2.U.3e, 2.U.4e, 2.U.5e, 2.U.6e, 10.U.6, 10.U.6	An evaluation of feral pigs and their management in the Macquarie Marshes, NSW	Invasive Animals Cooperative Research Centre	Australian research
Ben Allen	Honours Completed 2006	Hon	9.4	The spatial ecology and zoonoses of urban dingoes – a preliminary investigation	NSW Department of Primary Industries	Australian industry
Melissa Snape	Honours Completed 2007	Hons	8.4	Traits for baits: an analysis of factors influencing bait acceptance in urban brushtail possums	Continued to PhD project with Invasive Animals CRC	Australian research
Marlene Jahnke	Masters Conferred 2010	Masters	7.2	Genetic diversity and evolution of a non-pathogenic calicivirus in wild rabbit populations in Australia	University of East Anglia, UK	International research
Kana Koichi	Masters Conferred 2012	Masters	2.1	Socio-economic and ecological costs and benefits of feral pigs in the Wet Tropics	Invasive Animals CRC	Australian industry

## VOCATIONAL EDUCATION AND TRAINING

The IA CRC is developing and revising nationally-accredited Vocational Education and Training (VET) pest training material that is consistent with the recent Australian Pest Animal Strategy (APAS) and the new operating environment and to promote the adoption of the revised packages to current and future pest managers.

### 2012-2013 VET Highlights

- IA CRC in concert with AgriFood Skills Australia reviewed pest management jobs to determine appropriate skills and competencies for those working in the Conservation and Land Management field. Further consultation will occur during 2013, followed by the establishment of project committee to oversee the development of new training packages for submission to the National Skills Studies Council early in 2014.
- Partnerships with Vertebrate Pests committee agencies, Natural Resource Management Boards, NSW DPI and TOCAL Agricultural College to enable development of training packages established.
- Work has begun to articulate the VET Diploma in Conservation and Land Management into an undergraduate degree to give students a career path from vocational certificate courses to higher education.
- Assessment has begun of the [www.feral.org.au](http://www.feral.org.au) and Invasive Animals CRC PestSmart toolkit of educational materials to identify suitability and required changes to enable future use in delivering the revised VET training packages.
- A workshop on best practices pest management techniques was run for the Border Rivers – Gwydir CMA in November 2012.

## Uniting practical experience and academic excellence

A wide range of research projects examining the human dimensions of invasive animal management make up the Facilitating Effective Community Action research program of the IA CRC under Outcome 4. Kick-starting this program at the inaugural research program initiation meeting at the University of New England (UNE) in Armidale, NSW was (back row, left to right) Robyn Bartel (UNE), Darryl Low Choy (Griffith University), Don Hine (UNE), Graham Marshall (UNE), Bernadette York (NSW DPI), Ted Alter (Penn State University), (front row, left to right) Paul Martin (UNE) Lynette McLeod (IA CRC PhD student at UNE/ NSW DPI), Patty Please (UNE) and Craig Elliott (Tasmania DPI/PWE).



# COMMERCIALISATION & UTILISATION

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## *Strategy*

Invasive Animals CRC has formulated and adopted a strategy that ensures robust and constructive engagement between the IA CRC management company, its two participant small to medium sized enterprises (SMEs) Animal Control Technologies (ACTA) and Connovation, together with the other CRC Participants.

The strategy calls for Invasive Animals Ltd (IAL) to play a brokering role that advances early stage co-investment in commercially-focussed R&D projects through participant SMEs, industry research and development corporations and Invasive Animals Limited.

This strategy diversifies the key risks involved in innovation in this field:

- Research/technical failure.
- Market failure due to high R&D/regulatory compliance costs and a need by the market of a low-cost product.
- Market failure due to lack of product acceptance on different grounds such as effectiveness, ease of use, animal welfare concerns and human health concerns.

Additionally, this brokering and co-investment strategy improves end-user/SME engagement in the generation of CRC R&D outputs. This builds trust and credibility in resultant products. The following projects are examples of this strategy looking to solve key market problems that advance efficiencies in controlling pest animals and improve animal welfare outcomes:

- Development of a new humane poison and bait for feral pig control in Australia.
- Taking Australian R&D in the new feral pig poison bait to the USA to progress its development, registration and sale in the USA.
- Development of a lethal trap device to reduce animal welfare concerns over leg-hold trapping of wild dogs, foxes and feral cats.
- Development of a species-targeted remote-sentinel device for automated humane euthanasia of feral cats and foxes.
- Researching lead candidates for new rodenticide(s) that can be safely used by land managers/producers to batch mouse control products.
- Researching lead candidates for new avicide product(s) for pest bird management.

## *Intellectual Property management*

Management of Intellectual Property (IP) in this five-year extension of the IA CRC takes its lead from the management of IP demonstrated in the previous IA CRC.

## *IP from previous CRCs*

### *(IA CRC 2005-2012 and Pest Animal Control CRC pre-2012)*

In the previous IA CRC, 100% of project IP was owned by the management company IAL and rights to commercialise project IP were licensed early in research projects to the co-investing SME participant or expressions of interest were called for from participants where there was not SME co-investment in project(s).

This strategy gave co-investing SMEs direct input into the management of R&D and the surety that they had the freedom to operate in the event that R&D was successfully commercialised. These outcomes of our IP management strategy and processes aligned SME (co-investor), research and development corporation (primary investor) and IAL management of projects and expectations for project IP commercialisation.

Invasive Animals Ltd manages IP that has been novated to it from the Pest Animals Control CRC. Licensed IP that generates royalties from the sale of products from the Pest Animals Control (PAC) CRC (pre 2012) is disbursed to IP owners from that PAC CRC. Licenced IP that generates royalties from the sale of products developed through the IA CRC (2005-2012) is reinvested into the current extension IA CRC. IP novated and/or managed by IAL in this extension is related to the commercialisation of:

1. PIGOUT® (2012-13 financial year royalty of \$7,000 - distributed to Pest Animal Control (PAC) CRC Participants).
2. HOGHOPPER™ (2012-13 financial year royalty \$17,244 - retained by IAL).
3. New fox and wild dog baits containing a new active (2012-13 financial year royalty, \$0 yet to be released to the market).

Note the fox and wild dog baits are currently in the last phase of commercialisation (regulatory assessment by the Australian Pesticides and Veterinary Medicines Authority) and are not yet available for sale.

### Patents

IAL has maintained and managed patents and patent applications for the use of nitrite salts as poisons in baits for omnivores. The development work in nitrite salts is focused on feral pig control, though the application for the use of nitrite salts in the control of rodents and invasive birds and potentially other feral animals is being researched. Patented IP managed during the period includes:

- Australian granted patent 2008221237 - Nitrite Salts as Poisons in Baits for Omnivores.
- New Zealand granted patent 579357- Nitrite Salts as Poisons in Baits for Omnivores.

- International Published Patent Application (WO/2008/104028) which includes the United States of America - Nitrite Salts as Poisons in Baits for Omnivores.
- International Published Patent Application (WO/2008/104028) which includes Canada - Nitrite Salts as Poisons in Baits for Omnivores.
- International Published Patent Application (WO/2008/104028) which includes India - Nitrite Salts as Poisons in Baits for Omnivores.
- International Published Patent Application (WO/2008/104028) which includes China - Nitrite Salts as Poisons in Baits for Omnivores.

IAL did not file any new patent applications in the period.

Indian and Chinese applications will most likely be abandoned as European 'prior art' (not cited against the application in USA and Canada) will prevent claims protecting the use of sodium nitrite for rodent control in these jurisdictions.

### IP strategy in this IA CRC

IP has been split into IP for public good and IP with commercial potential. Public good IP will continue to be managed in the same way as the previous CRC that is: all public good IP is available to all CRC Participants for their own use in research, training and adoption.

IP with commercial potential will be managed as follows:

- Co-investors (participants) in a project will be allowed to legally and beneficially co-own project IP. The project is then managed as a Specified Project and IP is classified as Specified Project IP rather than Centre IP.
- Specified Project IP ownership is determined based on a process that is agreed to by the participants directly involved in the project.
- All investors in a Specified IP project have a say in developing the terms under which project IP will be commercialised. This IP management strategy was an outcome of participant consultation during the IA CRC application process.

This approach is consistent with national principles for the management of IP generated using publicly-funded research and ensures that R&D that is commercialised accrued benefits Australia and Australian investors in innovation in pest animal management.

## UTILISATION AND COMMERCIALISATION

A Board-approved Commercialisation and Utilisation Plan (CUP) from the previous Invasive Animals CRC is currently being used as the strategic framework for project technology transfer. It is in the process of being revised.

These strategies will strengthen the adoption process within the IA CRC extension and feed into the promotion of new products.

Importantly, a Community Engagement (CE) research program has been integrated into the structure of this IA CRC extension that will implement research initiatives that the organisation can use to grow the number of end-users adopting IA CRC project outputs. The CE program will also assess the effectiveness of initiatives that the IA CRC uses to advance best-practice adoption rates and behavioural change by a typically conservative end-user group.

## End-user engagement

### *Community Engagement Program*

The Community Engagement research program aims to interrogate the key barriers and drivers of adoption. The program will test the effectiveness of the interplay between government organisations, industry research sponsors (research and development corporations), SMEs and end-users and how messages are received and assimilated depending on the mode of communication.

### *Research and development corporations (MLA, AWI and GRDC)*

This IA CRC extension aims to strongly align its R&D management teams with the needs of its keystone RDC investors in delivering new technologies and services to end-users via participant SMEs. To achieve this, each Specified IP Project has research and governance management teams encompassing IAL, RDC and SME personnel skilled in managing not only research but the pathways to adoption that are critical to delivering new technologies in this field eg national and state agency regulation of pest control products.

### *Land managers*

Private land managers, including large corporates and public-land managers will participate in product testing, which will encourage greater product familiarity, acceptance and credibility. These mechanisms help build trust and importantly establish local product champions who are more likely to be early adopters and whose testimonials generally influence uptake by later adopters.

The place stories (case studies) that create engagement and trust will be captured in the PestSmart Toolkit produced by the IA CRC. PestSmart will provide tools such as factsheets and case studies that explain integrated pest animal management for each species of interest and how new products can be integrated into conventional management practice.

### *Government*

An end-user engagement strategy incorporating Commonwealth and State Government stakeholders is critical due to their key roles in assessing, approving, regulating and auditing the use of many of the control tools this IA CRC extension plans to commercialise and promote the utilisation of these control tools, which encompass:

- Biocontrols for European carp and wild rabbits.
- Lethal control tools for wild rabbits, foxes, wild dogs, rodents and European starlings.

- Fertility control tools for over-abundant herbivores including native animals, eg kangaroos.
- Tools that facilitate communities of best practice being established and or strengthened so that participation rates in pest animals management programs can be optimised at appropriate scales. This will achieve greater cost-effectiveness and allow the benefits of such management programs to accrue to Australian agricultural production and biodiversity. It will also enhance the sustainability and resilience of regional communities and the SMEs that service the pest animal management market.

### *National Facilitators*

To manage the risks of damage caused by pest animals there is a growing recognition of the need for:

- Coordinated and strategic management of pest animals at appropriate scales.
- Engaging and empowering communities of best practice to cost-effectively manage pest animal damage risks.

These needs are best addressed using human capital that can build networks, support community-led action and provide excellent advice regarding pest animal management. The IA CRC and its participants are investing in National Facilitators in three keystone fields:

- Natural resource management.
- Wild dogs.
- Wild rabbits.

So that:

- There is an increased awareness of strategic management.
- There is a resource to help in the development and implementation of management plans.
- There is a source of information about how to integrate new IA CRC-developed tools into management programs.

National Facilitators have and will promote the development of nationally-consistent approaches to pest animal management.

# COMMUNICATIONS

Communications activities are undertaken in accordance with the Invasive Animals (IA) CRC Strategic Communications Plan.

## ACHIEVEMENTS

While traditional mass media, such as industry publications, newspapers, radio and television, continue to play a main role in communicating with end-users on research innovation to more effectively control feral animals, the IA CRC has also been increasingly using social media to communicate its messages and connect with stakeholders.

IA CRC communications are reaching more people than ever before and as a result we are seeing unprecedented engagement.

## MEDIA RELEASES

To help gain media coverage throughout 2012-13, the following 14 media releases were issued by the IA CRC:

1. National Rabbit Facilitator appointed  
27 June 2013
2. Wild dogs and sheep don't mix  
26 June 2013
3. Join the search for Feral Photos  
17 June 2013
4. On the move to map pest animals using any mobile phone  
12 June 2013
5. National Award for PestSmart Toolkit and  
22 May 2013
6. PhD solutions for rabbit, invasive fish and feral pig problems  
10 May 2013
7. Public go wild for pest animal APP  
9 May 2013
8. New Pest Animals APP for Smart Phone users  
23 April 2013
9. Rabbit biocontrol saves agriculture \$70 billion: new study  
8 March 2013

10. Unravelling the dingo mystery with long-term research underway  
28 January 2013

11. Working Plan to Manage Wild Dogs  
5 October 2012

12. BUSH'S BIG BROTHER - Camera traps expose the secret lives of wildlife!  
11 September 2012

13. World-first scientific evidence that Indian Mynas harm native Australian bird populations  
8 August 2012

14. Renewed multi-million dollar solutions to pest animal problems  
30 July 2012

## PRINT AND ONLINE STORIES

Media monitoring during 2012-13 counted 898 (compared with 501 in 2011-13) print and online articles with specific IA CRC mentions.

Due to an increasing number of feral animals stories reported by the mass media the proportion of the IA CRC 'slice' of these stories has decreased from 50% in 2011-12 to around 30% in 2012-13.

Despite this proportional decrease, this is still a very good outcome with a heightened overall media presence on feral animals' issues. This should translate to an increased awareness by the community on the importance of better control and management of feral animals and the extensive environmental and agricultural damage that they cause. The continuing aim of our media relations work is to associate this problem with the solutions being developed by the IA CRC.

	Annual Total
Total number of feral animals-related stories	3,372
Total number of IA CRC mentioned stories	898

## Media monitoring 2012-13 counts print and online articles with specific IA CRC mentions over the 12-month reporting period

Feral animals species / issues monitored in the media	Quarter 1	Quarter 2	Quarter 3	Quarter 4
	1 July to 30 September 2012	1 October to 31 December 2012	1 January to 29 March 2013	1 April to 30 June 2013
Rabbits	9	48	78	80
Rats/Mice	8	8	17	22
Foxes	86	51	115	89
Wild dogs/dingoes	145	191	296	398
Feral cats	15	35	115	156
Feral pigs	26	72	69	113
European Carp	23	57	42	30 (including tilapia)
Cane toads	26	26	31	74
Feral goats	2	18	14	38
Myna birds	26	37	18	55
Feral camels	6	3	9	9
Wild horses/Deer/Kangaroo	3	6	14	77
Miscellaneous Invasive Animals CRC stories inc. Apps / PhDs / Feral Photos	21	8	13	170
General media on invasive animals eg shooting ferals in NSW national parks	3	109	192	No longer recorded by media monitoring*
<b>Total</b>	<b>399</b>	<b>669</b>	<b>1,023</b>	<b>1,311</b>

\*In order to concentrate on IA CRC focal pests: wild rabbits, European carp, wild dogs, foxes and feral pigs. Other invasive species are monitored in the media to gauge overall community interest in the feral animal problem and solutions offered by innovative technology and methods such as those developed through the IA CRC.

Media articles on the issue of wild dogs continue to dominate the coverage of feral animal issues.

The metropolitan media's wide range of feral animals' stories that featured the IA CRC included:

- *The Age* newspaper in Victoria on 23 September 2012, continuing its series of articles on Indian Mynas (prompted by the IA CRC's 12 August media release).
- Two articles in the *Sydney Morning Herald*, also on 23 September 2012, on wild rabbits and wild dogs (as the result of liaison from the IA CRC).

## BROADCAST

Some highlights on television for the IA CRC included continuing regular rural and regional television coverage on feral animals' issues plus some and increasing metropolitan television coverage on feral animals including:

- *7pm ABC News*, ABC Television (national) – 'Brimming waterways boost carp numbers', 21 July 2012 (two-minute story on carp, distilled from *Landline* interview). [www.abc.net.au/news/2012-07-21/brimming-waterways-boost-carp-numbers/4145862](http://www.abc.net.au/news/2012-07-21/brimming-waterways-boost-carp-numbers/4145862)

- *Landline*, ABV Television (national) – ‘Carp Wars’, 22 July 2012 (20-minute story) <http://www.abc.net.au/landline/content/2012/s3550676.htm>
- *10 News*, Channel 10 Television (National) – story on the Camera-Trapping Colloquium held in Sydney (sponsored by the Invasive Animals CRC and others), 14 September 2012.
- *PRIME7 News*, PRIME7 Television (Regional NSW, Vic, WA, QLD) – ‘Long-term work has eradicated rodents, rabbits and goats on Montague Island’, 26 February 2013
- DigitalFarm TV (national online news and features) – ‘WoolProducers Australia combat wild dogs’, 5 March 2013
- Catalyst, ABC Television (national) – ‘Maremma guardian dogs protecting penguins from foxes’, 7 March 2013
- DigitalFarmTV (national online news and features) – ‘Rabbit biocontrol saves billions’, 8 April 2013
- DigitalFarmTV (national online news and features) – ‘New smartphone App *Field Guide to Pest Animals of Australia* from Invasive Animals CRC’, 29 April 2013.
- *Four Corners*, ABC Television (national) – ‘The Hunting Party’, 6 June 2013
- *7pm News WA*, ABC Television (WA) – ‘Cane toads impact on native wildlife worse than expected’, 6 June 2013
- ABC Television and ABC Radio (multiple national and local news broadcasts) – ‘Tasmanian Government is ending its fox baiting and hunting program’, 14 June 2013

In the remaining four years of the IA CRC extension to 30 June 2017, it is expected that the number of stories broadcast by radio and television stations will increase as research projects enter their more substantive years following the initial start-up year.

On radio, ABC Rural Radio and Radio National reported most often on a diversity of feral animals’ stories throughout the year. Although sourced from one region, these ABC radio stories are generally syndicated across the Australian ABC radio network to other rural regions.

Among the feral animals topics covered in the radio stories, where IA CRC researchers and others officers were interviewed, were stories on the

priority research areas of wild rabbits, European carp, wild dogs and feral pigs. In addition, radio stories reported on innovations from the IA CRC in the delivery of research information such as apps for smart phones and promotion of the third year of the IA CRC feral photos competition.

Over the years the photo competition has contributed to many of the images used in the PestSmart Toolkit on how to manage and control a variety of feral animals. Even some images used in this annual report have been sourced from entries in the 2013 feral photos competition.

## SOCIAL MEDIA

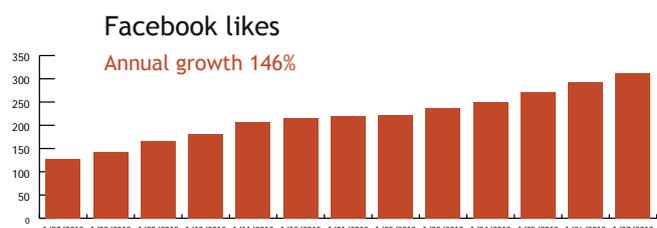
Social media has also become a valuable way to communicate with, engage and inform our digital audience in 2012-13. Media monitoring by the IA CRC since 2005 has shown a steadily-increasing social media profile for invasive animals issues.

### Facebook

Support for the IA CRC Facebook page ([facebook.com/PestSmart](https://facebook.com/PestSmart)) increased 146% from 127 to 313 ‘likes’ during the reporting period.

IA CRC Facebook posts included links to our YouTube videos, publications, new mobile applications, media articles mentioning the IA CRC, industry news articles and videos, promotion of the ‘Feral Photos’ competition and links to the IA CRC media releases and Feral Flyer newsletter. IA CRC Facebook posts that reached the most viewers included:

- Promotion of the *Field Guide to Pest Animals of Australia* (posted April 2013, 420 views).
- Announcement of IA CRC’s winning entry into the CRC Association’s 2013 Innovation Award for the PestSmart Toolkit and PestSmart Roadshows (posted May 30 2013, 393 views).
- Notice of an upcoming SBS One Television episode of *Insight* on feral cats (posted April 2013, 217 views).



## Twitter

A Twitter account ([twitter.com/PestSmartCRC](https://twitter.com/PestSmartCRC)) was created in March 2012 and gained 566 followers by the end of June 2013. Through the IA CRC's PestSmart Twitter account, we engage in regular industry conversations, including the #AgChatOz forum held each Tuesday evening.

Month	Twitter followers by end month
June to August 2012	160
September to November 2012	252
December 2012 to January 2013	366
March to May 2013	450
June 2013	566

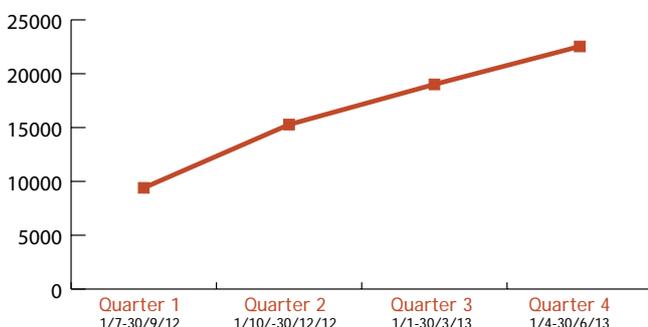
## YouTube

The PestSmart YouTube channel ([youtube.com/PestSmart](https://youtube.com/PestSmart)) was established in March 2012 and contains all the video clips from the two PestSmart DVDs (*Introduction to using foot hold traps for the capture of wild dogs and foxes* and *DVD Guide to practical pest animal management*).

Other video clips on feral pigs and feral cats produced as part of the PestSmart Toolkit can also be found on the YouTube channel. The channel received 9,400 views in the July-September 2012 quarter and more than 22,500 views in the April-June 2013 quarter.

The IA CRC has achieved an increasing trend of more people viewing our YouTube audio-visual presentations. Due to this increasing popularity, it is likely YouTube will feature even more prominently in ongoing IA CRC social media communications.

YouTube Visitation/Views for 2012-2013

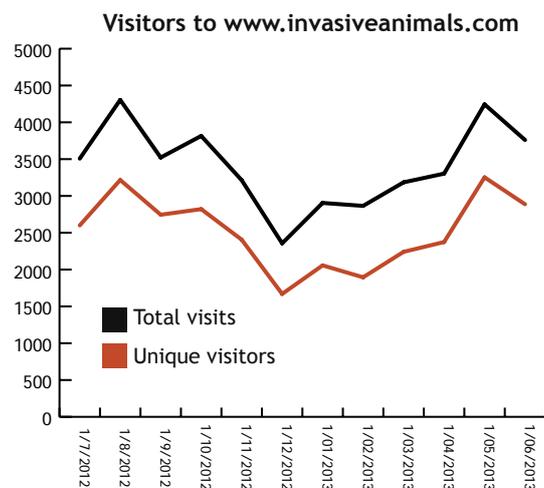


## WEBSITES

The IA CRC and the PestSmart brand continued to build a strong online presence during 2012-13. Invasive Animals CRC has two main websites:

- [www.invasiveanimals.com](http://www.invasiveanimals.com)  
 This is the corporate website of the IA CRC. It achieved an increase in traffic over the reporting period, with visitor activity and pages viewed up 45% and 58% respectively.

It averaged around 3,800 visitors per month over the 2012-13 year. The pattern of www visitors was more new initial visitors compared to returning visitors.



- [www.feral.org.au](http://www.feral.org.au)  
 This site is the home of the PestSmart Toolkit of information products that inform end-users and other interested persons on research information to more effectively manage and control feral animals with innovative technology of all types from commercial products and services to policy recommendations.

## IA CRC E-NEWSLETTER — FERAL FLYER

*Feral Flyer* is a fortnightly e-newsletter published by the IA CRC, which has 1,700 subscribers, mainly external to the IA CRC, comprised of both public and private agency representatives and individuals across Australia.

During 2012-13, an additional 100 subscribers were added to the *Feral Flyer* subscription list, which outnumbered the number of people unsubscribing, keeping the total number of subscribers relatively stable.

<i>Feral Flyer</i> total subscribers	30 June 2013	1,744
Total increase in 2012-13		101
Average monthly subscriber increase		8

## IA CRC INTERNAL E-NEWSLETTER — AROUND THE TRAPS

With the commencement of the new IA CRC extension on 1 July 2012 and its very different streamlined research program to the past CRC, a number of new people became involved in the IA CRC's feral animals' activities.

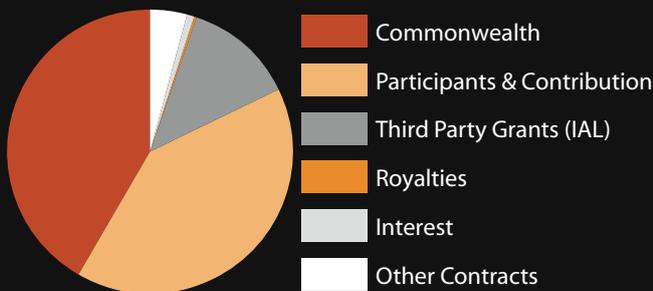
To better communicate with the 126 people who make up the greater IA CRC, an internal e-newsletter, *Around The Traps* was introduced in March 2013.

# FINANCIAL PERFORMANCE

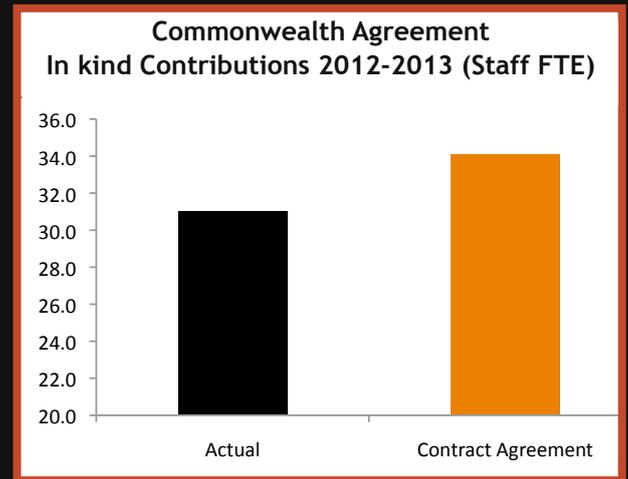
The Invasive Animals CRC has completed its first year of five-years funding (2012-2017). FY2013 has seen the start-up of the extension CRC with new accounts and processes created to support the new program of work.

Invasive Animals Ltd (IAL) manages the IA CRC. Total revenue received was \$9,450,488. Of this, the Commonwealth CRC Program provided \$3,920,000 and Participants invested \$3,825,951, with the remainder derived from other sources as shown below. The significant revenue from third party grants secured by Invasive Animals Ltd will continue to be pursued in future years.

**FY13 Revenue**



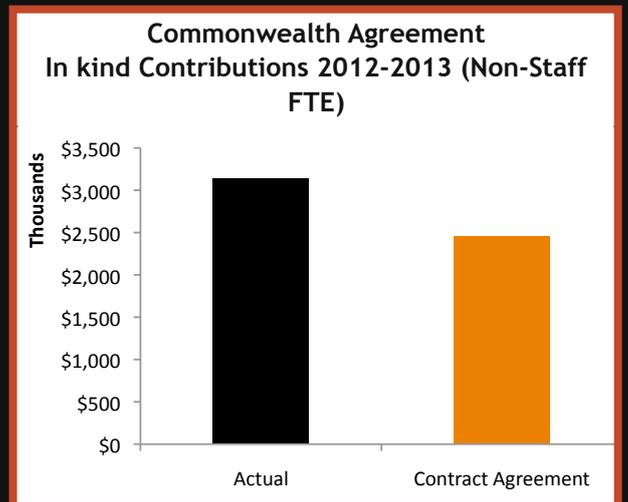
For the 2012-13 Financial Year our target for in-kind contributions of staff time to CRC projects was 34.1 Full Time Equivalents (FTE). We fell slightly short of the target, with the actual level of contributions being 31.0 FTE, reflecting variations in commencement dates of some projects in their first year.



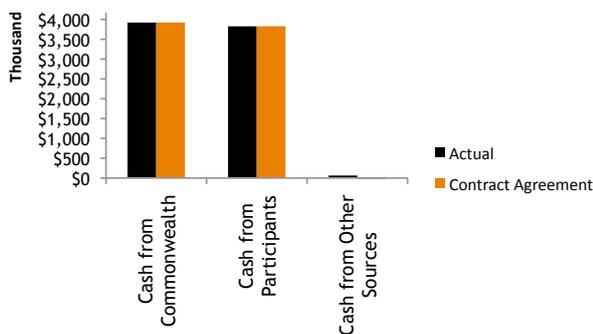
In-kind contributions that were non-staff related amounted to \$3,138,000, which well exceeded the annual target of \$2,455,000.

## Achievement against Commonwealth Agreement Budget

CRC activities were supported by the Australian Government and Participants, to the level shown below.

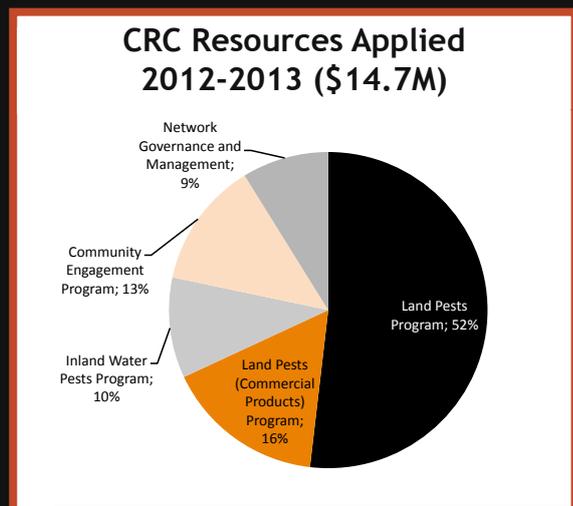
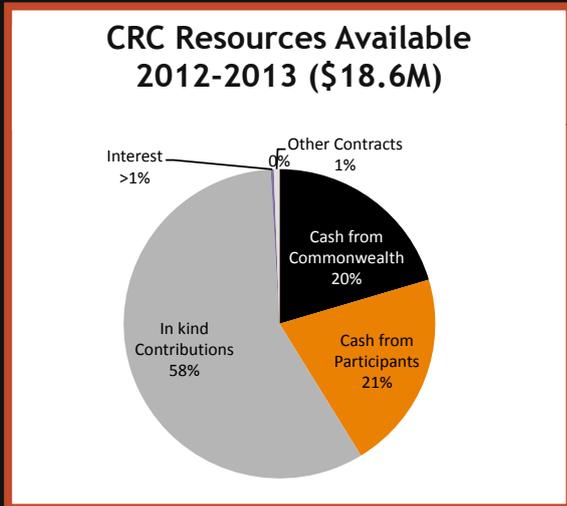


**Commonwealth Agreement Cash Based Contributions 2012-2013**



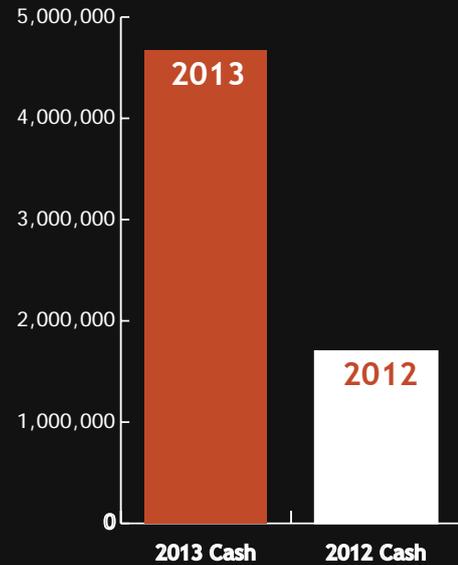
## Financial performance continued

The available resources of the IA CRC were derived and applied as indicated between the four CRC programs and network governance and management costs over 2012-2013.

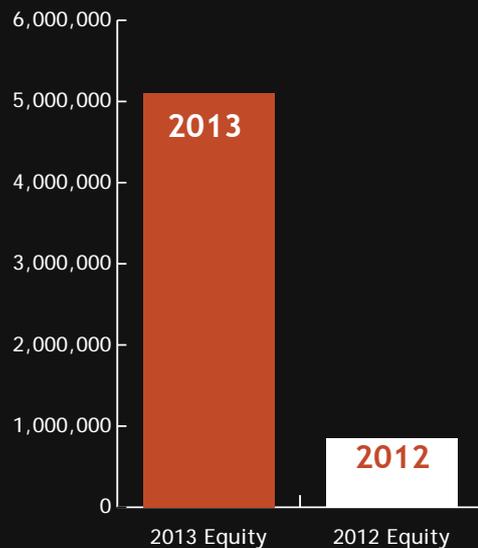


At the end of June 2013, the IAL cash position was \$4,672,034, up \$2,971,049 from the start of the CRC. The equity position at June 2013 was \$5,102,717 up \$4,251,888 from the start of the CRC. The 2013 figures indicate the CRC is in a healthy financial position.

### Cash at Bank



### Equity



The complete Audited Financial Statements are available for download from [www.invasiveanimals.com](http://www.invasiveanimals.com)

# ADDITIONAL ACTIVITIES & GRANTS

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IAL was involved in two significant activities outside the Commonwealth Agreement namely:

1. Caring for our Country (CFOC) Pest Animal Projects Review: funded by Department of Sustainability, Environment, Water, Population and Communities (SEWPaC)

The objectives of the CFOC review were to:

- Identify the methods of vertebrate pest animal control used in the 'Caring for our Country' projects and evaluate if these have been effective methods for control for the particular project in that particular area.
- Draw together the onground experiences of land managers who received funding under 'Caring for our Country' to evaluate the assumption that best-practice management is widely known and applied for wild rabbits, foxes, feral pigs and wild dogs achieved through effective onground management.

- To estimate through a series of selected case studies, the benefits of reducing these pest animal species.
  - Assess the legacy of the investments by evaluating the extent of community engagement and practice change for the management of wild rabbits, foxes, feral pigs and wild dogs.
2. Protecting the endangered Malleefowl from introduced predators near Mount Hope, NSW: funded by the 'Caring for our Country' Biodiversity Fund administered by the Department of Sustainability, Environment, Water, Population and Communities (SEWPaC)

The overall goal of the project is to establish a long-term integrated predator-control program using innovative control tools and solutions to increase the density and distribution of the endangered Malleefowl.

## GRANT SOURCES

The Invasive Animals Ltd did not receive any new grant funding during the reporting period.

# GLOSSARY

AAHL	Australian Animal Health Laboratories
ACTA	Animal Control Technologies Australia
APVMA	Australian Pesticides and Veterinary Medicines Authority
AWI	Australian Wool Innovation
adventitious	coming from another source and not inherent or innate
annulus	Latin for 'ring' — in fish research refers to annual rings that form in fish scales or bone sections (otoliths)
antibodies	an immunoglobulin, a specialised immune protein produced because of the introduction of an antigen into the body and which combines with the very antigen that triggered its production either destroying the antigen directly or facilitating the white blood cells to destroy it
avirulent	not virulent — refers to an infectious agent that does not produce pathological (disease manifestation) effects
biodiversity	variety of taxonomic life forms
biosecurity	protective measures to prevent a country from the entry and spread of unwanted animals pests diseases and weeds
canid	members of the family Canidae (carnivorous mammals) which includes the foxes, wolves, dogs, jackals and coyotes
calicivirus	a genus in the family Caliciviridae, a family of RNA viruses. They possess a characteristic six-pointed starlike shape whose surfaces have cup-shaped (chalice) indentions. Caliciviruses include the hepatitis E virus a form of swine virus, feline calicivirus and RHDV. We refer to the latter.
CIP	Centre Intellectual Property
cohort (student)	an organisational group defined to facilitate the analysis of student progression comprising programmes commencing in a particular academic year
CRC	Cooperative Research Centre
daughterless	genetic engineering technique using species-native genes that are inheritable and bias offspring sex ratios towards males
DNA	deoxyribonucleic acid
eDNA	environmental DNA
efficacy	the ability to produce a desired amount of a desired effect
endemic	unique to its own place or region – found only there and not naturally anywhere else
EPBC	Environmental Protection Biodiversity Conservation
eutherian	mammals having a placenta
exotic	introduced — not native to Australia
felid	members of the family Felidae (carnivorous mammals) which includes the big cats and domesticated cat
GRDC	Grains Research and Development Corporation
invasive	usually non-indigenous species that adversely effect the habitats they invade economically environmentally or socially. We include some native animals where altered environments have caused their numbers or range to increase artificially
IA	short form of 'Invasive Animals'
IAL	Invasive Animals Ltd
IZS	Istituto Zooprofilattico Sperimentale della Lombardia e dell'Emilia Romagna (IZS), Italy
hybrid	something of mixed origin or composition. (Genetics) the offspring of genetically dissimilar parents or stock especially the offspring produced by breeding plants or animals of different species or races
judas	captive animal used to attract others or which is fitted with a transmitter and release leading researchers or hunters to a herd
KHV	koi herpes virus
KTP	Key Threatening Process
macropod	member of the Macropodidae family which includes kangaroos, wallabies, tree-kangaroos, pademelons and several others
macro-invertebrate	refers to aquatic invertebrates, including insects, crustaceans, molluscs and worms
mesopredator	a medium-sized predator which often increases in abundance when larger predators are eliminated; eg. raccoons, skunks, snakes, cats, foxes.
monoclonal	of forming or derived from a single clone
myxomatosis	a virus specific to rabbits causes by the myxoma virus
PAPP	para-aminopropiophenone
pathogenic	capable of causing originating or producing disease
pathological	of or relating to causing disease
PCR	polymerase chain reaction
pheromone	chemical that triggers an innate behavioural response in another member of the same species
RHD	rabbit haemorrhagic disease (see caliciviruses)
RHDV	rabbit haemorrhagic disease virus
RSPCA	Royal Society for the Prevention of Cruelty to Animals
scat	faeces, droppings
shelf-stable	(non formal) a product that has been altered so it can be safely stored and sold in sealed containers at room temperature while still having a useful shelf life (quality for a suitable time)
SMEs	small to medium enterprises
spawning	production or depositing of large quantities of eggs in water
specificity	intended for applying to or acting on a particular thing (species)
sylvatic	referring to diseases or pathogens affecting only wild animals terrestrial land based
threatened	at risk of becoming endangered (plant or animal)
toxin	poisonous substance produced by living cells or organisms
virulence	a. extremely infectious malignant or poisonous. Used of a disease or toxin. b. capable of causing disease by breaking down protective mechanisms of the host. Used of a pathogen.

# APPENDIX A: MILESTONE REPORT

Progress against revised Commonwealth Agreement Schedule 1 milestones due in FY 2012-2013					
Output/ Milestone Number	Description	Contracted Achievement date	Achieved	Reason/Details	Strategies to achieve unmet milestone
<b>Output R1.1</b> National incursions response system technologies					
R1.1.1	National incursions response system technologies writing group and Terms of Reference (TORs) established.	31 June 2013	In Progress	Project commenced 1 July 2013.	Project Leader in place and milestone will be achieved by 30 June 2014.
R1.1.2	Incursion risks prioritised.	30 June 2013	In Progress	Project commenced 1 July 2013.	Project Leader in place and milestone will be achieved by 30 June 2014.
R1.1.3	Cost-sharing agreements and current incursion response strategies reviewed and gaps in documentation defined.	30 June 2013	In Progress	Project commenced 1 July 2013.	Project Leader in place and milestone will be achieved by 30 June 2014.
R1.1.4	Scoping of requirements for mobile applications and devices, and web-mapping tools completed.	30 June 2013	In Progress	End-user needs identified for many project outputs. Theme leaders consulted (wild rabbits, mice, fish and wild dogs). Initial consultation with partners completed.	Further discussion with Theme leaders required to fully-define project outputs and end-users needs. This will take place between August and September 2013.
R1.1.5	One PhD student enrolled.	30 June 2013	Yes	Pablo García-Díaz, University of Adelaide.	
<b>Output R1.2</b> Technologies and strategies for long-term Tasmanian fox incursion response					
R1.2.1	Risk assessment process for alternate control strategies started.	30 June 2013	Yes		
R1.2.2	Field staff employed.	30 June 2013	Yes		
R1.2.3	Robotic extraction for trace DNA developed and implemented.	30 June 2013	In Progress	Robotic extraction technology for trace DNA has been developed. Sample size for implementation is still required.	Sample size for implementation will be achieved 30 June 2014.
R1.2.4	Two PhDs enrolled.	30 June 2013	Yes	Catriona Campbell and Elodie Modave, University of Canberra.	
<b>Output R1.3</b> RHD Boost: roll-out of new RHDV strains					
R1.3.1	Two PhD students enrolled.	30 June 2013	Yes	Alireza Zahed and Amy Iannella, University of Adelaide.	
<b>Output R1.4</b> RHD Accelerator platform technology					
R1.4.1	Six different RHD monoclonal antibodies sourced or developed.	30 June 2013	In Progress	Discussions have been held with key collaborator Lorenzo Capucci (IZS Brescia), and a suite of suitable monoclonal antibodies have been identified for selection of virus in rabbits. One monoclonal antibody is already available and currently being used to optimise passive antibody injection procedures for the selection of virus.	Awaiting the first shipment from the Italy-based IZS prior to the exchange of these key reagents. AQIS import permits are in place.
R1.4.2	One rabbit cell line with compromised interferon-response established and tested for ability to support RHDV replication.	30 June 2013	In Progress	Pre-selection of cell lines for modification required.	Pre-screen primary rabbit cell lines first for ability to support replication without compromising Interferon pathways.
R1.4.3	One PhD student enrolled.	30 June 2013	Yes	Nadya Urakova, University of Canberra.	
<b>Output R1.5</b> Strategic wild dog control					
R1.5.1	Stakeholder advisory committee established.	30 June 2013	In Progress	Stakeholder committee formation in progress.	Some committee members approached and have accepted nomination.

R1.5.1	At least two PhD students enrolled (covering ecological mesopredator interactions, prey-plant interactions and social/economics).	30 June 2013	In Progress	PhD student Helen Morgan appointed (commenced August 2013). One UNE Professional Doctorate student, Bernadette York, commenced. Two UNE PhDs students appointed. One UNE Hons student appointed.	Further advertising to attract PhD students for prey and social/economics projects. Possibility of internal NSW DPI economist to address economics project.
R1.5.2	Field sites identified and established.	30 June 2013	Yes	Ecological field sites established and stakeholder agreements and licences in place.	
R1.5.3	Stage 1 field study undertaken - wild dogs, foxes, feral cats and spotted-tail quolls fitted with GPS/radio collars for study of temporal and spatial interactions in two mesic agro-ecosystems. Canid control implemented in mesic treatment sites.	30 June 2013	Yes		
U1.5.1	First annual update to stakeholders using project advisory committee and the National Wild Dog Advisory Group (NWDAG) and partner extension processes.	30 June 2013	Yes	Two NWDAMAG meetings have been held in Walcha, November 2012 and Sydney, March 2013.	
<b>Output R2.1 Avicide</b>					
R2.1.1	Achilles' heel review for potential new starling actives/avicides completed.	30 June 2013	In Progress	Negotiating and executing the Collaborative Research And Development Agreement (CRADA) and Other Participants Agreement (OPA) between the IA CRC and the USDA delayed achieving this milestone.	Scientific literature related to bird physiology has been screened so that the Achilles' heel review can be finalised before 20 December 2013.
<b>Output R2.2 Rodenticide</b>					
R2.2.1	Achilles' heel review for potential new rodenticides completed.	30 June 2013	In Progress	The Achilles' heel review for potential new rodenticides has begun but the majority of the work did not start until the CRADA and OPA were signed. This has delayed its start until August 2013, but it is now progressing well.	20 December 2013
<b>Output R2.3 Feral pig management products</b>					
R2.3.1	Non-toxic field trials of feral pig baits in the USA completed.	30 June 2013	In Progress	Negotiation of the Collaborative Research And Development Agreement (CRADA) and Other Participants Agreement (OPA), which underpinned the United States Department of Agriculture's inputs to field trials in the USA were complex and delayed this project's implementation. The development of a complete HOGGONE® bait formulation that is stable and effective has also not yet been achieved. Until such a bait is developed, field trials will be on hold.	An Australian - and US - developed feral pig bait matrix will be tested for attractiveness and palatability in the US in collaboration with IAL/ACTA/USDA and Texas Parks and Wildlife Department.  Nine new microencapsulated formulations of sodium nitrite will also be tested in the US in the preferred bait matrix. The most palatable and efficacious encapsulated nitrite/bait matrix formulation(s) will be taken through to field trials in the US and Australia.
U2.3.1	HOGGONE® and a nitrite concentrate registration package submitted to APVMA in Australia.	30 June 2013	In Progress	A completed HOGGONE® bait formulation that is stable and effective has not been developed to date.	The testing of multiple new microencapsulated formulations of sodium nitrite/bait matrices will be used to reduce the risk that the project does not develop a commercial feral pig bait for use in Australia. Once the preferred commercial feral pig bait is tested in the US and/or Australia in the field and stability data is to hand, a new product application will be submitted to the APVMA.

<b>Output R2.4 Fertility control</b>						
R2.4.1	Horse bacteriophage fertility control project started.	30 June 2013	Yes			
R2.4.1	Two PhD students enrolled.	30 June 2013	Yes	Sally Hall and Aleona Swegen, University of Newcastle.		
R2.4.2	Investigation of an orally-deliverable anti-fertility formulation(s) (eg GnRH constructs) by a post-doctoral fellow started.	30 June 2013	Yes	Sameer Sharma, CSIRO.		
U2.4.1	GonaCon™ registration package prepared and submitted to APVMA.	30 June 2013	In Progress	The GonaCon™ registration packages approved by the Environmental Protection Agency in the USA have not been available to the project until such time that the Collaborative Research And Development Agreement (CRADA) and Other Participants Agreement (OPA) were signed. This has delayed the presentation of the data to the APVMA. In the interim, the registration process in Australia has been explored. Under the Australian regulatory system, this product will be assessed as an animal drug by the APVMA. This will require additional regulatory data particularly around its manufacture. Given the proposed use of GonaCon™, it may be assessed as a minor use product which would potentially expedite its availability. A dialogue between the project and the APVMA to assess the applicability of this approach is currently being had to progress the availability of this fertility management product in Australia.	30 June 2014	
<b>Output R3.1 Genetic tools for detection of pest fish at low densities</b>						
R3.1.1	Quantitative evaluation of eDNA detection technique in controlled situations undertaken.	30 June 2013	Yes			
R3.1.2	Field testing of efficacy of eDNA detection method completed.	30 June 2013	In Progress	Field collections were made early in the project, but it will be prudent to collect fresh samples at the end of the dry season to confidently determine the efficacy of the eradication program.	Final field collections are planned for October 2013 when dry season flow is lowest and detection is most likely.	
R3.1.3	Development of molecular markers for required species started.	30 June 2013	Yes			
R3.1.4	Two PhD students enrolled.	30 June 2013	Yes	Jonas Bylemans and Rheyda Hinlo, University of Canberra.		
<b>Output R3.2 Koi Herpes Virus (KHV) evaluation and rollout</b>						
R3.2.1	Research plan to guide KHV scientific evaluation project prepared in consultation with APVMA.	30 June 2013	Yes			
R3.2.2	KHV susceptibility trials on additional selected non-target species started.	30 June 2013	Yes	A total of 11 species of fish have now been tested for susceptibility to KHV (10 native species and one introduced species).		
R3.2.2	Post doc project started.	30 June 2013	Yes	Agus Sunarto started March 2013		
<b>Output R4.1 Facilitate collective action</b>						
R4.1.1	IA CRC internal report-identifying community partner groups' support needs and support plans, based on needs assessment, completed.	30 June 2013	In Progress	Appointment of suitable project staff led to slight project delay.	Support needs and plans are being identified through discussion with community partners as collaborations are developed. This milestone will be met by March 2014.	
R4.1.2	Community engagement research hypotheses and methodologies for action research documented.	30 June 2013	In Progress	Appointment of suitable project staff led to slight project delay.	Data collection is underway. This milestone will be met by March 2014	

R4.1.3	One PhD student enrolled.	30 June 2013	Yes	Katrina Dickson, University of New England.	
<b>Output R4.2</b>					
<b>Triggers for effective action</b>					
R4.2.1	Literature review and initial theories documented as a technical paper or publication.	30 June 2013	In progress	Appointment of suitable project staff led to slight project delay.	Post-doctoral fellow and PhD student have been assigned to this aspect of the project. Literature review has commenced. Review will be completed by 30 May 2014.
R4.2.2	One PhD student enrolled.	30 June 2013	Yes	Lynette McLeod, University of New England.	
<b>Output R4.3</b>					
<b>Reduction of legal and institutional impediments.</b>					
R4.3.1	Working paper or technical report on the legal and institutional arrangements for invasive animal control completed.	30 June 2013	In Progress	Appointment of suitable project staff led to slight project delay.	Desktop and key informant interviews are being conducted. Paper will be finalised by 30 March 2014.
R4.3.2	One PhD student enrolled.	30 June 2013	In Progress	No viable candidates for institutional research have yet been identified in previous round.	Re-promote the opportunity for 2014. Expect to deliver by 30 April 2014.
<b>Output R4.4</b>					
<b>Balanced Researcher program</b>					
R4.4.1	At least 15 PhD student projects have been selected that align with ongoing IA CRC projects.	30 June 2013	Yes	17 PhD students were selected and aligned with the IA CRC projects: <ul style="list-style-type: none"> <li>• Two PhDs in the incursions response theme.</li> <li>• Three PhDs in the wild rabbit theme.</li> <li>• Four PhDs in the wild dog theme.</li> <li>• Two PhDs in the fertility control theme.</li> <li>• Two PhDs in the pest fish theme.</li> <li>• Four Professional Doctorates in the community engagement theme.</li> </ul>	
R4.4.2	At least 15 PhD scholarships advertised for 2013 intake.	30 June 2013	Yes		
R4.4.3	At least 10 PhD students and at least five post-doctoral fellows selected and started on basis of suitability to individual projects.	30 June 2014	Yes	Achieved one year ahead of schedule.	
R4.4.4	Balanced Researcher program started.	30 June 2014	Yes	Achieved one year ahead of schedule.	
<b>Output R4.5</b>					
<b>Vocational Education and Training (VET)</b>					
R4.5.1	In concert with AgriFood Skills Australia (ASA), review of pest management jobs to determine appropriate skills and competencies started.	30 June 2013	Yes		
U4.5.1	Partnerships established with Vertebrate Pests Committee (VPC) agencies, Natural Resource Management Boards, NSW DPI and TOCAL Agricultural College to enable development of training packages.	30 June 2013	In Progress	Revised qualifications were circulated widely for comment on 2 July 2013. An out-of-session paper informing VPC about the revised qualifications and asking for their input was sent through the NSW VPC Rep on 1 July.	Initial consultation with TOCAL re their input was held in January 2013. Funds were allocated by the IA CRC Board to work with TOCAL to develop appropriate material to assist delivery of the revised training packages.  The anticipated new date for this milestone is December 2013.
U4.5.2	Complementary market analyses of training needs and likely utilisation undertaken in NSW DPI in conjunction with TOCAL College, and other state pest management agencies.	30 June 2013	In Progress	Milestone delayed awaiting the review of the training packages and their circulation for comment. This was due to Agrifood expanding the review to cover the job roles for weeds and Conservation and Land Management in general.	Marketing analysis of training needs to be completed by December 2013.

Other Reporting requirements

O1.1	Final annual report for IA CRC under previous Commonwealth Agreement submitted to Commonwealth	31 October 2012	Yes		
O1.2	Exit report for IA CRC under previous Commonwealth Agreement submitted to Commonwealth.	31 October 2012	Yes		
O1.3	Operational performance of rabbit warren fumigator determined under field simulated conditions.	30 June 2013	In Progress	The engineering of a working prototype is not yet complete, as CO emissions have peaked at 3-3.5% against an operating specification of 4.5-5%. Spark advancement or retardation and the use of a special fuel mixture are the two options remaining to increase CO emissions. There is a moderate to high risk that this milestone will be delayed.	Field testing of prototype units is due to be completed by the end of November 2013.
O1.4	National APVMA registration package for rabbit warren fumigator submitted.	30 June 2013	In Progress	Modifications to the devices have hampered field evaluation efforts required to complete registration package for APVMA consideration.	Animal Ethic approval extended, modification of the device being carried out November 2013, with draft registration package expected by 30 June 2014.
T1.1	Transition plan submitted to Commonwealth	30 November 2012	Yes		
T1.2	Transition plan revised and submitted to Commonwealth	30 June 2013	Yes		

# APPENDIX B: PUBLICATIONS LISTING

The full publication listing follows:

- 2.1 Formal publications
  - 2.1.1 Formal book
  - 2.1.2 Formal book chapter
  - 2.1.3 Formal articles in scholarly-refereed journal
  - 2.1.4 Formal full written conference paper – refereed proceedings
- 2.2 Publications and reports for industry and other end users
  - 2.2.1 Conference abstract in a non-refereed proceedings publication
  - 2.2.2 Invasive Animals CRC technical report
  - 2.2.3 PestSmart technical report/factsheet/guides/standard operating procedures (SOP)
  - 2.2.4 PestSmart case study
  - 2.2.5 Other agency report

## Publications Summary

During 2012-13, the Invasive Animals CRC Extension (2012-2017) published:

- Two formal articles in scholarly-refereed journals
- Two formal full written conference papers-refereed proceedings
- Six conference abstracts in a non-refereed proceedings publication
- Two Invasive Animals CRC technical reports
- Three other agency reports

During 2012-13, the Invasive Animals CRC (2005-2012) published:

- One formal book chapter
- 32 formal articles in scholarly-refereed journals
- 41 PestSmart publications
  - » Five factsheets
  - » Two technical reports
  - » Four A5 guides
  - » 27 standard operating procedures (SOP)
  - » Three case studies

## Invasive Animals CRC Extension (2012-2017) scientific publications from 2012-2013 research

Publication type	Date Published	Title	Publisher	Authors	Relevant Project
<b>OUTCOME 1: NO NEW VERTEBRATE PESTS ESTABLISHED IN AUSTRALIA</b>					
2.1.3 - Formal articles in scholarly-refereed journals	March 2013	Are there really foxes: Where does the doubt emerge?	<i>Journal of Knowledge Management Practice</i> : 14(1)	Blackman, D, Corcoran, A, Sarre, S	1.L.21
2.2.1 - Conference abstract in a non-refereed proceedings publication	April 2013	Estimating Species Presence with confidence: a conceptual Framework for eDNA Detection	Poster - Biodiversity Genomics conference, Centre for Biodiversity Analysis, ACT	Furlan, E, Duncan, R, Gleeson, D.	1.W.2
2.2.1 - Conference abstract in a non-refereed proceedings publication	June 2013	MynaScan - What it tells us and new developments	Presentation - Canberra Myna Bird Conference, Canberra Indian Myna Action Group Inc, ACT	West, P	1.L.5
2.2.5 - Other agency report	June 2013	Monitoring the effectiveness of the release of RHD-Boost	Victorian Department of Primary Industries unpublished report	Ramsey, D	1.L.2
<b>OUTCOME 2: PREDICTION AND CONTROL OF EMERGING OUTBREAKS</b>					
Nil					
<b>OUTCOME 3: RECOVERY OF KEY LAND AND WATER REGIONS AFTER HUMANE CONTROL OF RABBITS, WILD DOGS AND CARP</b>					
<b>Wild Rabbits</b>					
2.1.3 - Formal articles in scholarly-refereed journals	June 2013	Desktop surveys: Using social media in rabbit biological control	<i>Biocontrol News and Information</i> , 34(2):10N-11N	Peacock, D	3.L.5
2.2.1 - Conference abstract in a non-refereed proceedings publication	July 2012	The Changing Face of Rabbit Control	Keynote address - Queensland Pest Animal Symposium	Cox TE, Liu J, Strive T, Read, A and Saunders G	3.L.1

2.2.1 - Conference abstract in a non-refereed proceedings publication	July 2012	Seeking additional biological control agents to augment rabbit haemorrhagic disease virus (RHDV) and myxomatosis: Managing Australia's recovering <i>Oryctolagus cuniculus</i> pest population.	Poster - 61st International Wildlife Disease Association and 10th Biennial European Wildlife Disease Association joint conference, France	Peacock, D and Mutze, G	3.L.5
2.2.1 - Conference abstract in a non-refereed proceedings publication	December 2012	Serological status to RHDV and RCV-A1 in rabbit populations across Australia	Poster - Australasian Wildlife Management Society Conference	Cox TE, Liu J, Strive T and Saunders G	3.L.1
2.2.2 - Invasive Animals CRC technical report	May 2013	Benefits of rabbit biocontrol in Australia	Report to Invasive Animals CRC	Cox TE, Strive T, Mutze G, West P and Saunders G	3.L.1
2.2.5 - Other agency report	January 2013	The increasing problem of rabbits	Article in <i>Kararehe Kino: Vertebrate Pest Research</i> (Landcare Research New Zealand), 21(9):19	Duckworth, J	3.L.3
2.2.5 - Other agency report	June 2013	Monitoring the effectiveness of a new strain of rabbit haemorrhagic disease virus - RHD-Boost	Report to Invasive Animals CRC from the Arthur Rylah Institute for Environmental Research	Ramsey, D	3.L.1
<b>Wild Dogs</b>					
2.2.1 - Conference abstract in a non-refereed proceedings publication	July 2012	The nature and impact of peri-urban wild dogs	Presentation - Proceedings of the Queensland Pest Animal Symposium, Caloundra	Gentle, M. and Allen, L	3.L.13
2.2.2 - Invasive Animals CRC technical report	April 2013	Trophic responses to lethal control of placental predators in Australia	Invasive Animals CRC technical report (proceedings from an expert workshop, Sydney)	Ballard, G, and Fleming, P	3.L.11
<b>European Carp</b>					
Nil					
<b>OUTCOME 4: NEW SOCIAL NETWORKS AND INSTITUTIONAL 'ARCHITECTURE' ENHANCED AROUND PEST ANIMAL CONTROL</b>					
2.1.4 - Formal written conference paper – refereed proceedings	March 2013	Principles underpinning best practice management of the damage due to pests in Australia	Presentation – Proceedings of the 25th Vertebrate Pest Conference (Ed Timm, RM) (University of California: Davis) 2012:300-307	Braysher, M, Buckmaster, T, Saunders, G. and Krebs, C	4.E.1
2.1.4 - Formal written conference paper - refereed proceedings	March 2013	Strategic Vertebrate pest training	Presentation - Proceedings of the 25th Vertebrate Pest Conference (Ed Timm, RM) (University of California: Davis) 2012:296-299	Buckmaster, T, and Braysher, M	4.E.11

## Invasive Animals CRC (2005-2012) scientific publications from 2012-2013 research

Publication type	Date Published	Title	Publisher	Authors	Relevant Project
<b>OUTCOME 1: A BENEFIT OF \$29 MILLION P.A. BY REDUCING THE IMPACTS OF FOX AND WILD DOGS BY 10%</b>					
2.1.2 - Formal book chapters	August 2012	Top-predators as biodiversity regulators: Contemporary issues affecting knowledge and management of dingoes in Australia	Chapter 4 in <i>Biodiversity Enrichment in a Diverse World</i> (Ed. Lameed, GA) pp. 85-132 (InTech <sup>®</sup> , doi:10.5772/50246)	Allen, BL, Hayward, M, Fleming, PJS, Allen, LR, Engeman, RM, Ballard, G and Leung, LK-P	10.T.5, 1.T.4
2.1.3 - Formal articles in scholarly-refereed journals	October 2012	A permanent security post for camera trapping	<i>Australian Mammalogy</i> , 35:123-127	Meek, PD, Ballard, GA and Fleming, PJS	11.T.5
2.1.3 - Formal articles in scholarly-refereed journals	December 2012	User-based design specifications for the ultimate camera trap for wildlife research	<i>Wildlife Research</i> 39(8):649-660	Meek, PD and Pittet, A	11.T.5
2.1.3 - Formal articles in scholarly-refereed journals	February 2013	Understanding the drivers and barriers to participation in wild canid management in Australia: Implications for the adoption of a new toxin, para-aminopropiophenone	<i>International Journal of Pest Management</i> , 59(1):35-46	Southwell, D, Boero, V, Mewett, O, McCowen, S and Hennecke, B	1.D.1
2.1.3 - Formal articles in scholarly-refereed journals	March 2013	As clear as mud: A critical review of evidence for the ecological roles of Australian dingoes	<i>Biological Conservation</i> , 159:158-174	Allen, BL, Fleming, PJS, Allen, LR, Engeman, RM, Ballard G and Leung, LK-P	10.T.5, 3.L.11, 3.L.13
2.1.3 - Formal articles in scholarly-refereed journals	March 2013	Are there really foxes: Where does the doubt emerge?	<i>Journal of Knowledge Management Practice</i> , 14 (1), doi:http://www.tlinc.com/articl325.htm	Blackman, D, Corcoran, A and Sarre, S	9.D.10
2.1.3 - Formal articles in scholarly-refereed journals	May 2013	Anthropogenic resource subsidies determine space Use by Australian arid zone dingoes: An improved resource selection modelling approach	<i>PLOS ONE</i> , 8 (5), doi:10.1371/journal.pone.0063931	Newsome, TM, Ballard, GA, Dickman, CR, Fleming, PJS and Howden, C	10.T.5
2.1.3 - Formal articles in scholarly-refereed journals	May 2013	Genetic profile of dingoes ( <i>Canis lupus dingo</i> ) and free-roaming domestic dogs ( <i>C. L. Familiaris</i> ) in the Tanami Desert, Australia	CSIRO <i>Wildlife Research</i> , 01/2013, doi:http://dx.doi.org/10.1071/WR12128	Newsome, TM, Stephens, D, Ballard, GA, Dickman, CR, A and Fleming, PJS	10.T.5
2.2.3 - PestSmart factsheet		PAPP FAQs	Invasive Animals CRC, Canberra, ACT		
2.2.3 - PestSmart guide		Working plan to manage wild dogs (green book)	Invasive Animals CRC, Canberra, ACT		
2.2.3 - PestSmart guide		Guidelines for preparing a working plan to manage wild dogs (brown book)	Invasive Animals CRC, Canberra, ACT		
2.2.3 - PestSmart guide		Glovebox guide	Invasive Animals CRC, Canberra, ACT		
2.2.3 - PestSmart SOP		Trapping using soft net traps	Invasive Animals CRC, Canberra, ACT		
2.2.3 - PestSmart SOP		Ground baiting of foxes with sodium fluoroacetate (1080)	Invasive Animals CRC, Canberra, ACT		
2.2.3 - PestSmart SOP		Aerial baiting of foxes with sodium fluoroacetate (1080)	Invasive Animals CRC, Canberra, ACT		
2.2.3 - PestSmart SOP		Ground shooting of foxes	Invasive Animals CRC, Canberra, ACT		
2.2.3 - PestSmart SOP		Fumigation of fox dens using carbon monoxide	Invasive Animals CRC, Canberra, ACT		
2.2.3 - PestSmart SOP		Trapping of foxes using padded-jaw traps	Invasive Animals CRC, Canberra, ACT		
2.2.3 - PestSmart SOP		Trapping of foxes using cage traps	Invasive Animals CRC, Canberra, ACT		
2.2.3 - PestSmart factsheet		Fox legislation in Australia	Invasive Animals CRC, Canberra, ACT		
2.2.3 - PestSmart factsheet		Baiting for fox control	Invasive Animals CRC, Canberra, ACT		

## OUTCOME 2: A NATIONAL BENEFIT OF \$16 MILLION P.A. BY REDUCING FERAL PIG DAMAGE BY 15%

2.1.3 - Formal articles in scholarly-refereed journals	July 2012	Are feral pigs ( <i>Sus scrofa</i> ) a pest to rainforest tourism?	<i>Journal of Ecotourism</i> 11(2): 132-148	Koichi, K, Kaur, K, Cottrell, A and Gordon, IJ	2.U.5e
2.1.3 - Formal articles in scholarly-refereed journals	August 2012	Aboriginal rangers' perspectives on feral pigs: Are they a pest or a resource? A case study in the Wet Tropics World Heritage Area of Northern Queensland	<i>Journal of Australian Indigenous Issues</i> , 15(1):2-19	Koichi, K, Kaur, K, Cottrell, A and Gordon, IJ	10.U.6b
2.1.3 - Formal articles in scholarly-refereed journals	April 2013	What determines the acceptability of wildlife control methods? A case of feral pig management in the Wet Tropics World Heritage Area, Australia	<i>Human Dimensions of Wildlife</i> , 18(2): 97-108	Koichi, K, Kaur, K, Cottrell, A and Gordon, IJ	2.U.5e
2.2.3 - PestSmart SOP		Trapping of feral pigs	Invasive Animals CRC, Canberra, ACT		
2.2.3 - PestSmart SOP		Aerial shooting of feral pigs	Invasive Animals CRC, Canberra, ACT		
2.2.3 - PestSmart SOP		Ground shooting of feral pigs	Invasive Animals CRC, Canberra, ACT		
2.2.3 - PestSmart SOP		Use of Judas pigs	Invasive Animals CRC, Canberra, ACT		
2.2.3 - PestSmart SOP		Poisoning of feral pigs with 1080	Invasive Animals CRC, Canberra, ACT		
2.2.4 - PestSmart case study		Feral pig HOGGONE® baiting trials in Goondiwindi, Qld	Invasive Animals CRC, Canberra, ACT		

## OUTCOME 3: A BENEFIT OF \$7 MILLION P.A. BY REDUCING RODENT DAMAGE BY 20%

Nil

## OUTCOME 4: A CAPACITY TO DELIVER IMPROVED QUALITY AND AVAILABILITY OF INLAND WATER THROUGH REDUCED IMPACTS AND RATES OF SPREAD OF CARP AND OTHER PEST FISH SPECIES

### European Carp

2.1.3 - Formal articles in scholarly-refereed journals	June 2013	Nursery sources and cohort strength of young-of-the-year common carp ( <i>Cyprinus carpio</i> ) under differing flow regimes in a regulated floodplain river	<i>Ecology of Freshwater Fish</i> doi:10.1111/eff.12075	Macdonald, JI and Crook, DA	4.F.5
2.2.3 - PestSmart factsheet		Daughterless carp	Invasive Animals CRC, Canberra, ACT		

### Tilapia

2.1.3 - Formal articles in scholarly-refereed journals	May 2012	Reproductive strategies of two invasive tilapia species <i>Oreochromis mossambicus</i> (Peters 1852) and <i>Tilapia mariae</i> (Boulenger 1899) in northern Australia	<i>Journal of Fish Biology</i> , 80:2176-2197	Russell, DJ, Thuesen, PA and Thomson, FE	4.F.10
2.1.3 - Formal articles in scholarly-refereed journals	September 2012	A review of biology, ecology, distribution and control of Mozambique tilapia <i>Oreochromis mossambicus</i> (Peters 1852) (Pisces: Cichlidae) with particular emphasis on invasive Australian populations.	<i>Reviews in Fish Biology and Fisheries</i> , 22(3):533-554	Russell, DJ, Thuesen, Pa and Thomson, FE	4.F.10
2.1.3 - Formal articles in scholarly-refereed journals	April 2013	Age and growth of two newly established invasive populations of <i>Tilapia mariae</i> in northern Australia	<i>Journal of Fish Biology</i> , 82(4):1211-1225	Russell, DJ, Thomson, F and Thuesen, PA	4.F.10 4.F.18

## OUTCOME 5: DELIVER INNOVATIVE, PRACTICAL CONTROL MEASURES AGAINST CANE TOADS

2.1.3 - Formal articles in scholarly-refereed journals	October 2012	Host-parasite relationships during a biologic invasion: 75 years post invasion, cane toads and sympatric Australian frogs retain separate lungworm fauna	<i>Journal of Wildlife Diseases</i> 48: 951-961	Pizzatto, L, Kelehear, C, Dubey, S, Barton, D, and Shine, R	5.T.1
2.1.3 - Formal articles in scholarly-refereed journals	January 2013	The early toad gets the worm: Cane toads at an invasion front benefit from higher prey availability	<i>Journal of Animal Ecology</i> , 82(4):854-862	Brown, GP, Kelehear, C and Shine, R	5.T.1
2.1.3 - Formal articles in scholarly-refereed journals	February 2013	Invasive parasites in multiple invasive hosts: the arrival of a new host revives a stalled prior parasite invasion	<i>Oikos</i> , 122:1317-1324, doi:10.1111/j.1600-0706.2013.00292.x	Kelehear, C, Brown, GP and Shine, R	5.T.1

## OUTCOME 6: REDUCED IMPACT OF FERAL CATS OVER FIVE MILLION HECTARES

2.1.3 - Formal articles in scholarly-refereed journals	August 2012	Den use, home range and territoriality of the koomal ( <i>Trichosurus vulpecula hypoleucus</i> ) with implications for current forest management strategies	<i>Australian Journal of Zoology</i> , 60(3):141-151	Cruz, J, Sutherland, DR, Leung, LK.-P	10.U.1
2.1.3 - Formal articles in scholarly-refereed journals	December 2012	Are smaller subspecies of common brushtail possums more omnivorous than larger ones?	<i>Austral Ecology</i> , 37(8):893-902	Cruz, J, Sutherland, DR, Martin, GR, Leung, LK-P	10.U.1
2.1.3 - Formal articles in scholarly-refereed journals	March 2013	Early onset of reproduction in the agile antechinus, <i>Antechinus agilis</i>	<i>Australian Mammalogy</i> , 35(1):115-118	Buckmaster, AJ and Dickman, CR	10.U.4
2.1.3 - Formal articles in scholarly-refereed journals	May 2013	Anti-predator responses of koomal ( <i>Trichosurus vulpecula hypoleucus</i> ) against introduced and native predators	<i>Behavioural Ecology and Sociobiology</i> , 67:1329-1338	Cruz, J, Sutherland, DR, Anderson, DP, Glen, AS, de Tores, PJ and Leung, LK-P	10.U.1
2.2.3 - PestSmart SOP		Ground shooting of feral cats	Invasive Animals CRC, Canberra, ACT		
2.2.3 - PestSmart SOP		Trapping of feral cats using cage traps	Invasive Animals CRC, Canberra, ACT		
2.2.3 - PestSmart SOP		Trapping of feral cats using padded-jaw traps	Invasive Animals CRC, Canberra, ACT		

## OUTCOME 7: INCREASED AGRICULTURAL PROFITABILITY THROUGH IMPROVED INTEGRATION OF EXISTING BIOLOGICAL, CONVENTIONAL AND NEWLY-DEVELOPED CONTROL OPTIONS FOR WILD RABBITS

2.1.3 - Formal articles in scholarly-refereed journals	September 2012	A sensitive and specific blocking ELISA for the detection of rabbit calicivirus RCV-A1 antibodies	<i>Virology Journal</i> 9:182, doi:10.1186/1743-422X-9-182	Liu J, Kerr PJ and Strive T	7.T.1
2.1.3 - Formal articles in scholarly-refereed journals	November 2012	Rabbit haemorrhagic disease: Are Australian rabbits ( <i>Oryctolagus cuniculus</i> ) evolving resistance to infection with Czech CAPM 351 RHDV?	<i>Epidemiology &amp; Infection</i> , 140(11):1972-1981	Elsworth, PG, Kovalski, J, Cooke, BD	7.T.5
2.1.3 - Formal articles in scholarly-refereed journals	March 2013	The economic benefits of the biological control of rabbits in Australia, 1950-2011	<i>Australian Economic History Review</i> , 53:91-107	Cooke B, Chudleigh P, Simpson S and Saunders G	7.T.3
2.1.3 - Formal articles in scholarly-refereed journals	May 2013	The economics of rabbit biocontrol in Australia	<i>Biocontrol News and Information</i> , 34(2):9N-10N	Cooke, B	7.T.3
2.2.3 - PestSmart guide		Glovebox Guide	Invasive Animals CRC, Canberra, ACT		
2.2.3 - PestSmart factsheet		Fumigation for rabbit control	Invasive Animals CRC, Canberra, ACT		
2.2.3 - PestSmart technical report		Planning landscape-scale rabbit control	Invasive Animals CRC, Canberra, ACT		

## OUTCOME 8: DELIVER IMPROVED AND HUMANE APPROACHES TO REDUCE THE PRODUCTION AND BIODIVERSITY IMPACTS OF EXPANDING OR OTHER OVERABUNDANT AND WIDESPREAD SPECIES

### Birds

2.1.3 - Formal articles in scholarly-refereed journals	July 2012	Is it benign or is it a pariah? Empirical evidence for the impact of the Common Myna ( <i>Acridotheres tristis</i> ) on Australian birds	<i>PLoS ONE</i> , 7(7):e40622, doi:10.1371/journal.pone.0040622	Grarock, K, Tidemann, C, Wood, J and Lindenmayer, D	PhD
2.1.3 - Formal articles in scholarly-refereed journals	April 2013	Are invasive species drivers of native species decline or passengers of habitat modification? A case study of the impact of the common myna ( <i>Acridotheres tristis</i> ) on Australian bird species	<i>Austral Ecology</i> , doi:10.1111/aec.12049	Grarock, K, Tidemann, CR, Wood, JT and Lindenmayer, DB.	PhD
2.1.3 - Formal articles in scholarly-refereed journals	May 2013	Does human-induced habitat modification influence the impact of introduced species? A case study on cavity-nesting by the introduced Common Myna	<i>Environmental Management</i> , doi:10.1007/s00267-013-0088-7	Grarock, K, Lindenmayer, DB, Wood, JT and Tidemann, CR	PhD
2.2.3 - PestSmart SOP		Trapping of pest birds	Invasive Animals CRC, Canberra, ACT		
<b>Feral Deer</b>					
2.2.3 - PestSmart SOP		Ground shooting of feral deer	Invasive Animals CRC, Canberra, ACT		
<b>Feral Donkeys</b>					
2.2.3 - PestSmart SOP		Ground shooting of feral donkeys	Invasive Animals CRC, Canberra, ACT		

2.2.3 - PestSmart SOP	Aerial shooting of feral donkeys	Invasive Animals CRC, Canberra, ACT
<b>Feral Goats</b>		
2.2.3 - PestSmart SOP	Ground shooting of feral goats	Invasive Animals CRC, Canberra, ACT
2.2.3 - PestSmart SOP	Aerial shooting of feral goats	Invasive Animals CRC, Canberra, ACT
2.2.3 - PestSmart SOP	Mustering of feral goats	Invasive Animals CRC, Canberra, ACT
2.2.3 - PestSmart SOP	Trapping of feral goats	Invasive Animals CRC, Canberra, ACT
2.2.3 - PestSmart SOP	Use of Judas Goats	Invasive Animals CRC, Canberra, ACT
2.2.4 - PestSmart case study	Feral goat eradication on Kangaroo Island	Invasive Animals CRC, Canberra, ACT

**OUTCOME 9: REDUCED RISKS OF ECONOMIC LOSSES, ENVIRONMENTAL DAMAGE AND SOCIAL STRESS BY FORECASTING AND RESPONDING TO POTENTIAL, NEW OR EMERGING INVASIVE ANIMAL PROBLEMS**

2.2.4 - PestSmart case study	A new exotic found in the wild: Green iguana in QLD	Invasive Animals CRC, Canberra, ACT
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**OUTCOME 10: GROWTH IN AUSTRALIAN INVASIVE ANIMAL PEST CONTROL INDUSTRIES, THROUGH INDUSTRY COLLABORATION ON THE REGISTRATION, MARKETING, EXPORT AND COMMUNITY UPTAKE OF NEW PRODUCTS, THE INVASIVE ANIMALS CRC WILL ENHANCE CONTROL OF PROBLEM SPECIES**

Nil

**OUTCOME 11: INCREASED PROFESSIONAL AND PRACTICAL SKILLS BASE IN INVASIVE ANIMAL MANAGEMENT THROUGH EDUCATION, TRAINING AND COMMUNITY AWARENESS**

Nil

**OUTCOME 12: ESTABLISHED NATIONAL AND LOCAL BENCHMARKS FOR INVASIVE ANIMAL IMPACT, DENSITY AND DISTRIBUTION FROM WHICH PERFORMANCE ON DELIVERY OF ALL OUTCOMES CAN BE ASSESSED**

2.1.3 - Formal articles in scholarly-refereed journals	October 2012	A permanent security post for camera trapping	Australian Mammalogy, 35:123-127	Meek, PD, Ballard, GA and Fleming, PJS	11.T.5
2.1.3 - Formal articles in scholarly-refereed journals	December 2012	User-based design specifications for the ultimate camera trap for wildlife research	Wildlife Research 39(8):649-660	Meek, PD and Pittet, A	11.T.5
2.1.3 - Formal articles in scholarly-refereed journals	February 2013	The success of GPS collar deployments on mammals in Australia	Australian Mammalogy, 35:65-83	Matthews, A, Ruykys, L, Ellis, B, FitzGibbon, S, Lunney, D, Crowther, MS, Glen, AS, Purcell, B, Moseby, K, Stott, J, Fletcher, D, Wimpenny, C, Allen, BL, Van Bommel, L, Roberts, M, Davies, N, Green, K, Newsome, T, Ballard, G, Fleming, P, Dickman, CR, Eberhart, A, Troy, S, McMahon, C and Wiggins, N	10.T.5 1.T.4
2.1.3 - Formal articles in scholarly-refereed journals	May 2013	Which camera trap type and how many do I need? A review of camera features and study designs for a range of wildlife research applications	<i>Hystrix, the Italian Journal of Mammalogy</i> , (24)2, doi:10.4404/hystrix-24.2-6316	Rovero, F, Zimmermann, F, Berzi, D and Meek, P	11.T.5
2.2.3 - PestSmart technical report		An introduction to camera trapping for wildlife surveys in Australia	Invasive Animals CRC, Canberra, ACT		
2.2.3 - PestSmart SOP		Methods of euthanasia	Invasive Animals CRC, Canberra, ACT		
2.2.3 - PestSmart SOP		The care & management of dogs used in the control of pest animals	Invasive Animals CRC, Canberra, ACT		
2.2.3 - PestSmart SOP		Trapping using soft net traps	Invasive Animals CRC, Canberra, ACT		

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