Invasive Animals CRC

Invasive Animals
Cooperative Research Centre

ANNUAL REPORT 2014–15

Together, create and apply solutions

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ACT Government
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MURRAY–DARLING BASIN AUTHORITY

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MEAT & LIVESTOCK AUSTRALIA

Australian Government
Department of Agriculture
ABARES

awi
Australian Wool Innovation Limited

Connovation
CONSERVATION BY INNOVATION

Department of Agriculture and Food

NSW GOVERNMENT
Local Land Services

Department of
Economic Development,
Jobs, Transport & Resources

State Government
Victoria

NSW GOVERNMENT
Department of
Primary Industries

Department of Conservation
Te Papa Atawhai

Landcare Research
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The Food and Environment
Research Agency

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USDA

Government
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Primary Industries
and Regions SA

THE UNIVERSITY OF
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New England

Tasmanian
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GRDC
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OF QUEENSLAND
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Department of Industry,
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Centres Programme

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Introduction

'Together, create and apply solutions'

The Invasive Animals Cooperative Research Centre (IA CRC) is Australia's largest integrated collaboration for invasive animal research and innovation, with 27 participating organisations.

We combat the threat of invasive animals by developing new technologies and integrated strategies that are more humane, target specific and effective, to reduce the impact of invasive animals on Australia's economy, environment and people.

We concentrate on developing:

- smarter tools to prevent and detect new invasions
- advanced and tactical tools to strengthen integrated management strategies for carp and other pest fish
- integrated management strategies for major pests, including wild dogs, foxes, feral pigs, mice and rabbits
- innovative approaches to facilitate and deliver community-led pest animal management.

Our purpose

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

Our outcomes

1. No new vertebrate pests established in Australia
2. Improved prediction and control of emerging outbreaks
3. Recovery of key land and water regions from rabbit, wild dog and carp impacts
4. Strengthened social networks and institutions around pest animal control
5. An enduring organisation dedicated to innovative pest animal control research and training

Our programs

Land pests

Developing products and strategies to manage land pests affecting agriculture, urban areas and biodiversity. The focus is on developing a national incursions response system and strategic landscape-scale approaches to control of rabbits (using new strains of rabbit haemorrhagic disease virus) and wild dogs.

Land pests (commercial products)

Developing a new rodenticide, a new pest bird toxin, and fertility control agents for kangaroos and wild horses.

Inland water pests

Developing products and strategies to detect new pest fish incursions using new environmental DNA (eDNA) techniques, and completing the science to enable release of Australia's first biological control agent for carp.

Community engagement

Ensuring the availability and adoption of new products, and the capacity to manage pests — by understanding and influencing policies and social drivers in pest animal control, encouraging cooperation, and overcoming economic and social barriers.

National Science and Research Priorities

The Australian Government has developed a new set of nine Science and Research Priorities and associated Practical Research Challenges, which map out research areas of critical importance to the nation.

The IA CRC's research is of national significance and fits within two of the new priority areas.

Science and Research Priority	Practical Research Challenge
Food	Knowledge of the social, economic and other barriers to achieving access to healthy Australian foods
Environmental change	Improved accuracy and precision in predicting and measuring the impact of environmental changes caused by climate and local factors Options for responding and adapting to the impacts of environmental change on biological systems, urban and rural communities, and industry

Chair's foreword

2014–15 has been a mixed year. The Invasive Animals Cooperative Research Centre (IA CRC) has continued to perform well. The IA CRC 'Whole of CRC Research Review' offered a great opportunity for all IA CRC people to enhance and exchange their knowledge and ideas. The year culminated in a most successful third-year review. Although this is very encouraging, we are not complacent, and we will continue to augment the potential of the current CRC program to its maximum. You can read more about this very positive achievement in the body of this report.

These highs were tempered by the incomprehensible passing of Board Director Dr Dave Choquenot, Professor and Director of the Institute for Applied Ecology, University of Canberra. Dave's contribution to Board discussions was invaluable, and was instrumental in shaping the future Centre for Invasive Species Solutions (CISS). The Invasive Animals Limited (IAL) Board is honouring Dave's contribution and dedication to environmental sciences by renaming the IA CRC Chair's annual prize the Dave Choquenot Science Prize for scientific excellence, originality and potential impact. Additionally, in memory of our colleague Dave and his strong ideal for robust science and its practical application, the Board has established the Golden Birkenstock perpetual award. The inaugural award will be given this November.

The IAL/IA CRC Board and management have made good progress in finalising the prospectus for CISS, a new and sustainable national organisation. The willing engagement of Participants and stakeholders through the long consultative process is much appreciated, and has been very important in ensuring that their wisdom and needs shape the new organisation.

The true value of CISS to potential Members and Partners emerged during the Participant and stakeholder discussions that built the prospectus. High on the benefits list are the leveraging of investment dollars and the subsequent availability of those dollars for the best research institutions; the markedly lower costs to provide contract, staffing and budget management for programs compared with costs to maintain dedicated Member/Partner in-house staff; ensuring timely institutional and statutory reporting obligations; and a vast, active network with the capacity and capability to proactively tackle invasive species impacts at all stages of the biosecurity continuum.

CISS will take the best of the IA CRC forward — a vast and energetic network with a well-governed business and financial management structure, and an innovative science program that includes human and institutional dimensions of invasive animal management in Australia. Maximising these well-established assets leverages the considerable investment of government and industry in the CRC. These assets will be converted into a business opportunity for a national institution to plan, fund

and coordinate enduring, collaborative, applied research, development and extension to combat invasive species in Australia. CISS will provide substantial value to investors in both the Member and Partner categories.

The major focus for the coming year will be ensuring the process for a smooth transition to CISS, talking to potential Partners, delivering the prospectus, revising the IAL Constitution for CISS Members' consideration, and launching a basic website (www.invasives.com.au).

I take this opportunity to welcome Dr Andrew Sanger, who became an IAL Director in May 2015. Andrew's extensive background in freshwater fisheries and biosecurity research, management and compliance has already enhanced our Board deliberations. In recognising Dr Dedee Woodside's resignation, I would like to commend her substantial contribution through four CRCs, and as Chair of the Audit & Risk Committee and Deputy Chair through the setting-up period for the current IA CRC. Dedee's strong background in social science was instrumental in the formation of our very important Social Engagement Program.

My sincere thanks go to all Board Directors, past and present, for their earnest approach to ensuring the success of the IA CRC and building the new CISS. I sincerely thank Andreas Glanznig, the management team and the entire IA CRC network for their continued dedication to achieving a more ethical, economical and efficient approach to invasive species management.

I look forward to our collective efforts to securing CISS for the future in the coming year.

Helen Cathles
Chair
Invasive Animal CRC

Barnaby Joyce, Australian Government Minister for Agriculture, launching the National Wild Dog Action Plan Portal on the PestSmart Connect website in June 2015, alongside National Wild Dog Facilitator Greg Mifsud and IA CRC Chair Helen Cathles

Stakeholder endorsements

'This year has seen the commencement of the implementation of a national approach to wild dog management through the National Wild Dog Action Plan. The Invasive Animals CRC has been integral in working closely with stakeholders from around Australia to minimise the negative impacts of wild dogs on agricultural, biodiversity and social assets.'

Duncan Fraser
Chair, Implementation Steering Committee, National Wild Dog Action Plan

'The Invasive Animals CRC has excelled yet again with putting practical research and control tools into the hands of land managers seeking to protect native wildlife. We also value their constructive role in strengthening Australia's biosecurity system and the important work of the National Incursions Response Facilitator.'

Andrew Cox
CEO, Invasive Species Council

'I have been on the land just north of Wangaratta for over 45 years and have seen first hand the damage to native plants, pasture and farm animals by introduced pest animals. The primary production losses caused by rabbits are particularly devastating to vegetation and pasture, causing soil erosion and affecting water quality. Something has to be done to control rabbits for the long term, and it needs to be effective, efficient and economical.

'I believe in the benefits of a scientific approach that will be practical and cost-effective, and that will overcome the rabbit problem on farms and in periurban areas, where the problem is increasing rapidly. Rabbits have been kept in check with myxo then calicivirus, and now we know that more work needs to be done to keep them in check for the following decades. This is why I am pleased to see the IA CRC's research project for a new strain of calicivirus. Their community engagement work is valuable too. Getting community support is just as important as managing the pest.'

Susan Campbell
OAM and farmer

CEO's report

Momentum is rapidly building as our CRC passes its halfway mark. Our first technologies are already in use, and preparations are well advanced for the national release of the first rabbit biocontrol agent in 20 years. Our glowing Third Year Review validates why our CRC is such a strong model to drive high-impact collaborative research, development and extension (RD&E), and has shown potential investors in our future Centre for Invasive Species Solutions that we have an efficient and well-supported way to deliver new technologies and apply them.

The operating environment has changed considerably over the course of the year.

The release of the Australian Government's *Agricultural Competitiveness* White Paper is an important policy development for pest animal management innovation and extension. The IA CRC especially welcomes the commitment to provide an additional $100 million to extend the Rural R&D for Profit program to 2021–22, and $50 million to give farmers better tools and control methods against pest animals and weeds. This new funding will boost pest animal management innovation, and help deliver new technologies and methods to farmers sooner.

The recent national Threatened Species Summit and launch of the Australian Government's Threatened Species Strategy are also significant developments, and give prominence to the feral cat challenge. Feral cats were put in the spotlight by the *Action Plan for Australian Mammals 2012* (published in 2014) as the pest animal with the highest overall impact on terrestrial mammals.

The increased focus from the Australian Government on pest animals has already resulted in rubber hitting the road through new IA CRC government–industry partnership funding to quadruple the scale of the national roll-out of our new rabbit biocontrol agent, and develop the Wild Dog Alert system to put land managers on the front foot with early warning pest surveillance tools. Additional government investment has also been provided to foster a national way forward on the feral cat management challenge and develop a new community feral cat mapping tool.

This new investment is testament to the role of our management company in efficiently brokering new collaborative RD&E as needs and opportunities arise. Our financial report shows that, once again, our core governance and management costs are running at well under 10% of the total CRC investment to ensure strong return on investment for Participants.

The high performance of the CRC management company and the CRC RD&E portfolio was underscored by an extremely positive independent review from the Australian Government Department of Industry, Innovation and Science, held in June 2015. It highlighted the high quality and balance of our research portfolio, the calibre of the governance and management team, and the high quality of our extension platform. At the core of this outstanding result is the strength and dedication of the researchers and national facilitators who are the driving force of the CRC's RD&E agenda.

Finally, I would like to thank Tim Blackman, former Commercialisation and Marketing Director, for his efforts, particularly in leading the development of the IA CRC Digital Strategy.

I commend this annual report to you.

Andreas Glanznig
Chief Executive Officer
Invasive Animals CRC

CEO's executive summary

> "The CRC enjoys extraordinarily strong and broad support from its participants and other stakeholders (both multijurisdictional and international) who clearly value the role and function of the CRC and its national capacity building, who see a present and future market and government need being filled by the CRC, and who fully support the CRC's governance arrangements and its interactions with participants."
>
> Independent Third Year Review Panel Report, June 2015

Research and collaboration highlights

New DNA-based technology to detect tilapia incursions developed and adopted

The spread of tilapia in northern and eastern Australia is a national problem that, if left unchecked, could result in problems that rival those associated with carp in southern Australia. A major priority is stopping tilapia invading the Murray–Darling to the south and Gulf of Carpentaria catchments to the west.

Environmental DNA (eDNA) detection technology offers an efficient early warning tool. The Queensland Department of Agriculture and Fisheries, and James Cook University, through the IA CRC, have developed an eDNA method, which has validated the success of the 2008 eradication of tilapia from a Gulf of Carpentaria catchment. The eDNA method was shown to be a more effective detection technique than the existing electrofishing method, and has been adopted by the Fitzroy Basin Association and Catchment Solutions in their tilapia surveillance efforts.

Important advances made in next-generation feral pig toxin development

Pilot feral pig bait trials in the USA and Australia, and the sharing of research data, have accelerated agreement on the best bait matrix for each country by international research experts. HOGGONE® will be available as a pour-on product so land managers can apply it to grain or other substrates, or a ready-made bait designed to be attractive to feral pigs under the majority of Australian conditions. The new prototype is ready for large-scale field trials.

Priority threat management to protect biodiversity under climate change analysis completed

Many regions of Australia will be more vulnerable to pest animal impacts under climate change, which will require new adaptive management approaches. The CSIRO, through the IA CRC, has released *Priority Threat Management of Invasive Animals to Protect Biodiversity in Lake Eyre Basin*. This provides practical strategic planning approaches to allocating resources over time so that states, and regional and community practitioners, can most effectively manage the basin's pest animals.

Commercialisation and utilisation highlights

New agreement with Texas Government established

Given the size of the feral pig problem in Texas, the Texas Parks and Wildlife Department (TPWD) has been working closely with the IA CRC – US HOGGONE® project for several years. This cooperation has now been formalised through a Collaborative Research and Licence Agreement signed with TPWD, Animal Control Technologies Australia (ACTA) and the IA CRC management company Invasive Animals Limited (IAL). This brings TPWD (not a Participant) into the project, enhances international collaboration across multiple jurisdictions and allows ACTA to commercialise TPWD-owned intellectual property, if the project needs it, to register and sell HOGGONE® in the USA as well as Australia.

Education and training highlights

Doctoral students

CRC target	Enrolled
15	14

Traditional PhDs

4

Professional doctorates

New rabbit biocontrol agent regulatory assessment in final stages

The regulatory assessment process for the new rabbit haemorrhagic disease virus (RHDV) K5 strain is on track to be completed by the end of 2015, and the virus to be released nationally in March–April 2016. In tandem with this process, the Australian Government Department of Agriculture — in partnership with Australian Wool Innovation, Meat & Livestock Australia, the NSW Department of Primary Industries (NSW DPI) and CSIRO — has provided additional resources to the IA CRC to increase the number of national release sites to 40, and implement a national community surveillance program to monitor the spread and impact of the first rabbit biocontrol agent to be released in 20 years.

All the IA CRC participants, including a large international contingent from the USA, and key industry and government stakeholders took part in an energetic, midterm Whole of CRC Research Review in Canberra, April 2015.

Awards

This year, three IA CRC awards were presented.

The IA CRC Chair's prize for excellence in science was awarded to Professor Stephen Sarre, Professor in Wildlife Genetics at the Institute for Applied Ecology (University of Canberra) for his work on mechanised extraction and next-generation sequencing for the analysis of trace DNA in predator scats.

The Participant's prize for outstanding contribution to invasive animal management was awarded to Colin Somerset, Biosecurity Officer, Local Land Services, Central Tablelands Region, for his successful delivery of technical vertebrate pest management training courses held by NSW DPI and the IA CRC. Over the past 19 years, Colin has tirelessly assisted researchers based at NSW DPI's Vertebrate Pest Research Unit in research activities primarily relating to foxes and rabbits. His support has greatly assisted all researchers in their important work, which has led to providing land managers with new tools and strategies to control these invasive species.

The Chief Executive's prize for achievement as an IA CRC student was awarded to Pablo García-Díaz, IA CRC PhD candidate at the School of Earth and Environmental Sciences at the University of Adelaide. The work that Pablo has conducted has been beneficial to Australia's future vertebrate pest management system. His ongoing work on vertebrate risk assessment and pet-trade pathway models has been very important to Vertebrate Pest Committee decision making and policy, and he already has two manuscripts published in highly cited international journals.

In March 2015, Dr Glen Saunders, our Research Adviser, was awarded an Australian Government Department of Agriculture Biosecurity Award. Recipients are awarded based on their efforts in keeping Australia's biosecurity system strong. Dr Saunders was particularly noted for his proactive approach to pest management and research in Australia, which has major implications for Australia's biosecurity integrity. His active work in the fields of wild pig ecology, fox and rabbit control, and humane pest animal control have led to substantial improvements in the methods used by governments, landowners and environmental groups to reduce the impact of invasive vertebrate pests.

Publications summary

Over the year, the IA CRC published 25 PestSmart publications and 52 journal articles — a fourfold increase from last year.

The full publications list is at Appendix B.

PestSmart publications

25

Journal articles

52

Communications summary

PestSmart Connect visits

23%

122 330

PestSmart Connect document downloads

6658

Twitter @PestSmartCRC growth

57%

PestSmart YouTube channel views

67 036

Risks and impediments

The major risk to the IA CRC timetable continues to be the uncertainty associated with obtaining regulatory and policy approvals for our next-generation viral biocontrol agents and toxins. The IA CRC seeks to manage this risk by active and regular liaison with the Australian Pesticides and Veterinary Medicines Authority, and active participation in the national Invasive Plants and Animals Committee as an observer. We have also faced technical challenges associated with several of our higher-risk projects, including developing an oral formulation for our fertility control products.

Feral cats in the spotlight

The IA CRC brought experts together from all over Australia for an important national feral cat workshop to discuss current research into feral cats, their impacts and innovative management action. Workshop outcomes provided important insights for a review of the Australian Government's threat abatement plan for feral cats.

This was followed by the launch of the IA CRC's feral cat mapping tool — the FeralCatScan app — which was launched at the Threatened Species Summit in July 2015. This app will be vital for mapping sightings, damage and control activities, and will be an important field-ready monitoring tool for land managers as they plan management activities.

Feral cats impact heavily on Australia's native wildlife through predation, and are one of the primary factors in the decline and extinction of many native mammals.

Threatened Species Commissioner Gregory Andrews at the national feral cat management workshop

The year has also seen the unforeseen outbreak of two new RHDV variants — the Chinese strain of RHDVa, and a new European strain of RHDV2. Both of the outbreaks are different from the Korean strain of RHDVa (RHDV K5) that has been evaluated for use as a new rabbit biocontrol agent through the IA CRC RHD Boost project. The IA CRC has provided an assessment of the implications of these outbreaks to the impending release of the RHDV K5 strain and concluded that it should proceed as planned.

End-user environment

The IA CRC's five-year strategy and innovation program has been developed in close consultation with our Participants and end-user stakeholders. They continue to be involved through our management theme groups that bring researchers, end users and investors together to discuss progress on project themes such as wild dogs, rabbits, pest fish, toxins and community engagement.

The IA CRC Strategic Plan scope and direction remain unchanged. Established pests — wild dogs, rabbits, carp, feral pigs, feral cats and mice — remain a policy and investment priority for the IA CRC's industry and government end users. This has been strengthened through the Australian Government's *Agricultural Competitiveness* White Paper and Threatened Species Strategy. As a consequence, the IA CRC has been able to secure additional funds to expand the national roll-out of the RHDV K5 strain, develop a Wild Dog Alert system that builds on our FeralScan community mapping and surveillance platform, develop a feral cat community monitoring app, and hold a national feral cat management workshop to feed into the revision of the Australian Government feral cat threat abatement plan.

Industry partners — Australian Wool Innovation, Meat & Livestock Australia, and the Grains Research and Development Corporation — are all in the process of reviewing their corporate plans, and it is expected that wild dogs in particular will continue to be a significant investment priority.

The IA CRC continues to play an active part in the implementation of the National Wild Dog Action Plan, which aims to promote and align wild dog management approaches and action around the country. The IA CRC administers the new Australian Government Stage 2 grant and remains the R&D representative on the steering committee for the plan.

Impacts

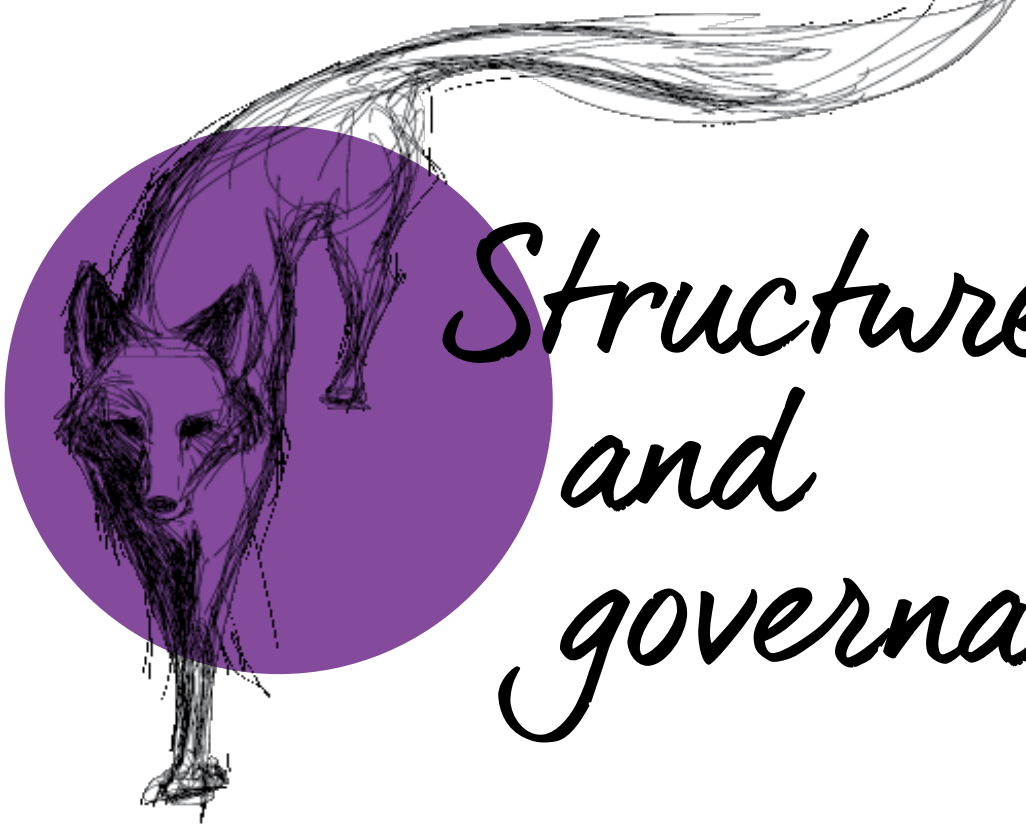
The IA CRC's projected economic impact was revised in 2015 to reflect changes to market conditions and likelihood of output delivery, and broadened in scope to include USA economic benefits from CRC products. This has resulted in a modest increase in the CRC's projected benefits, from $1.2 billion to $1.4 billion over 15 years from 2012, and to the benefit–cost ratio, from 14.27 to 16.00 (Table 1). This represents the best-case scenario for IA CRC outputs.

This impact is calculated from only five of the IA CRC's more than 40 potential outputs — two new rabbit biocontrol agents (resulting from the RHD Boost and RHD Accelerator projects), roll-out of a new feral pig toxin in the USA, a new rodenticide, and a new bird toxin. All RHD Boost impacts are attributed to the IA CRC extension, given that the early-stage funding was provided outside the previous IA CRC. Major exclusions from the analysis include Australia's first potential carp biocontrol agent, and adoption of community-led management approaches.

The major measurable economic benefit results from increased agricultural productivity due to the expected release of the RHDV K5 strain in 2016 — the first new rabbit biocontrol agent in 20 years. The other significant economic benefits result from increased agricultural productivity in the USA from use of the first registered feral pig bait. The increased likelihood of producing and applying these two outputs increased the risk-adjusted economic benefit values. These were offset by major decreases in the likelihood of producing a new bird toxin (project unsuccessful) and a decrease in the likelihood of delivering a new rodenticide by 2027, given the inability of nanoencapsulated sodium nitrite to meet performance specifications.

Table 1 Projected benefits of the CRC's programs

Program	Expected benefits ($)	Expected costs ($)	Expected benefit–cost ratio	Comment
Land pests	1 015 309 722	41 996 947	24.18	Most benefits from rabbit biocontrols (includes agricultural productivity as well as carbon biosequestration benefits)
Land pests (commercial products)	398 448 552	26 953 077	14.78	Most benefit from more efficient feral management in USA from use of sodium nitrite–based bait
Inland water pests	–	7 527 252	–	Economic benefits from more efficient detection tools and carp biocontrol not quantified
Community engagement	–	11 890 383	–	Economic benefit of accelerated adoption of CRC products and sustained community-led action not quantified
Overall	Up to 1 413 758 275	88 367 659	Up to 16.00	Very high benefit–cost ratio value driven by the cost-effectiveness of rabbit biocontrol technologies



Structure and governance

The IA CRC is a joint venture between the Participants, which include the management company IAL.

IAL is a public company limited by guarantee, incorporated and domiciled in Australia. 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 IA CRC provide strong support to its operations (Figure 1).

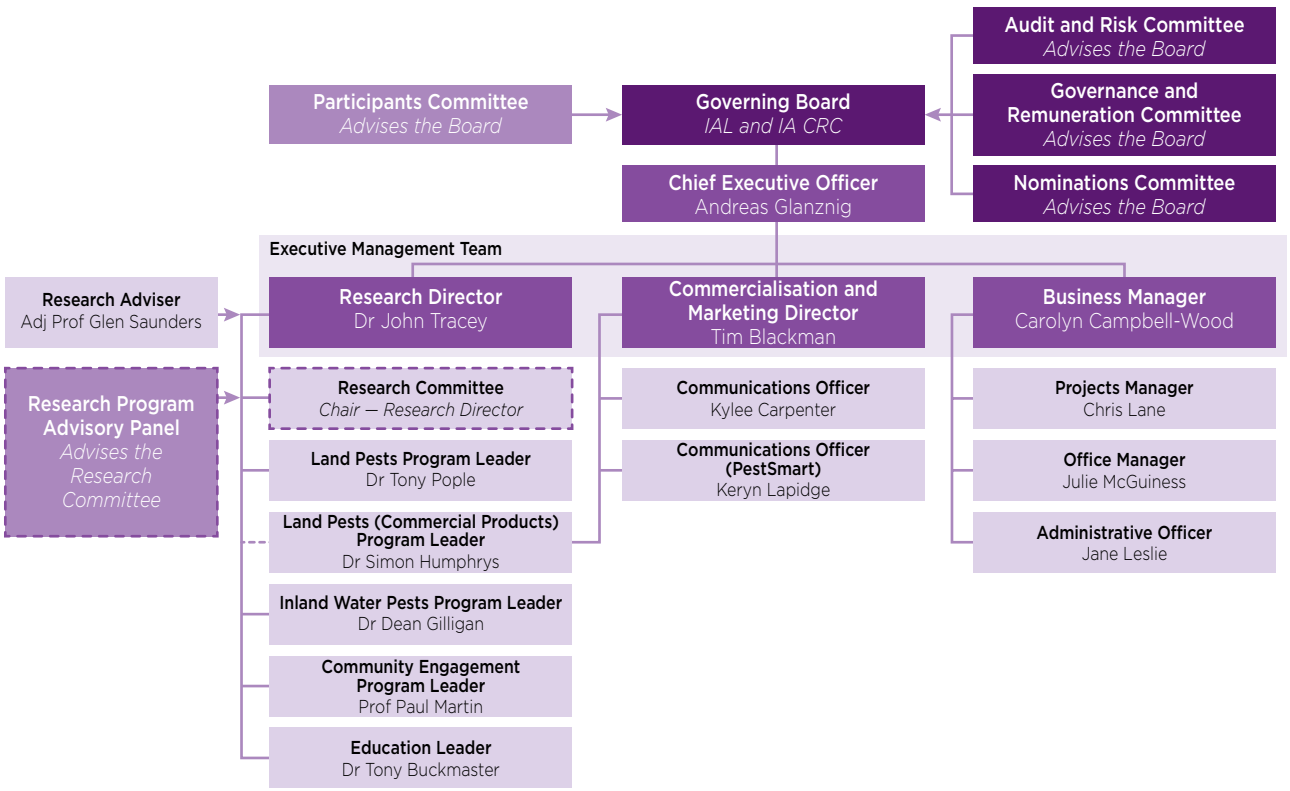


Figure 1 Invasive Animals CRC governance and management structure as at June 2015

Board

The IA CRC is led by a Board of skills-based directors, the majority of whom are independent from the CRC Participants (see Tables 8–10). The Governing Board meets at least four times each year and is committed to comply with both the *Australian Charities and Not-for-profits Commission Act 2012* and the *Corporate Governance Principles and Recommendations* published by the Australian Securities Exchange Corporate Governance Council.

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

Dr Andrew Sanger was appointed as a Director in April 2015.

The names and details of the directors in office during the financial year, and up to the date of this report, are listed in Table 2.

Committees

The Audit and Risk Committee (Table 3) operates under terms of reference approved by the Board. The committee is responsible for the oversight of fiscal and legal matters, and for ensuring that appropriate procedures and internal controls are in place. The committee is also responsible for the independence of the external auditors, and manages the internal audit program.

The Governance and Remuneration Committee (Table 4) operates under terms of reference approved by the Board. The committee is responsible for IAL governance policy and procedures, and the remuneration policy.

The Nominations Committee (Table 5), operating under a committee charter approved by the Board, is responsible for the Board directors nomination process and facilitating the election of directors.

Director's meetings

Meetings attended by the directors during the financial year are provided in Table 6. The directors listed were in office during the financial year. The committee chairs held their positions as at 30 June 2015.

Staff

Four staff sit on the Executive Management Team. Their role is to continually assess the activities and performance of the CRC, and provide management information to support the decision making of the Governing Board.

Staff changes

No staff changes occurred during the reporting period.

Members of the Governing Board; new director Dr Andrew Sanger not shown (Photo: J Smith)

Table 2 Board members of Invasive Animals Ltd, July 2014 to June 2015

Director	Role	Key skills	Independent/organisation
Helen Cathles	Chair	Director since 2005. Corporate governance, primary production, pest animal control	Independent
Dr Dedee Woodside	Deputy Chair	Director since 2005. Conservation, social sciences, business and commercial	Independent
Dr Helen Scott-Orr	Director	Director since 2007. Primary production, pest animal control, management of research and development	Independent
Prof David Choquenot	Director	Director from October 2012 to January 2015. Corporate governance, management of research and development	Institute for Applied Ecology, University of Canberra
David Palmer	Director	Director since 2013. Governance, management, policy development	Independent
Murray Rankin	Director	Director since 2013. Governance, communication, business and commercial	Independent
Dr Andrew Sanger	Director	Director appointed April 2015. Applied scientific research, management, regulatory governance	NSW Department of Primary Industries
Public Officer			
Carolyn Campbell-Wood	Company Secretary	Appointed March 2014	

Table 3 Members of the Audit and Risk Committee

Name	Role	Key skills	Independent/organisation
Dr Dedee Woodside	Chair	Director since 2005. Conservation, social sciences, business and commercial	Independent
Prof David Choquenot	Director	Director from October 2012 to January 2015. Corporate governance, management of research and development	Institute for Applied Ecology, University of Canberra
Murray Rankin	Director	Director since 2013. Governance, communication, business and commercial	Independent

Table 4 Members of the Governance and Remuneration Committee

Name	Role	Key skills	Independent/organisation
Dr Helen Scott-Orr	Chair	Director since 2007. Primary production, pest animal control, management of research and development	Independent
Helen Cathles	Board Chair	Director since 2005. Corporate governance, primary production, pest animal control	Independent
David Palmer	Director	Director since 2013. Governance, management, policy development	Independent

Table 5 Members of the Nominations Committee

Name	Role	Key skills	Independent/organisation
Dr Jim Thompson	Chair	Chair of the Participants Committee	Chief Biosecurity Officer, Queensland Department of Agriculture and Fisheries
Dr Geoff Hicks	Member	Participants representative	Chief Scientist, New Zealand Department of Conservation
Helen Cathles	Chair, IAL Board	Director since 2005. Corporate governance, primary production, pest animal control	Independent
Dr Helen Scott-Orr	Chair, IAL GRC	Director since 2007. Primary production, pest animal control, reseach and development	Independent
David Palmer	Director, IAL	Director since 2013. Governance, management, policy development	Independent

GRC = Governance and Remuneration Committee; IAL = Invasive Animals Ltd

Table 6 Board and committee meetings, July 2014 to June 2015

	Board (6 meetings)		Audit and Risk Committee (4 meetings)		Governance and Remuneration Committee (4 meetings)		Nominations Committee (4 meetings)	
	Eligible to attend	Attended	Eligible to attend	Attended	Eligible to attend	Attended	Eligible to attend	Attended
Directors								
Helen Cathles (Chair)	6	6	1	1	4	4	4	3
Prof David Choquenot	2	2	2	1	–	–	–	–
David Palmer	6	6	–	–	4	4	2	1
Murray Rankin	6	4	4	4	1	1	–	–
Dr Andrew Sanger	1	1	–	–	–	–	–	–
Dr Helen Scott-Orr (Chair, Governance and Remuneration Committee)	6	6	–	–	4	4	2	2
Dr Dedee Woodside (Chair, Audit and Risk Committee)	6	4	4	3	1	–	–	–
Participants								
Dr Jim Thompson (Chair, Nominations Committee)	–	–	–	–	–	–	4	4
Dr Geoff Hicks	–	–	–	–	–	–	4	4

Vale Professor David Choquenot

24 November 1959 – 2 January 2015

The IA CRC Community was extremely saddened by the passing of Professor David Choquenot on 2 January 2015. Dave was an IAL Board Director, and Director of the Institute for Applied Ecology at the University of Canberra.

Dave was a great champion for science-informed management of the environment, an exceptional manager and a larger-than-life character in the natural resource management sector in New Zealand, Australia and beyond. His research focused on population dynamics and management, often of feral animals in Australia and New Zealand, and including mammals, birds and reptiles.

Dave's contribution to the IAL Board was invaluable. His dynamic thinking drew on his great depth of experience and his vital passion to make a difference. From his early work with NSW Agriculture as a field vertebrate pest researcher, through his international experience in Canada and New Zealand, he was able to marry practical realities and theoretical concepts to bring new insights and approaches to our field, always with good humour and a zest for life. It has been a privilege to know and work with Dave, and he will continue to be greatly missed.

Table 7 Staff of the Invasive Animals CRC Management Team and Invasive Animals Limited

Name	Organisation	CRC position/role	Time committed
Andreas Glanznig[a]	Invasive Animals Ltd	Chief Executive Officer	100%
Tim Blackman[a]	Invasive Animals Ltd	Commercialisation and Marketing Director	60%
Carolyn Campbell-Wood[a]	Invasive Animals Ltd	Business Manager	100%
Dr John Tracey[a]	NSW Primary Industries	Research Director	60%
Dr Tony Pople	Qld Agriculture 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%
Chris Lane	NSW Primary Industries	Projects Manager	100%
Keryn Lapidge	Invasive Animals Ltd	PestSmart Officer	60%
Kylee Carpenter	Invasive Animals Ltd	Communications Officer	100%
Julie McGuiness	Invasive Animals Ltd	Office Manager	100%
Jane Leslie	Invasive Animals Ltd	Administrative Officer	100%

a Executive Management Team

Participants of the IA CRC

Table 8 Essential Participants

Participant	Type	Business/company number
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
Local Land Services (formerly Livestock Health and Pest Authority State Management Council [NSW])	State government	ABN 57 876 455 969
State of Queensland acting through its Department of Agriculture, Fisheries and Forestry; and Biosecurity Queensland	State government	ABN 66 934 348 189
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 through its Department of Primary Industries, Parks, Water and Environment	State government	ABN 58 259 330 901
State of Victoria through its Department of Environment and Primary Industries; and Biosecurity Victoria	State government	ABN 90 719 052 204
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
Australian Wool Innovation Ltd	Industry/private sector/SME	ABN 12 095 165 558
Grains Research and Development Corporation (GRDC)	Industry/private sector/SME	ABN 55 611 223 291
Meat & Livestock Australia Limited	Industry/private sector/SME	ABN 39 081 678 364
The University of Adelaide	University	ABN 61 249 878 937
University of Canberra	University	ABN 81 633 873 422
The University of Newcastle	University	ABN 15 736 576 735
University of New England	University	ABN 75 792 454 315
The University of Queensland	University	ABN 63 942 912 684
Connovation Ltd	International	NZCN 831417
Department of Conservation, New Zealand	International	Not applicable
Landcare Research New Zealand Limited	International	NZCN 546064

ABN = Australian business number; ACN = Australian company number; NZCN = New Zealand company number; SARDI = South Australian Research and Development Institute; SME = small-to-medium enterprise

Table 9 Other Participants

Participant	Type	Business/company number
Penn State University, USA	International	Not applicable
United States Department of Agriculture	International	Not applicable
The Food and Environment Research Agency (Fera), UK	International	Not applicable

Table 10 Third-party project Participants

Participant	Type	Business/company number
Braysher Consulting	Industry/private sector/SME	ABN 35 078 050 718
Brisbane City Council	Other	ABN 72 002 765 795
Far North Queensland Regional Organisation of Councils	Other	ABN 52 034 736 962
Gold Coast City Council	Other	ABN 84 858 548 460
Griffith University	University	ABN 78 106 094 461
Istituto Zooprofilattico Sperimentale della Lombardia e dell'Emilia Romagna	Other	Not applicable
James Cook University	University	ABN 46 253 211 955
Logan City Council	Other	ABN 21 627 796 435
Moreton Bay Regional Council	Other	ABN 92 967 232 136
Somerset Regional Council	Other	ABN 77 195 375 530
Sunshine Coast Regional Council	Other	ABN 37 876 973 913
Terrain Natural Resource Management	Industry/private sector/SME	ABN 53 106 385 899
The University of Sydney	University	ABN 15 211 513 464

ABN = Australian business number; SME = small-to-medium enterprise

Research achievements

Research numbers

Australian and international research, commercial and industry collaborators that are part of the end user-driven partnerships of the IA CRC

80

IA CRC projects

38

Articles published in scholarly refereed journals in 2014–15

52

Doctoral research students undertaking research and industry placement in the IA CRC's Balanced Researcher Program

14

Our research leaders

Dr John Tracey

Research Director

Dr Tony Pople

Program Leader:
Land Pests

Dr Dean Gilligan

Program Leader:
Inland Water Pests

Professor Paul Martin

Program Leader:
Community Engagement

Dr Simon Humphrys

Program Leader:
Land Pests
(Commercial Products)

Dr Tony Buckmaster

Leader:
Education

Outcome 1: No new vertebrate pests established in Australia

Theme leaders

Incursions and intelligence: **Dr Andrea Byrom**, Landcare Research New Zealand, and **Dr Andrew Woolnough**, Victorian Department of Economic Development, Jobs, Transport and Resources

The theme leaders oversee four subthemes. Highlights of each theme are mentioned below, and outputs from outcome 1 and the collaborations are listed in Table 11. Full progress against project milestones is provided in Appendix A.

National incursions response and pest intelligence

National incursions response system:

- Developing an incursions response decision support system, capability and tools, including pathway analysis and risk modelling, to better enable a nationally coordinated, efficient and effective response to new invasive animal incursions.

Citizen science mapping and surveillance:

- Creating new phone- and web-mapping technology for pest management that will build stronger community involvement in citizen science mapping and surveillance.

2014–15 highlights

- A national incursions response strategy has been prepared by the National Incursions Response Facilitator. This will be a national guiding document for incursion prevention, early detection and effective response.
- A 'top 10' list of high-risk vertebrate species not yet in Australia has been compiled and submitted for national endorsement.
- Through the Pest Information Hub, a bio-economic framework has been developed to determine the most cost-effective management of a low-density starling population in Western Australia that experiences ongoing immigration.
- The FeralScan community mapping system was strengthened through the launch of a stand-alone iOS and Android mobile app for community mapping and surveillance of wild dogs, feral cats, mice, rabbits, foxes and pest fish.

Long-term Tasmanian fox incursion response

Next-generation invasive carnivore detection tools, techniques and strategies:

- Developing an optimal strategy to eradicate foxes from Tasmania through the development of next-generation DNA invasive carnivore detection tools, techniques and strategies. This long-term and risk-based strategic planning approach aims to minimise impact to native species and the sheep industry.

2014–15 highlights

- Robotic extraction for trace DNA was developed and implemented.
- New DNA detection technologies have been progressively adopted by the Tasmanian Government.
- A survey of fox and other predator scats was completed and a final report submitted.
- Next-generation sequencing approaches for detection of Tasmanian-specific prey from scats are well developed and ready for the next phase of testing.
- Identification of prey in fox scats has been achieved but is subject to ongoing refinement.
- The scat survey goal was achieved of sampling from a selection of 200–300 previously surveyed units that were evenly distributed across areas of optimal fox habitat and previously located fox evidence. The scat survey will improve estimates of fox distribution in Tasmania and forms an integral part of the post-control monitoring procedures adopted by the Tasmanian Government. No further evidence of foxes has been found in Tasmania since 2011, so the results of the predator scat survey will inform future decisions about resource allocation and monitoring efforts required for foxes in the state.
- Three studies further supporting risk-based and efficient strategies for future management of the fox incursion were published:
  - rates of degradation of fox scats in the field and their detection probability
  - specificity (true negative rate) and sensitivity (true positive rate) of genetic testing of fox scats
  - a model based on sighting data suggesting that the Tasmanian fox population is likely extinct or highly localised.

Forecasting, adaptive management and planning

Strategic forecasting and planning to enable pre-emptive invasive animal management:

- Enabling priority regions to use macro-ecological modelling to assess potential patterns of biological invasion under extreme weather events and climate change, and to determine the most cost-effective pest management strategies.

2014–15 highlights

- A cutting-edge research paper was published describing the prioritisation of invasive animal management strategies for the Lake Eyre Basin.
- Rules of thumb were developed to best manage the invasive fish *Gambusia holbrooki* to better protect a threatened native fish species in the high-conservation-value Edgbaston artesian spring complex.

Community pest animal surveillance improved through new FeralScan app

The FeralScan pest animal surveillance website made the transition to an app this year to further support communities in recording sightings, damage and control activities. Users can now input data using the app for wild dogs, feral cats, mice, rabbits, foxes and pest fish, and even record data in remote areas where mobile reception is poor.

The MouseAlert component of FeralScan got a boost this year with the first national Mouse Census Week, which enabled grain producers to use the app and website to record mouse activity. The widely promoted week led to more than 100 on-farm assessments of mouse activity, and was a collaborative effort between the IA CRC, the Grains Research and Development Corporation, CSIRO and Landcare Research.

A new FeralCatScan was added to the FeralScan app, funded by the Australian Government Department of the Environment. It was launched at the national Threatened Species Summit held at Melbourne Zoo in July 2015 by the Threatened Species Commissioner, Mr Gregory Andrews.

MouseAlert — part of the FeralScan suite of apps (Photo: GRDC)

Pest fish detection technologies

Developing pest fish detection tools:

- Supporting a national incursions response system through an efficient and accurate field surveillance technique to detect national and state priority pest fish at low densities.

Tilapia containment:

- Assisting government agencies to more efficiently detect tilapia spread to prevent invasion of both Gulf catchments and the Murray–Darling Basin.

2014–15 highlights

- An eDNA method to detect tilapia has been developed. It has validated that the 2008 eradication of tilapia from a Gulf of Carpentaria catchment was successful, and has been a more effective detection technique than the existing electrofishing method. It has since been used by the Fitzroy Basin Association and Catchment Solutions in their tilapia surveillance efforts.
- An eDNA metabarcoding methodology was developed and field tested to target detection of multiple species within a community.

Tilapia eDNA detection technology

Invasive fish pose a major threat to aquatic ecosystems worldwide. Their impact can be severe in tropical regions, such as northern Australia, where more than 20 invasive fish species have been recorded in freshwater rivers and streams. Preventing new incursions of invasive species is the goal; however, when prevention fails, early detection of incursions is critical for successful control measures. Environmental DNA (eDNA) — the DNA that an organism leaves behind in the ecosystem — is a promising early detection tool for invasive aquatic species and has been used successfully to detect incursions of temperate invasive species.

The method involves collecting and filtering water samples, and testing the filtrate for the presence of tilapia eDNA with a species-specific probe. Successful development of a tilapia-specific probe and selection of appropriate filter types for turbid tropical environments were essential to implementing this method.

Sampling revealed that no tilapia eDNA was detected in any samples from Eureka Creek, adding further weight to the evidence that tilapia species were successfully eradicated from that system.

The effectiveness of eDNA as a surveillance tool was tested alongside electrofishing (the primary traditional sampling tool for tilapia) in a survey in the lower Fitzroy River catchment, where a recent invasion of tilapia was reported. In this setting, eDNA surveillance was an effective early detection tool for tilapia incursions and is likely to be more sensitive than traditional survey methods. However, eDNA surveillance requires considerable care and precision because of the potential for sample contamination.

Environmental DNA technology was successfully adapted for the specific purpose of tilapia surveillance, and this has resulted in a high-quality service that will help many organisations and associations detect tilapia incursions early. The Fitzroy Basin Association and Catchment Solutions have already employed the eDNA services developed in this project to survey the recent invasion of tilapia in central Queensland.

Oreochromis mossambicus, Mozambique tilapia

Tilapia major, black mangrove tilapia

Table 11 Outcome 1 outputs and collaborations

Output	Collaborations
1.L.1. National Incursions Response Facilitator	New Zealand Ministry for Primary Industries Landcare Research New Zealand Department of Agriculture and Food Western Australia Vertebrate Pest Committee Department of Primary Industries and Regions South Australia New Zealand Department of Conservation
1.L.2. Pest Information Hub (Pest iHub)	University of Adelaide University of Queensland Arthur Rylah Institute, Victoria Department of Agriculture and Food Western Australia Victorian Department of Economic Development, Jobs, Transport and Resources NSW Department of Primary Industries Landcare Research New Zealand New Zealand Department of Conservation
1.L.4. Exotic vertebrate risk analysis and complex invasion pathway framework	University of Adelaide Biosecurity South Australia Victorian Department of Economic Development, Jobs, Transport and Resources Department of Agriculture and Food Western Australia NSW Department of Primary Industries Landcare Research New Zealand
1.L.5. Mobile devices and web-mapping tools for pest species	NSW Department of Primary Industries NewtonGreen Technologies University of Adelaide University of Western Sydney University of New England Atlas of Living Australia Vertebrate Pest Committee National Indicators Working Group Clarence Valley Conservation in Action Landcare Group Upper Murrumbidgee Demonstration Reach Murrumbidgee Landcare Group Wollongong City Council Canberra Indian Myna Action Group Inc. Granite Borders Landcare Group NSW Local Land Services
1.L.5. Mobile devices and web-mapping tools for pest species (continued)	Tenterfield Wild Dog Control Group Australian Bureau of Agricultural and Resource Economics and Sciences CSIRO Grains Research and Development Corporation Department of Agriculture and Food Western Australia Landcare Research New Zealand
1.L.11. Prioritising adaptation actions for managing invasive animals under climate change	CSIRO University of Queensland Queensland Department of Agriculture and Fisheries Terrain Natural Resource Management Far North Queensland Regional Organisation of Councils
1.L.21. Mechanised extraction and next-generation sequencing for the analysis of trace DNA in predator scats	University of Canberra Tasmanian Department of Primary Industries, Parks, Water and Environment Queen Victoria Museum Tasmanian Museum and Art Gallery Illumina
1.L.22. Detection and monitoring for fox incursion in Tasmania	Tasmanian Department of Primary Industries, Parks, Water and Environment Landcare Research New Zealand
1.L.23. Risk assessment for new fox control techniques	Charles Sturt University Nick Mooney (private) Cawthron Institute
1.L.24. Long-term strategy for the Tasmanian fox program	University of Queensland CSIRO NSW Department of Primary Industries University of Tasmania Landcare Research New Zealand
1.W.1. The utility of eDNA as a tilapia surveillance tool	Queensland Department of Agriculture and Fisheries James Cook University
1.W.2. New eDNA surveillance for multiple high-risk invasive aquatic species	University of Canberra CSIRO Department of Primary Industries and Regions South Australia NSW Department of Industry Cawthron Institute University of Waikato, New Zealand The Nature Conservancy, United States

Michelle Christy, National Incursions Response Facilitator

Dr Michelle Christy

The National Incursions Response Facilitator project has been established to research and develop a nationally recognised incursions prevention and response system that will decrease the risk of new invasive vertebrates establishing in Australia. The project strongly aligns with Goal 2 of the Australian Pest Animal Strategy, which is to 'prevent establishment of new pest animals'. It also helps deliver vertebrate pest components of the Intergovernmental Agreement on Biosecurity in relation to national improvements in decision making, surveillance, emergency preparedness and response arrangements.

The highest priority in year one has been establishing baseline capacity, and networks to connect agencies and experts around Australia and New Zealand. These networks are creating new opportunities for collaboration and information exchange. Although still in development, they have proved incredibly valuable and informative, and information gathered is already shaping the project's future.

I have also commenced drafting Australia's first national incursions prevention and response (NIPR) strategy, in partnership with the Invasive Plants and Animals Committee's Vertebrate Pest Incursions Expert Group. The NIPR Strategy will establish a nationwide planning structure that provides clear direction to governments, industries and communities for the management of vertebrate incursions across Australia. The document focuses on complementary and nationally consistent processes to ensure the best coverage and protection for Australia from new vertebrate threats, both at the international border and from animals present in captivity in the country.

Outcome 2: Improved prediction and control of emerging outbreaks

Theme leader

New toxins and fertility control themes:
Dr Simon Humphrys, IAL

The theme leader oversees two themes. Highlights of each theme are mentioned below, and outputs from outcome 2 and the collaborations are listed in Table 12. Full progress against project milestones is provided in Appendix A.

New toxins

More efficient and sustained control of mouse outbreaks:

- Enabling local preparation of grain-based bait; research and development of a new humane rat and mouse toxin; and development of a mouse outbreak response system.

Advancing a new pest bird toxin:

- Reducing the impact of starlings on intensive agriculture.

New tactical tools and feral pig management products:

- Enabling registration of a carbon monoxide pressure fumigator for burrowing animal control and lethal trap device, and undertaking field trials in the USA to enable registration of HOGGONE® in Australia and the USA.

2014–15 highlights

- Science excellence was achieved across the entire program's projects through international collaboration between IAL (Aus), ACTA (Aus), CSIRO (Aus), University of Newcastle (Aus), University of Queensland (Aus), Meat & Livestock Australia (Aus), Grains Research and Development Corporation (Aus), NSW DPI (Aus), Queensland Department of Agriculture and Fisheries (Aus), Queensland Murray-Darling Committee (Aus), Connovation (NZ), Landcare Research (NZ), United States Department of Agriculture (USA), and Texas Parks and Wildlife Department (USA).
- Global databases for new rodenticide active constituents were screened.
- An application was submitted to the US Environmental Protection Agency for the approval of sodium nitrite as a pesticide.
- New tactical tool (lethal trap device/carbon monoxide pressure fumigator) prototypes were developed that meet specifications and enable field trials to start.
- IAL collaborated with Phebra — an Australian-owned pharmaceutical company — and the Australian Veterinary Association to secure approval from the Australian Pesticides and Veterinary Medicines Authority (APVMA) for Blue Healer as an antidote to new bait products containing PAPP (para-aminopropiophenone).

Fertility control

Nonlethal periurban and urban kangaroo management tool:

- Enabling APVMA registration of injectable fertility control — GonaCon™.

Advancing species-specific bacteriophage-based platform fertility control technology:

- Developing species-specific fertility control that can be applied to humanely manage those species where lethal control is not socially acceptable; and R&D of oral delivery of fertility control.

2014–15 highlights

- World-first proof of concept was established for a noninjectable immunocontraceptive with a suppressive effect on the testis in rodents (model mammal species).

Table 12 Outcome 2 outputs and collaborations

Output	Collaborations
2.C.1. Avicides	Meat & Livestock Australia Feedlot and piggery managers Grains Research and Development Corporation Grain storage facilities Australian Pork Limited United States Department of Agriculture
2.C.2. Rodenticides	Grains Research and Development Corporation Animal Control Technologies Australia University of Queensland United States Department of Agriculture Landcare Research New Zealand
2.C.3. Surveillance and forecasts for mouse outbreaks in Australian cropping systems	CSIRO Grains Research and Development Corporation NSW Department of Primary Industries Landcare Research New Zealand
2.C.4. HOGGONE® — US field trials and registration	Animal Control Technologies Australia Queensland Murray-Darling Committee Animal and Plant Health Inspection Service, United States Department of Agriculture Texas Parks and Wildlife Department
2.C.5. Managing finalisation of new tactical tools	NSW Department of Primary Industries NSW Local Land Services State Management Council WB&G Manufacturing Ecological Horizons General Dogs Body University of New England Gavin Hall NSW National Parks and Wildlife Service
2.C.12. Fertility control oral delivery	CSIRO Meat & Livestock Australia United States Department of Agriculture
2.C.13. Development of reagents for the sterilisation of pest animal species	University of Newcastle University of Queensland

First new pesticide and bait for predators in 50 years is recommended for approval in Australia

After a decade in development and testing, and another two years under assessment by the APVMA, the new toxin PAPP has been recommended by all external and internal reviewers of the data packages as a new agricultural chemical, and baits containing PAPP as new agricultural products.

This paves the way for the APVMA to proceed to the final stages of the approvals process, where it will call for public submissions that support or oppose the intention to approve PAPP and products containing PAPP as additional tools for wild dog and fox management. Anyone can make a submission, from individual farmers to government agency staff to nongovernment organisations.

An effective antidote to PAPP is available from veterinarians. If approved, the supply and use of PAPP in integrated pest control programs will benefit local communities and, ultimately, Australian agriculture and biodiversity.

Outcome 3: Recovery of key land and water regions from rabbits, wild dogs and carp

Theme leaders

Rabbits: **Greg Mutze**, South Australian Department of Primary Industries and Regions, and **Dr Tanja Strive**, CSIRO

Wild dogs: **Dr Peter Fleming,** NSW DPI

Pest fish: **Dr Dean Gilligan**, NSW DPI

The theme leaders oversee three themes. Highlights of each theme are mentioned below, and outputs from outcome 3 and the collaborations are listed in Table 13. Full progress against project milestones is provided in Appendix A.

Landscape control — rabbits

Approval, release and performance monitoring of RHDV K5 strain:

- Gaining policy and regulatory approval for the release and monitoring of the RHDV K5 strain selected through the RHD Boost project, as part of an agreed national rabbit biocontrol release and monitoring plan.

Rabbit haemorrhagic disease (RHD) resistance model:

- Creating a comprehensive RHD resistance model and strategic knowledge to maintain RHDV as an effective biocontrol agent in Australia.

Strategic rabbit control:

- Undertaking strategic, efficient and effective implementation of new and existing rabbit control methods through a transferable Rabbit Decision Support System and National Rabbit Facilitator.

2014–15 highlights

- RHD Boost: An application for release of a second strain of RHDV is in the final stages of assessment by the APVMA. Prerelease monitoring is under way at 18 monitoring sites across Australia.
- The RHDV K5 Operations Working Group was established with members from the not-for-profit sector, industry, government and community. A joint RHDV K5 release communications strategy was prepared and submitted to the Invasive Plants and Animals Committee for endorsement.
- RHD Accelerator platform technology: Proof of concept was established that new RHDV variants can be naturally selected for in the laboratory to overcome immunity, and potentially resistance, to complement existing RHDV strains. This is an important preliminary step and offers hope that a biocontrol lid can be kept on Australia's rabbit population.
- Benign rabbit caliciviruses and RHDV in New Zealand: Through great persistence and strategic sampling, a New Zealand strain of a benign rabbit calicivirus has now been identified. The impact of this strain on rabbits, particularly how it affects susceptibility of rabbits to RHDV, is currently being assessed. Virulence testing of New Zealand RHDV isolates has been completed, and a high-virulence strain has been selected for further characterisation as a potential improved rabbit biocontrol agent.

Landscape control — wild dogs

Researching the impacts of wild dogs on agri-ecosystems:

- Determining if regional control of wild dogs influences populations of quolls, foxes, feral cats and native prey species. This will enable improved strategic wild dog management in sheep and cattle regions of Australia.

Improving policy for wild dog management across Australia:

- Determining the legislative and policy incentives for, and barriers to, effective co-management of wild dogs.

Wild dogs in periurban areas:

- Improving understanding of the ecology of periurban wild dogs in coastal eastern Australia, and the most effective management strategies and product mix to reduce wild dog impacts.

Nil-tenure regional management:

- Increasing adoption of regional nil-tenure wild dog management, and integrated use of existing and new wild dog products and techniques.

2014–15 highlights

- Four scientific papers on wild dog management were published. These cover the interactions between wild dogs, foxes and feral cats, and appropriate optimal monitoring methods.

- The National Wild Dog Facilitator has been supporting regional coordinators throughout Australia. In western New South Wales, more than 200 properties have been participating in eight wild dog management groups. The program saw baiting occur across 42% of New South Wales, including many properties with no history of baiting.
- Field testing of canid ejectors has been completed in periurban areas of New South Wales and Queensland. Satellite telemetry of wild dogs in periurban areas is continuing, and data have been collected on 36 dogs so far.

Catchment recovery after carp control

Carp biocontrol:

- Evaluating cyprinid herpesvirus 3 (CyHV-3) as a potential biological control agent for carp in Australia, with the expected outcome being reduction in carp populations over most of the Murray–Darling Basin.

2014–15 highlights

- A number of reptile, amphibian and fish species were demonstrated to be not susceptible to infection with CyHV-3.
- The proposed carp biocontrol delivery system was successfully tested by preparing samples of freeze-dried virus that could be resuspended in water and cause disease in susceptible carp.
- The genome of the Indonesian strain of CyHV-3 (strain C07) that has been selected as the preferred CyHv-3 strain for release as a carp biocontrol agent has been fully sequenced and annotated.
- Significant progress has been made towards obtaining cross-jurisdictional agreement to recommend to the Commonwealth Biological Control Authority that CyHV-3 and common carp be listed as agent organism and target species under the *Biological Control Act 1984*. This would facilitate commencement of risk assessment and public consultation processes under this legislation.
- The draft registration package for CyHV-3 has been completed for assessment under the *Agricultural and Veterinary Chemicals Code Act 1994* in relation to its safety and efficacy as a control agent for carp.
- A network of international contacts has been established, and an international study tour completed, to understand the first-hand experience of CyHV-3 introduction, impact and spread in Japan, the USA and Israel. This will address knowledge gaps associated with the potential use of CyHV-3 as a biocontrol agent in Australia.
- A Facebook page was established, titled 'Clearer Waters — improving river health through strategic carp control'.

Greg Mifsud, National Wild Dog Facilitator

Greg Mifsud

The past year has been very busy within the wild dog management space. The endorsement of the *National Wild Dog Action Plan* saw the delivery of foundation activities against milestones and objectives. The endeavours of all involved were rewarded in June 2015 with the Minister for Agriculture, Barnaby Joyce, announcing that the Australian Government would fund the action plan for another two years. This required a significant effort by all involved, but special mention needs to go to Michele Jackson, the Action Plan Implementation Manager, for the great job she did in keeping everyone focused on delivering the outcomes identified in the first phase of the project. In line with the action plan and support for producers, Australian Wool Innovation has funded a new coordinator in northern New South Wales. David Worsley will assist community groups to deliver more effective local and regional wild dog management programs, and joins me and another five industry-funded coordinators around the country. The success of this approach was realised in the results of the Australian Bureau of Agricultural and Resource Economics and Sciences study looking at functionality and success of wild dog management groups, where 67% of people surveyed reported that the groups were highly effective.

Table 13 Outcome 3 outputs and collaborations

Output	Collaborations
3.L.1. RHD Boost: roll-out of new RHDV strains	NSW Department of Primary Industries Department of Primary Industries and Regions South Australia Department of Agriculture and Food Western Australia CSIRO Queensland Department of Agriculture and Fisheries Australian Wool Innovation Meat & Livestock Australia ACT Government Environment and Planning Directorate ACT Government Territory and Municipal Services
3.L.2. Comprehensive RHD resistance model	Department of Primary Industries and Regions South Australia CSIRO NSW Department of Primary Industries University of Adelaide Meat & Livestock Australia University of Sydney Landcare Research New Zealand Istituto Zooprofilattico Sperimentale della Lombardia e dell'Emilia Romagna, Brescia, Italy CIBIO, Universidade do Porto, Portugal
3.L.3. Nonpathogenic rabbit caliciviruses	CSIRO Landcare Research New Zealand University of Otago AgResearch
3.L.4. RHD Accelerator	CSIRO University of Canberra NSW Department of Primary Industries Australian Wool Innovation Meat & Livestock Australia Istituto Zooprofilattico Sperimentale della Lombardia e dell'Emilia Romagna, Brescia, Italy
3.L.5. New potential rabbit biocontrol agent prospecting and assessment	Department of Primary Industries and Regions South Australia University of Canberra Wildlife Health Australia CSIRO Penn State University, USA Istituto Zooprofilattico Sperimentale della Lombardia e dell'Emilia Romagna, Brescia, Italy Rabbit Genome Biology Network (RGB-Net), Europe
3.L.6. Decision support systems for effective rabbit management	NSW Department of Primary Industries Queensland Department of Agriculture and Fisheries Victorian Department of Economic Development, Jobs, Transport and Resources ACT Government Territory and Municipal Services Meat & Livestock Australia Landcare Research New Zealand
3.L.11. Co-management solutions for wild dogs in agri-ecosystems: predators, prey, plants and the triple bottom line	NSW Department of Primary Industries University of New England NSW Local Land Services Australian Wool Innovation Meat & Livestock Australia Wild dog associations/livestock producers NSW National Parks and Wildlife Service National Wild Dog Management Advisory Group
3.L.13. Limiting the source — periurban wild dog control	Queensland Department of Agriculture and Fisheries NSW Department of Primary Industries Meat & Livestock Australia Moreton Bay Regional Council Somerset Regional Council Logan City Council Sunshine Coast Regional Council Brisbane City Council Gold Coast City Council United States Department of Agriculture, National Wildlife Research Center, Colorado, USA
3.L.14. Facilitating strategic management of wild dogs throughout Australia	Australian Wool Innovation Meat & Livestock Australia ACT Government Territory and Municipal Services Australian Bureau of Agricultural and Resource Economics and Sciences Queensland Department of Agriculture and Fisheries NSW Department of Primary Industries Victorian Department of Economic Development, Jobs, Transport and Resources Department of Primary Industries and Regions South Australia Department of Agriculture and Food Western Australia NSW Local Land Services

(continued)

Table 13 (continued)

Output	Collaborations
3.L.14. Facilitating strategic management of wild dogs throughout Australia (continued)	NSW Farmers WoolProducers Australia Queensland Parks and Wildlife Services (Queensland Department of National Parks, Sport and Racing) AgForce Queensland Granite Borders Landcare Victoria River District Conservation Association Gulf Rivers Landcare Territory Natural Resource Management Western Local Land Services Rangelands Natural Resource Management, Western Australia Northern New England Landcare Northern Territory Cattlemen's Association Tilpa Progress Association Wanaaring Wild Dog Committee Northern Territory Government Barrier Ranges Landcare Penn State University, USA
3.W.1. Koi herpesvirus (cyprinid herpesvirus 3 [CyHV-3]): its potential as a biological control agent for carp in Australia	CSIRO Victorian Department of Economic Development, Jobs, Transport and Resources NSW Department of Primary Industries (Fisheries NSW) Murray–Darling Basin Authority New Zealand Department of Conservation
3.W.2. Cyprinid herpesvirus 3 (CyHV-3) registration, release and selected monitoring	NSW Department of Primary Industries (Fisheries NSW) CSIRO Australian Government Department of Agriculture and Water Resources Australian Government Department of the Environment

Carp biocontrol – next stage of nontarget species testing completed

In addition to demonstrating that CyHV-3 is virulent in Australian carp, it is also important to demonstrate that the virus has no adverse effects on nontarget species. This involves testing a range of native and introduced fish, and representatives of other taxonomic groups.

Susceptibility studies on amphibians and reptiles tested CyHV-3 on tadpole and mature Peron's tree frog (*Litoria peronii*), mature spotted marsh frog (*Limnodynastes tasmaniensis*), juvenile water dragon (*Intellagama lesueurii*) and juvenile short-necked turtle (*Emydura macquarii*).

Testing consisted of daily clinical observation of all negative control and virus-challenged animals in the study. Molecular testing by a CyHV-3-specific polymerase chain reaction and histopathological examinations were also conducted. Carp were used as positive control fish.

Results showed no clinical signs of the disease, no histological lesions suggesting a viral infection, and no molecular evidence of CyHV-3 replication in any of the amphibians and reptiles examined in this nontarget species trial.

European carp (Photo: Stuart Mitchell)

Outcome 4: Strengthened social networks and institutional 'architecture' around pest animal control

Theme leader

Community engagement: **Professor Paul Martin**, University of New England

The theme leader oversees one theme. Highlights of the theme are mentioned below, and outputs from outcome 4 and the collaborations are listed in Table 14. Full progress against project milestones is provided in Appendix A.

Michael Reid, National Rabbit Facilitator

Michael Reid

The most significant challenges that I see for rabbit management are the human dimensions, and that's where I have been focusing my efforts as a national facilitator. The only way we can make serious headway against the rabbit is to work together in a much more collective and coordinated way.

To enable this type of collective effort, a highlight this year has been the piloting of a systems-based participatory approach in Victoria and the official launch of the Victorian Rabbit Action Network (www.rabbitaction.com). The lessons learned from this approach are important so we can extend the experience to other jurisdictions. A field trial planning workshop on RHD Boost and an Operations Working Group have been important for communication about the future release of the RHDV K5 strain. It has also been really exciting to build a network of practitioners to explore community engagement and rabbit management through a Rabbit Leadership Program.

Community-led pest animal management

- Improving agricultural productivity from accelerated adoption of best-practice pest animal control strategies and technologies by facilitating collective action, establishing triggers for effective action, and reducing legal and institutional impediments.

2014–15 highlights

- An Online Engagement Leaders' and Social Marketing Communities of Practice (CoP) and Capacity Building toolkit was released.
- A new *Behaviourally Effective Communications for Invasive Animals Management: a Practical Guide* was published, and is one of the most downloaded documents from the PestSmart Connect online toolkit.
- The online Communications Audit Tool, Queensland Murray-Darling Committee Communications Audit report, PestSmart Communications Audit report, and behaviour impact analysis and community survey for the Tasmanian Cat Management project were completed.
- Fieldwork was completed for three studies on engagement and communications, to form the basis of strategy development with state collaborators.
- The 2014–15 Enviro-Stories program was supported, which resulted in five schools across Australia creating storybooks on pest animals relevant to their local area. Educational workshops and book launches with teachers and students were organised at Rutherglen Primary School, Victoria; Borenore Pubic School, New South Wales; and Oak Valley Anangu School, South Australia.
- The Victorian Rabbit Action Network was established, guiding the Victorian Rabbit Management Collaboration Initiative in a community-led approach (see www.rabbitaction.com).

Jessica Marsh, National Natural Resource Management Facilitator

Jessica Marsh

My role is about bringing public and private land managers together. We want them to be able to reduce the impact of invasive animals by adopting best-practice management and working together. There is a really strong emphasis on capacity building — helping people to do good work themselves, with ongoing outcomes that eventually become self-sustaining.

This past year, running the Enviro-Stories program has resulted in numerous benefits for all involved. The students, teachers, natural resource management staff and research staff that participated all learned about pest animals and how to best get key messages across to primary school students. Allowing children to tell and illustrate their own stories provides such great insight into their understanding of problems and how to best deal with all the pest animals we have in Australia. It was very rewarding to see the students take information and write about it while remaining incredibly creative!

The Feral Photos competition was another great success in 2014, with more than 400 entries received. The photo competition has resulted in a great resource that can be used by anyone and has also built awareness about pest animals.

Accelerating adoption: behaviourally effective communications

The new IA CRC publication *Behaviourally Effective Communications for Invasive Animals Management: a Practical Guide* aims to make life easier for communication practitioners. It explains in plain English how advances in psychology can change behaviour, and empower farmers and land managers to adopt new approaches for best-practice pest animal control.

Lead author Professor Don Hine from the University of New England said that many of the problems associated with pest animal management were really problems of human behaviour. 'No matter what toxins, guns or other technologies are used, you still need a person to go out there and lay the bait, pull the trigger or install the ejector,' he said. 'The big question is how do we get people to do that?'

'If you're working on the ground undertaking pest animal control, or you're tasked with developing communications, we're hoping this guide will make your job easier.'

Professor Don Hine with a copy of the publication

Table 14 Outcome 4 outputs and collaborations

Output	Collaborations
4.E.1. Facilitating collective action	University of New England Meat & Livestock Australia Australian Wool Innovation Queensland Murray-Darling Committee Tasmanian Department of Primary Industries, Parks, Water and Environment Department of Agriculture and Food Western Australia NSW Department of Primary Industries Queensland Department of Agriculture and Fisheries Victorian Department of Economic Development, Jobs, Transport and Resources Penn State University, USA Cornell University, USA Sam Houston State University, USA
4.E.2. Triggers for effective action	University of New England Tasmanian Department of Primary Industries, Parks, Water and Environment NSW Department of Primary Industries Queensland Department of Agriculture and Fisheries Queensland Murray-Darling Committee Griffith University
4.E.3. Reduction of legal and institutional impediments	University of New England Griffith University Penn State University, USA
4.E.4. Action-driven coordination	University of New England Meat & Livestock Australia NSW Department of Primary Industries Tasmanian Department of Primary Industries, Parks, Water and Environment Griffith University Queensland Murray-Darling Committee Department of Agriculture and Food Western Australia Penn State University, USA Sam Houston University, USA
4.E.6. Facilitating community-led rabbit management in Australia	Victorian Department of Economic Development, Jobs, Transport and Resources University of New England Queensland Department of Agriculture and Fisheries Foundation for Rabbit-Free Australia Meat & Livestock Australia Australian Wool Innovation (continued)

Output	Collaborations
4.E.6. Facilitating community-led rabbit management in Australia (continued)	Victorian catchment management authorities Victorian Landcare networks and groups Parks Victoria Victorian Farmers Federation Penn State University, USA
4.E.11. Vocational education and training packages on strategic pest management	NSW Department of Primary Industries Braysher Consulting AgriFood Skills Australia University of Canberra, Faculty of Education, Science, Technology and Mathematics, and University of Canberra College
4.E.12. National NRM Facilitator	NSW Department of Primary Industries South Coast Natural Resource Management, Western Australia Northern Territory Natural Resource Management Natural Resources Adelaide and Mt Lofty Ranges Queensland Murray-Darling Committee Border Rivers Gwydir Catchment Management Authority Lachlan Catchment Management Authority Murrumbidgee Catchment Management Authority NSW Local Land Services NSW Office of Environment and Heritage West Gippsland Catchment Management Authority Agforce Queensland Victorian Department of Economic Development, Jobs, Transport and Resources Braysher Consulting Western Catchment Management Authority Northern and Yorke Natural Resource Management South West Natural Resource Management North East (NSW) Pest Animal Steering Group Riverina Local Land Services Central Tablelands Local Land Services Western Local Land Services Penn State University, USA
4.E.21. Balanced Researcher Program	Plant Biosecurity Cooperative Research Centre

Research collaborations

"All participants have been involved from the outset and are integrally embedded into the project and program structures created by the CRC to drive the whole value chain from end-user need through R&D to market and community adoption. Collaboration, particularly between researchers, industry and communicators, is strong and is also facilitated by the CRC's vertically and horizontally integrated structure."

Independent Third Year Review Panel Report, June 2015

Federal Minister for Agriculture Barnaby Joyce officially launched the Wild Dog Alert system project with Wal Merriman, Australian Wool Innovation Board Chair, and Dr Alex Ball, Meat & Livestock Australia, on a property near Walcha, New South Wales. Left to right: Ian Evans (Australian Wool Innovation), Wal Merriman, Minister Barnaby Joyce, Dr Greg Falzon (University of New England), Dr Alex Ball, Helen Cathles (Chair, IA CRC) and Rob Blomfield (landholder)

Wild Dog Alert system: getting farmers on the front foot in wild dog management

The Wild Dog Alert system aims to firmly place livestock producers and land managers on the front foot to manage wild dogs. Combining automated recognition of camera trap images with real-time messaging, the system will notify producers that wild dogs have invaded before livestock attacks occur. This will give farmers a 'first strike' capability in their fight against wild dogs, so they can be proactive in managing the problem.

Integrating the capability of Wild Dog Alert with the IA CRC's WildDogScan app will allow groups of cooperating landholders to receive information about the movements of individual wild dogs within their local area so they can act together to prevent livestock losses.

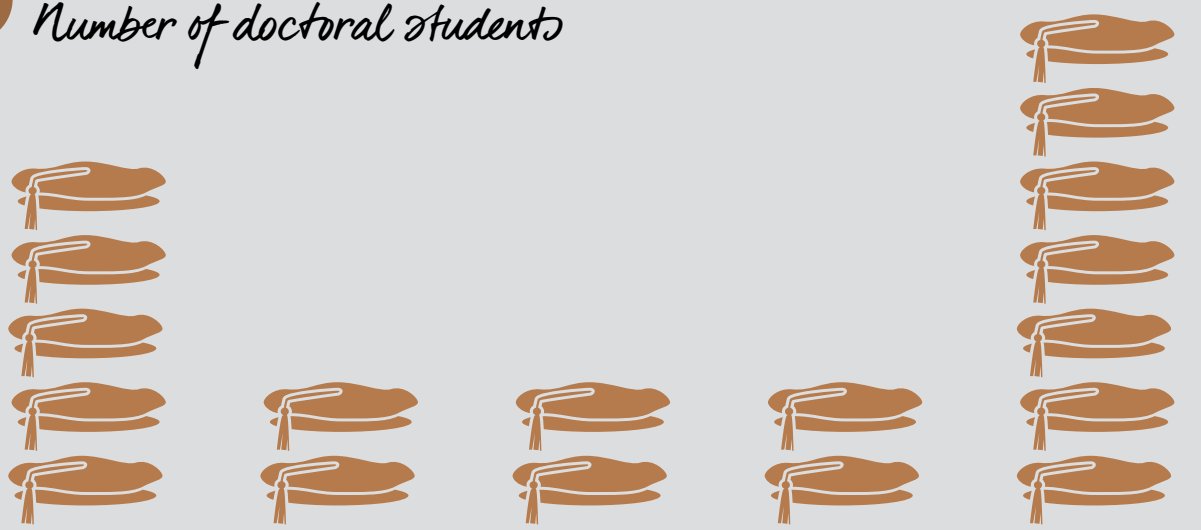
Wild Dog Alert will provide an opportunity to monitor wild dog activity and inform strategic regional wild dog management plans. Information about the location and identity of individual wild dogs could also be sent to wild dog controllers to aid them in their day-to-day work.

This is a collaborative project including the Australian Government Department of Agriculture and Water Resources, Australian Wool Innovation, Meat & Livestock Australia, NSW DPI and the University of New England.

Education and training

The IA CRC's successful PhD training initiative — the Balanced Researcher Program — and the Vocational Education and Training theme sit within the Community Engagement Program.

Number of doctoral students



PhD students working on a group project at the annual PhD camp held at Kioloa, New South Wales. Left to right: Michał Śmielak, Rheyda Hinlo, Elodie Modave and Jonas Bylemans

Postgraduate education

The Balanced Researcher Program aims to create multiskilled industry-ready graduates from the IA CRC's PhD program. Doctoral students undertake the 80-day professional development program over the course of their four-year research project and obtain skills that would not normally be possible through a traditional 'research-only' PhD program.

Skills are developed in areas such as leadership, management and stakeholder engagement. Training is also provided in statistical analysis and strategic communications. Students undertake at least 20 days' placement within industry to gain experience, and also to form enduring networks and linkages that add further depth to their research projects and intended careers.

To ensure that this additional training load does not adversely affect the students' ability to produce exceptional-quality research theses, the IA CRC fully funds an eight-semester scholarship.

The IA CRC has 18 doctoral research students enrolled in partner universities and actively engaged in IA CRC projects, including 4 professional doctorate students and 14 traditional PhD students (Table 15). Professional doctorate and traditional PhD students have the same status under level 10 of the Australian Qualifications Framework.

Enriching experience

"The Balanced Researcher Program has really enriched my PhD experience. I've been able to develop relationships with other researchers in my field from all over the country, leading to new research directions when some of my initial ideas didn't go as planned. Particularly valuable has been the collaboration with my industry supervisor and his team, who offer a wealth of unique experience and understanding of the big picture. The training has been a life saver, too; I've learned brand new genetic techniques for a project that wouldn't have been possible a few years ago, as well as the interpersonal skills that I'll need for a successful scientific career."

Amy Iannella, IA CRC PhD student

Student progress

All IA CRC traditional PhD students are enrolled in the Balanced Researcher Program, which started in 2013. The second PhD student camp was held at Kioloa, New South Wales, in October 2014. A grant writing workshop held as part of that camp allowed students to gain valuable experience in applying for competitive grant funding. As part of the workshop, participants applied for an IA CRC grant. Training in community engagement, innovation and creativity was also given as part of the students' professional development program.

Students at the PhD camp, Kioloa, New South Wales

The third student camp was held in conjunction with the Whole of CRC Research Review in March 2015. All PhD students in the program attended and presented at the review. Following the review, a training course led by Dr Peter Caley from CSIRO was held on the statistical program R.

Many of the students are already participating in their industry placements as part of the program. Students have had, or are currently undertaking, placements with Biosecurity South Australia, the Smithsonian Institute in Washington DC, the NSW National Parks and Wildlife Service, and Parks South Africa.

Postgraduate program review

To ensure that the education program meets the needs of end users, a longitudinal study has been undertaken on the long-term benefits of the enhanced skills enabled through the Balanced Researcher Program. The review showed that the program was valuable and created a strong feeling of cohesion among the students, facilitated the formation of linkages and collaborations, and contributed to the high completion rates of the IA CRC students. The investment by the IA CRC in the program was considered to be an important advantage for IA CRC students compared with a conventional PhD program.

The findings of the report have been used to fine-tune the current Balanced Researcher Program to ensure that it continues to benefit the PhD students. The second phase of the longitudinal study will commence in the second half of 2015.

Table 15 Current IA CRC doctoral students

Name	Draft thesis title	IA CRC output	Theme	Cwlth Agreement output	Partner university	Commencement date
Pablo Garcia-Diaz	Exotic vertebrate risk analysis and invasion pathway analysis	1.L.4	1	1.1	University of Adelaide	February 2013
Rheyda Hinlo	Parameterisation of eDNA detection probabilities for the identification of aquatic invasive species	1.L.4	1	3.1	University of Canberra	January 2013
Jonas Bylemans	Monitoring freshwater fish communities using eDNA metabarcoding	1.L.4	1	3.1	University of Canberra	December 2013
Elodie Modave	Distribution density in space and time and phylogeny of Tasmanian rodents using DNA in predators' scats and next-generation sequencing	1.L.21	1	1.2	University of Canberra	May 2013
Catriona Campbell	Using next-generation sequencing to determine ecosystem change and species interaction in Tasmania	1.L.21	1	1.2	University of Canberra	January 2013
Aleona Swegen	Identification of targets for immunocontraceptive fertility control in horses	2.C.13	3	2.4	University of Newcastle	February 2013
Sally Hall	Phage peptides fertility control for the nonsurgical sterilisation of feral horses	2.C.13	3	2.4	University of Newcastle	February 2013
Amy Iannella	Rabbit genetic resistance to RHDV variants in Australia	3.L.2	4	1.3	University of Adelaide	February 2013
Nadya Urakova	Identifying molecular virulence factors of RHDV	3.L.4	4	1.4	University of Canberra	February 2013
Helen Morgan	Management of wild canids and trophic cascades: is vegetation influenced by top-order predators?	3.L.11	5	1.5	University of New England	August 2013
Michał Śmielak	The community ecology of threatened, critical weight range, terrestrial mammals in response to wild canid and feral cat control	3.L.11	5	1.5	University of New England	May 2013
Darren Marshall	Using tracking collars to build community involvement in feral pig control	4.E.1	7	4.1	University of New England	June 2015
Katrina Dickson	Transformative learning in human dimensions in organisations involved in invasive animal control	4.E.1	7	4.1	University of New England	February 2013
Bernadette York	Wild dog aware	4.E.2	7	4.2	University of New England	February 2013
Roxane Blackley	mApps for rangeland decision makers	4.E.2	7	4.2	University of New England	July 2013
Lynette McLeod	Improving the behavioural effectiveness of cat management programs	4.E.2	7	4.2	University of New England	February 2013
Vivek Nemane	Reducing legal and institutional impediments	4.E.3	7	4.2	University of New England	March 2015
Lisa Yorkston	Social media: achieving active engagement	4.E.2	7	4.2	University of New England	February 2014

Themes:
1 Incursion response and pest intelligence systems; 3 Fertility controls; 4 Strategic rabbit control; 5 Strategic wild dog control; 7 Community engagement

Student completion rate, 2005–12

Students in the Balanced Researcher Program have an exceptional completion rate. Overall, 93% of the PhD students have been awarded their PhD, and only one student withdrew from the program (as a result of chronic illness, rather than an unwillingness to complete). This completion rate is well above the national average of 60%, and also above the 75% completion rate for the broad study area of science. The majority of completing students have entered Australian or international research organisations, and several have entered academic-based positions.

Dr Camilla Myers (standing) talking with IA CRC PhD students at the PhD grant writing workshop

Vocational education and training

The aim of the training and capacity-building program is to develop revised and nationally accredited vocational education and training (VET) pest training material that is consistent with the Australian Pest Animals Strategy and the new operating environment. The program also promotes the adoption of these revised training packages to current and future pest managers. The changing roles within state and regional extension organisations have led to an increase in requirements for training in best practice and short courses aligned to national competencies for pest management. A review of these competencies is currently being undertaken by Agrifood Skills Australia.

The revised job role statements for pest managers (both weeds and pest animals), formulated as part of the Agrifood Skills Australia review of pest management competencies, have been released and endorsed by industry. The new units of competency have been drafted, but are yet to be released for comment. The IA CRC is providing ongoing consultation and support of the review of these competencies.

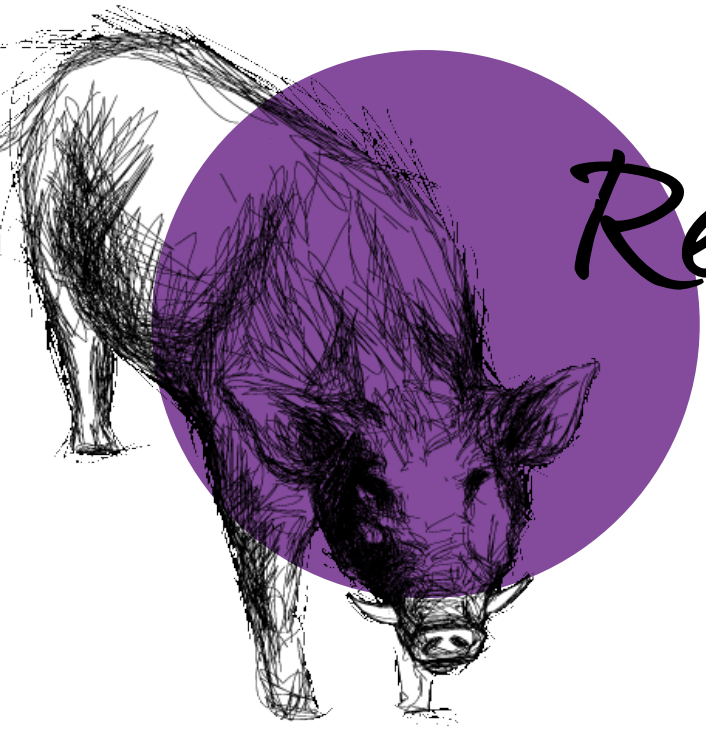
To assist with the changing roles within extension organisations, a comprehensive training resource is being developed by the IA CRC Community Engagement program to train staff in developing and implementing community programs for invasive species management.

Firm base for networking

"The Balanced Researcher Program has been fundamental to my progress through the PhD process. I have enhanced my skills through extra training of my choice, as well as group training at the student camps. My industry supervisor complements my academic supervisors, providing me with confidence and support. The opportunity to work within industry in conjunction with my research project has given me a firm network base in Australia to begin my search for work on completion. I would highly recommend the project to future PhD students, and I feel very lucky to be part of the IA CRC and the Balanced Researcher Program."

Catriona Campbell, IA CRC PhD student

Catriona is completing her industry placement with the NSW National Parks and Wildlife Service on the mountain pygmy possum (*Burramys parvus*) in Kosciuszko National Park.



Results

2014–15 has been a year of progress on many projects. This is best highlighted by the outcomes of the feral pig bait project (HOGGONE® Nitrite Salts) in Australia and the USA, and the following achievements:

- A collaborative research and licence agreement has been signed with the Texas Parks and Wildlife Department (TPWD), Animal Control Technologies Australia (ACTA) and IAL. This brings TPWD (not a Participant) into the project, enhances international collaboration across multiple jurisdictions and allows ACTA to commercialise TPWD-owned intellectual property, if the project needs it, to register and sell HOGGONE® in the USA as well as Australia.
- Feral pig bait trials in the USA and Australia and the sharing of research data have led to agreement on the best bait matrix for each country by international research experts.
- A registration data package for HOGGONE® to the APVMA for use in Australia is in preparation. The US Environmental Protection Agency is assessing multiple applications for the new poison so the project can start registration-compliant field trials in the USA.

The HOGGONE® project highlights the core brokering skills of IAL, bringing international expertise together to solve pest animal management problems in the most collaborative and effective way.

Justin Foster (Texas Parks and Wildlife Department), Gary Witmer (National Wildlife Research Center, USDA) and Lee Shapiro (Connovation, NZ) visiting Tidbinbilla during the Whole of CRC Research Review, Canberra, 2015
(Photo: T Blackman, IAL)

Commercialisation and utilisation

The commercialisation and utilisation strategy adopted by IAL focuses on IAL's brokering role to secure co-investment and partnerships in both commercially focused applied R&D projects and public good projects. These projects are captured in the CRC program of work. The IA CRC's two small-to-medium enterprise (SME) Participants, ACTA and Connovation, take a lead role in commercialising opportunities and are also heavily involved in the R&D phase (for more information on the commercialisation and utilisation strategy, please refer to the *Commercialisation and Utilisation Plan,* available from IAL head office).

This strategy diversifies key risks involved in innovation in this field, such as:

- research and technical failure
- overcoming market failure to develop products that meet end-user needs
- product development to meet market needs in terms of effectiveness, ease of use, animal welfare and human health concerns.

This brokering and co-investment approach improves end-user, CRC Participant and SME engagement, and builds trust and credibility in research outputs and products to market. The HOGGONE® project highlighted above is an example of this strategy in action.

Other initiatives of note are:

- Development of a lethal trap device to reduce animal welfare concerns over leg-hold trapping of wild dogs, foxes and feral cats.

  Status: Field-toxic prototypes will be tested in late 2015.

- Development of a new bait containing a new toxin (PAPP), and an antidote for these products in case of accidental consumption, for the humane management of wild dogs and foxes.

  Status: The baits and toxin packages are in the final stages of assessment by the APVMA. The outcome of this process is expected to be announced soon.

- Development of a new rabbit virus delivery mechanism: freeze-dried RHDV. This will allow land managers to apply a more effective rabbit virus in the field without the heavy costs of transporting the virus in a liquid form that readily degrades.

  Status: Registration approval was secured in 2015.

- Research into new rodenticides that can be safely used by land managers and producers.

  Status: Research is ongoing and in its early stages.

In conjunction with the product initiatives listed above, a community engagement research program has been integrated into the structure of the IA CRC extension program. The community engagement research outputs will be used to improve the adoption of the project outputs.

Intellectual property management

Intellectual property royalties, including from previous CRCs (IA CRC 2005–12 and Pest Animal Control CRC pre-2012)

Licensed intellectual property (IP) that generates royalties from the sale of products from the Pest Animal Control CRC (pre-2012) is disbursed to IP owners from that CRC. Licensed IP that generates royalties from the sale of products developed through the IA CRC (2005–12) is reinvested into the current extension IA CRC. IP that is novated and/or managed by IAL in this extension is related to the commercialisation of:

- PIGOUT®, 2014–15 financial year royalty of $2572.41, distributed to Pest Animal Control CRC Participants
- HOGHOPPER, 2014–15 financial year royalty of $4265.86, retained by IAL
- RODEMISE®, 2014–15 financial year royalty of $353.20, retained by IAL
- PAPP, 2014–15 financial year royalty of $0, pending approval for sale by the APVMA (expected late 2015 or early 2016).

Intellectual property strategy

IP as defined in the Participants Agreement encompasses all assets resulting from intellectual endeavour. Public Good IP will continue to be managed in the same way as the previous CRC — that is, all IP is 100% vested in IAL (called Centre IP) and available to all CRC Participants for their own use in research, training and adoption.

IP with commercial potential is managed as follows:

- Co-investors (Participants) in a project will be allowed to legally and beneficially co-own project IP.
- Specified Project IP is classified as Specified Project IP rather than Centre IP.
- Specified Project IP ownership is determined by a process that is agreed to by the Participants directly involved in the project.
- All investors in a Specified Project IP project have a say in developing the terms under which project IP will be commercialised, where possible.

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 benefits Australia and Australian investors in innovation in pest animal management.

Tables 16 and 17 provide a summary of currently held commercial IP and option agreements.

For more information, please refer to the 2015 *Commercialisation and Utilisation Plan*.

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, although its application in the control of rodents and invasive birds, and potentially other feral animals, is being researched. Patented IP managed during the reporting period includes:

- Australian granted patent AU 30526245 — Nitrite Salts as Poisons in Baits for Omnivores
- New Zealand granted patent 579357 — Nitrite Salts as Poisons in Baits for Omnivores
- United States of America granted patent US 8 795 649 B2 — Nitrite Salts as Poisons in Baits for Omnivores
- International Published Patent Application (WO/2008/104028) targeting Canada — Nitrite Salts as Poisons in Baits for Omnivores. This patent application was submitted in 2008 and has not yet been granted.

Digital assets

The IA CRC has a research program aimed at assisting communities to adopt best-practice integrated pest management. In an environment of reduced government funding and decreasing available labour, digital tools that inform and assist community engagement are an indispensable asset.

The IA CRC has developed a series of pest management digital tools, including:

- PestSmart Connect (knowledge hub)
- FeralScan (field monitoring app)
- community engagement tools.

The 'Internet of Everything' has been embraced by IAL and is seen as a core enabler of present and future best-practice pest animal management. In 2015, PestSmart Connect (our knowledge hub) and FeralScan (our mobile monitoring app) will be enhanced as we execute our digital strategy, and provide end users with improved community features and better ways to connect.

Small-to-medium enterprise engagement

End-user and SME engagement is important to the work of the IA CRC, and is reflected in our business, research and communications strategies. End users for the IA CRC include farmers, land managers (nongovernment organisations and government) and land management groups (natural resource management councils, catchment management authorities). Two SMEs are Participants of the IA CRC — Animal Control Technologies Australia Ltd and Connovation (New Zealand).

SME engagement has included:

- joint displays with IA CRC Participants and commercial SMEs at agricultural and predator field days
- co-branding and joint distribution of product updates
- regular commercialisation meetings involving SMEs and other Participants
- support for promotion of best-practice products from SMEs for invasive animals management.

In 2015–16, the IA CRC will be promoting the launch of various products as they become available, such as the new canid toxin PAPP.

Table 16 Intellectual property currently held for commercial purposes

IP description and product name	IP creation date	IP owners and ownership splits	Licence nature
Blue Healer trademark	2005	100% IAL	Not applicable
HOGGHOPPER design and manufacturing specifications	2010	100% IAL	Exclusive (worldwide)
Rodenticide pen/field efficacy studies	2005–08	100% IAL	Exclusive (in Australia)
Nitrite-based pesticide products: commercialisation of granted patents (Aus, NZ, USA) and pending patent applications (Canada, China)	2007	100% IAL	Exclusive (worldwide)
PIGOUT pen/field efficacy studies	2003–05	50% Pest Animal Control CRC Participants 50% Meat & Livestock Australia novated to IAL	Exclusive (in Australia)
PAPP wild dog and fox bait and toxin	2005–14	95% Australian Wool Innovation 5% IAL	Exclusive (worldwide)
PestSmart registered trademark	2012	100% IAL	Not applicable
Centre for Invasive Species Solutions registered trademark	2015	100% IAL	Not applicable

Table 17 Option agreements to commercialise intellectual property

IP description and product name	IP creation date	IP owners	Licence nature
Rodenticide (CRADA)	2013–17	USDA/IAL	Exclusive (worldwide)
HOGGONE USA (CRADA)	2013–17	USDA/IAL	Exclusive (worldwide)
Microencapsulated sodium nitrite formulations (CRLA)	May 2015	IAL/ACTA	Exclusive (worldwide)

ACTA = Animal Control Technologies Australia (IA CRC Commercial Participant); CRADA = Collaborative Research and Development Agreement (United States Department of Agriculture); CRLA = Collaborative Research and Licence Agreement (Texas Parks and Wildlife Department); USDA = United States Department of Agriculture
Note: IP ownership will be shared based on project inputs.

The IA CRC toxins theme group met and presented their research findings at the Research Portfolio Review in March 2015, in Canberra. This group includes representatives from the United States Department of Agriculture, Texas Parks and Wildlife, the Grains Research and Development Corporation, Meat & Livestock Australia, and the CRC's commercialisation small-to-medium enterprises — Connovation and Animals Control Technologies Australia.

Communications

> "External communication, extension and community engagement are not only part of the CRC's research and communications agenda, but are critical to the deployment, acceptance and uptake of the CRC's outputs. It is the panel's opinion that this aspect of the CRC is extremely well understood, established and managed."
>
> Independent Third Year Review Panel Report, June 2015

Communication is critically important to the IA CRC's mission to promote adoption of best-practice pest animal management. The IA CRC's communication strategy aims to engage end users, increase the profile of pest animal issues, and strengthen the role of the IA CRC as a centre for partnership-based invasive species solutions.

In addition to our PestSmart best-practice management platform, we are also gearing up for major communication campaigns associated with the roll-out of new wild dog, rabbit and carp control products. The aim is to have a collaborative approach to managing these community engagement and marketing campaigns in partnership with CRC Participant organisations.

Stakeholder engagement

PestSmart toolkit publications

A range of publications — including fact sheets, case studies, guides and technical reports — are all made publicly available at the PestSmart Connect website (www.pestsmart.org.au). The number and type of all publications published in 2014–15 are in Table 18. Appendix B provides publication details.

Feral Flyer newsletter

Feral Flyer is the IA CRC's fortnightly newsletter, which aims to inform subscribers of the latest IA CRC achievements, research, publications and events, and related external news. The newsletter is aimed at a diverse audience, including researchers, farmers, land managers, students and journalists. As of 30 June 2015, Feral Flyer had 1780 subscribers, a net increase of 70 from the previous year.

Table 18 PestSmart toolkit publications, 2014–15

Publication type	Number published in 2014–15	Total number published since 2011
Fact sheets	9	65
Case studies	6	32
Conference proceedings	1	3
Technical reports	6	31
Glovebox/field guides	2	7
Standard operating procedures	0	50
DVDs	0	2

Selected events

The IA CRC organised or helped coordinate significant events during the year, including:

- October 2014 — IA CRC Balanced Researcher PhD Student Camp
- October 2014 — Future of Pest Animal RD&E Forum
- October 2014 — Launch of the Victorian Rabbit Management Initiative
- November 2014 — Launch of FeralFishScan in the ACT
- December 2014 — Mt Hope Pest Animal Forum
- March 2015 — Whole of CRC Research Review
- April 2015 — National Feral Cat Workshop
- April 2015 — Mouse Census Week, encouraging use of the MouseAlert app
- June 2015 — Goondiwindi Field Day display with IA CRC national facilitators and FeralScan app promotion.

Mt Hope Pest Animal Forum

Internal communications

Recognising that the IA CRC's Board, staff and researchers are in diverse locations around Australia and internationally, internal communication is of the utmost importance to encourage collaboration and sharing of ideas, and facilitate being part of the IA CRC team. Internal communication is facilitated through:

- Participants Forum — Participant representatives gathered in Canberra in November 2014 for the annual general meeting and Participants forum
- IA CRC Research Portfolio Review — more than 120 researchers working on IA CRC projects met in Canberra in March 2015. The attendees from across Australia, New Zealand and the USA used this opportunity to present their research findings so far
- Around the Traps internal newsletter — a quarterly email newsletter to the Board, staff and researchers, featuring updates about future plans, policy and research highlights
- theme meetings — each theme group (incursions, rabbits, wild dogs, fertility control and toxins, pest fish, training and community engagement) aims to have at least one face-to-face meeting each year to discuss and share progress associated with their research.

Public awareness

> "Selecting the right message frame will help ensure that your message is noticed, processed and acted upon."
>
> *Behaviourally Effective Communications for Invasive Animals Management: a Practical Guide*, University of New England and Invasive Animals CRC, 2015

Websites and apps

The IA CRC corporate website (www.invasiveanimals.com) had 34 855 site visits in 2014–15, a 1% decrease from the previous year. The feral.org.au/PestSmart Connect site (www.pestsmart.org.au) had 122 330 site visits, a 23% increase from the previous year.

PestSmart Connect

The new PestSmart Connect website went live in March 2015, replacing the feral.org.au site, which had been a key digital platform for the IA CRC since 2004. PestSmart Connect provides end users with a one-stop shop of pest animal management information, and is a significant upgrade and improvement to the previous website. Significant changes included content built around a 'learn, act, connect' model to assist end users with practical on-ground action in an easy-to-use format. All research publications are available on the website, making it a useful tool for researchers.

Although the PestSmart Connect site was only live for the last 2.5 months of the reporting period (downward arrow in Figure 2), site usage statistics indicate that visitor traffic, page views and downloads have increased since the website upgrade and rebranding.

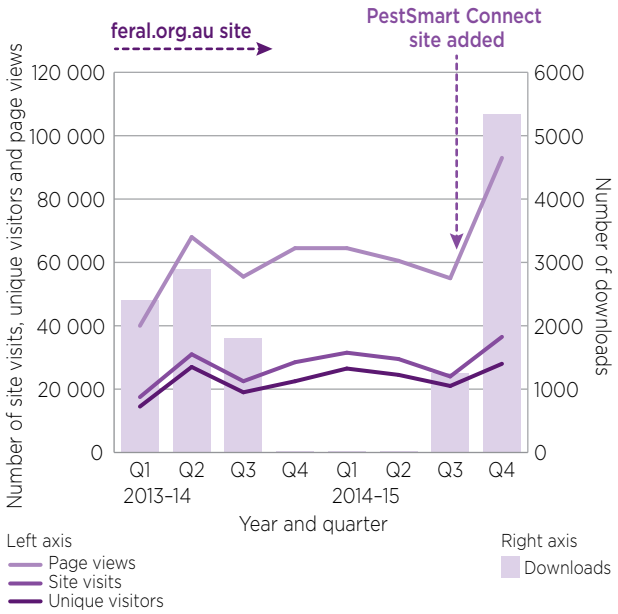


Figure 2 Feral.org.au and PestSmart Connect website statistics by quarter, 2013–14 to 2014–15

The National Wild Dog Action Plan portal (www.nationalwilddogactionplan.org.au) sits within the PestSmart Connect website, recognising that the IA CRC's innovative wild dog research and wild dog information materials have a good fit with this first-ever national action plan for wild dogs.

Federal Minister for Agriculture Barnaby Joyce officially launched the PestSmart Connect website and the National Wild Dog Action Plan portal at Parliament House, Canberra.

FeralScan community mapping and surveillance

A mobile app to complement the FeralScan website (www.feralscan.org.au) was launched in 2015, marking an important milestone for this community tool for mapping pest animal sightings, impacts and control activities. Available for both Apple and Android devices, the FeralScan app currently includes components for wild dogs, mice and rabbits. Other species, including a feral cat component, will be launched in 2015–16.

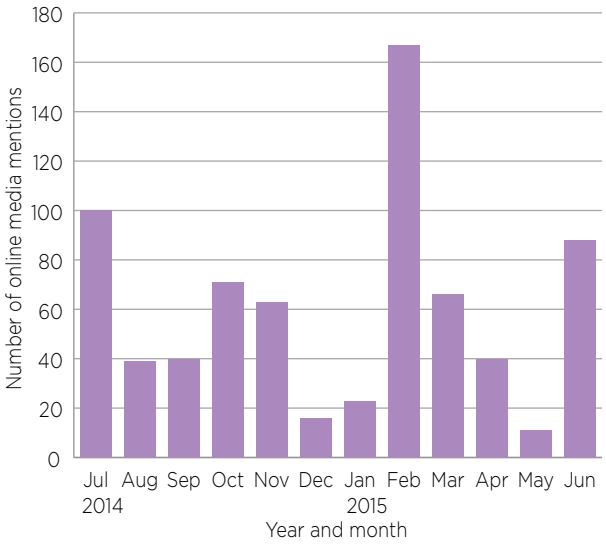
Media

To generate broader public awareness of the IA CRC's work, we have well-established relationships with journalists and leverage media opportunities collaboratively with Participants. Media is an important part of our communications strategy to continue to develop our profile, and generate awareness and support among our target audiences.

During 2014–15, 724 mentions of the IA CRC in online media were picked up by a media monitoring service (note that this does not include television, radio or newspaper coverage that is not online; Figure 3). This represents an increase in online media mentions of 72% from the previous year. An additional 345 IA CRC media mentions from radio, press and television resulted from Mouse Census Week. This was recorded by a participating organisation.

In 2014–15, the IA CRC issued 16 media releases:

- Help to combat pest animals is only a click away, 16 June 2015
- Change or fail: why human behaviour matters for pest animal control, 27 May 2015
- National Feral Cat Workshop in Canberra, 17 April 2015
- Mouse census underway across Australia, 13 April 2015
- Nation's first Mouse Census Week announced, 2 April 2015
- In the dark about feral cat numbers, 27 March 2015
- Research collaboration tackling the feral problem, 22 March 2015
- Young authors go 'feral', 25 February 2015
- Australia's worst Christmas present, 22 December 2014
- Map pest fish online with FeralFishScan, 17 November 2014
- Winning photographs have feral dogs and cats in focus, 4 November 2014



Source: Meltwater

Figure 3 Online media mentions of IA CRC by month, 2014–15

- Last days to expose feral animals, 23 September 2014
- Dingo control is no harm to wildlife, 18 September 2014
- Get ahead of the game with MouseAlert, 4 August 2014
- Search is on for the best feral photo, 9 July 2014
- Getting farmers on the front foot with new pest technology, 3 July 2014.

Media highlights

- The National Feral Cat Workshop in Canberra generated a Channel 7 news interview and report, with a viewership of 1.63 million. On the Channel 7 Facebook page, the video of the interview generated 233 000 potential views.
- Our Feral Photos competition, coordinated by the National NRM Facilitator, was the parting montage for the final show of 2014 on ABC television's Landline program.
- The Minister for Agriculture launched the PestSmart Connect website at an official media event at Parliament House in Canberra.
- The Minister for Agriculture held a media event at Walcha in northern New South Wales to announce funding for the Wild Dog Alert project in collaboration with partners.
- Mouse Census Week was a public media event collaboration with project Participants the Grains Research and Development Corporation, and CSIRO. The collaboration led to a television news interview and pick-up in the media that generated 345 media hits.

FeralFishScan was launched as a pilot in the ACT at an official media event featuring speeches from the ACT Minister for the Environment, Simon Corbell, and the IA CRC's Inland Water Pests Program Leader, Dr Dean Gilligan. There were even carp canapés on the menu.

Left to right: Dr Dean Gilligan, IA CRC Inland Water Pests Program Leader; Simon Corbell, ACT Minister for the Environment; and Helen Cathles, IA CRC Chair, at the ACT FeralFishScan launch

Feral Photos competition

2014 was the fourth year for this popular national photography competition that aims to promote the threat of invasive animals to agriculture, biodiversity and the community (Table 19). The winning entries were used as a montage for the final 2014 episode of ABC television's popular Landline program.

Table 19 Feral Photos competition entries

Year	2012	2013	2014
Number of entries	245	392	438

Social media

The IA CRC has been very active on social media, with the aim of engaging the audience in invasive animal management issues, building the profile of the IA CRC and directing traffic to the PestSmart Connect website.

Twitter

Followers on the IA CRC Twitter account (twitter.com/PestSmartCRC) increased by approximately 57% over the reporting year. A total of 1564 tweets were sent from the account during the year. This resulted in 4455 direct interactions (mentions, replies, favourites and retweets) and a combined potential reach of 3 904 502 for the year. Tweets that were most engaged with by followers included posts about Easter rabbits versus bilbies, the National Feral Cat Workshop and the Feral Photos competition.

Facebook

Followers on the IA CRC Facebook page (www.facebook.com/PestSmart) increased by 82%, from 474 to 864 during the reporting period. Posts with the highest reach and engagement included a link to a story on feral horses, a post about biosecurity and Johnny Depp's dogs, and research on the effects of wild dog control on wildlife.

YouTube

The PestSmart YouTube channel (www.youtube.com/PestSmart) received 67 036 views, and 202 038 minutes of video were watched during the reporting year. The five most watched videos during the year were:

- cage trapping of Indian myna birds
- fumigation with phostoxin for rabbit control
- trapping for feral pig control
- cage trapping for feral cats and rats
- Feral Pigs in Australia — part 1.

Enviro-Stories – young authors go 'feral'

Stories about 'feral foxes' and 'pesky camels' were just some of the creative tales written about the fight against ferals by young authors from five schools for an education project coordinated by National NRM Facilitator, Jessica Marsh, through the Enviro-Stories program (www.envirostories.com.au).

Students from Meckering Primary School, Western Australia; Rutherglen Primary School, Victoria; Borenore Public School, New South Wales; Yelarbon State School, Queensland (pictured); and Oak Valley Anangu School, South Australia, wrote and illustrated their own storybooks to raise awareness about feral animals.

Financial performance

IAL is a nonprofit scientific institution that promotes a managed and cooperative approach to collaborative research, development and education in the field of invasive pest animal management.

IAL's short-term objective is to govern and manage the IA CRC, in accordance with the Commonwealth Agreement and Participants Agreement.

IAL's long-term objective is to establish an enduring entity, the Centre for Invasive Species Solutions (CISS), which will be a service provider facilitating the efficient design, promotion, investment, brokering and management of large-scale collaborative invasive species RD&E programs to deliver new pest animal management tools and approaches.

The IA CRC, a 27-member collaboration, is in its third extension year to 2017. IAL's strong and effective financial management, demonstrated commitment to continual development and strong fiscal stewardship underpin the broader strategic objectives of the IA CRC.

In the 2014–15 financial year, there has continued to be a strengthening of internal control systems, policies and procedures (particularly finance and risk management), and a continued enthusiasm to support the IA CRC program of work through efficient and effective administration. IAL again kept core governance and management costs to less than 10%.

The total revenue for the 2014–15 financial year was $11 427 793. Of this, $6 340 000 was provided by the Commonwealth, $2 269 976 was invested by the Participants, and the balance was from other sources. Contracts secured by IAL continue to be sourced to support collaborative research initiatives, and this year provided additional research funds of $2 189 163 (Figure 4).

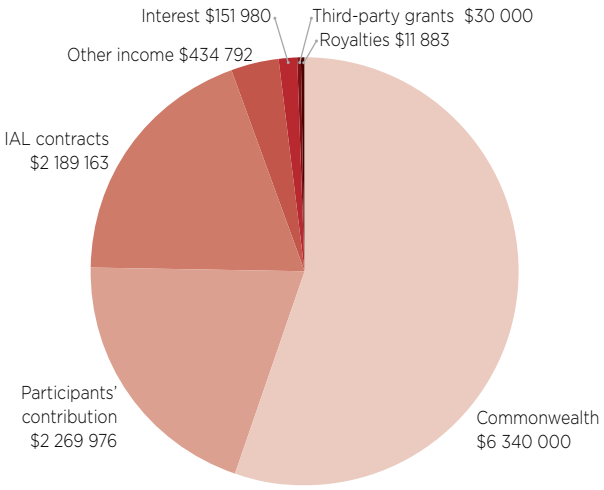


Figure 4 2014–15 revenue (consolidated)

With the inclusion of $10 799 000 for the 2014–15 in-kind contributions provided by the Participants in support of the IA CRC, the total combined resources available were $22 226 793.

The following broadly summarises the financial performance of IAL and the IA CRC.

Achievement against Commonwealth contract budget

IA CRC activities were supported by the Australian Government and Participants (Figure 5).

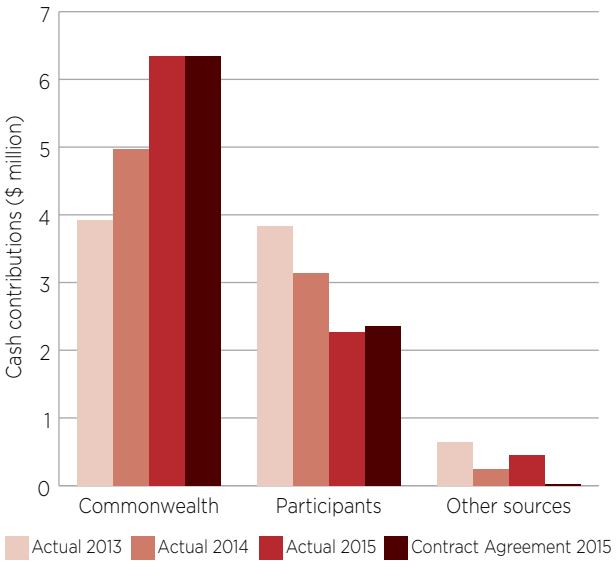


Figure 5 Commonwealth Agreement cash contributions

For the 2014–15 financial year, our target for contributions of personnel time was 31.6 full-time equivalents (FTE). The actual level of contributions obtained was 33.1 FTE, again reflecting the commitment of the Participants (Figure 6a).

The target of $2 060 000 for non-staff in-kind contributions in 2014–15 was again exceeded, with $2 732 283 of contributions confirmed by Participants (Figure 6b).

Financial strategy and management

Available resources were applied to the four main areas of CRC focus (Land Pests Program, Land Pests [Commercial Products] Program, Inland Water Pests Program and Community Engagement Program), and to network governance and management (Figure 7).

The positive financial position with consolidated cash position ($7 848 835 at June 2015) represents sufficient cash flow to meet both entities' combined liabilities of $6 952 085 (Figure 8). The current asset ratio (a measure of liquidity) was 1.15.

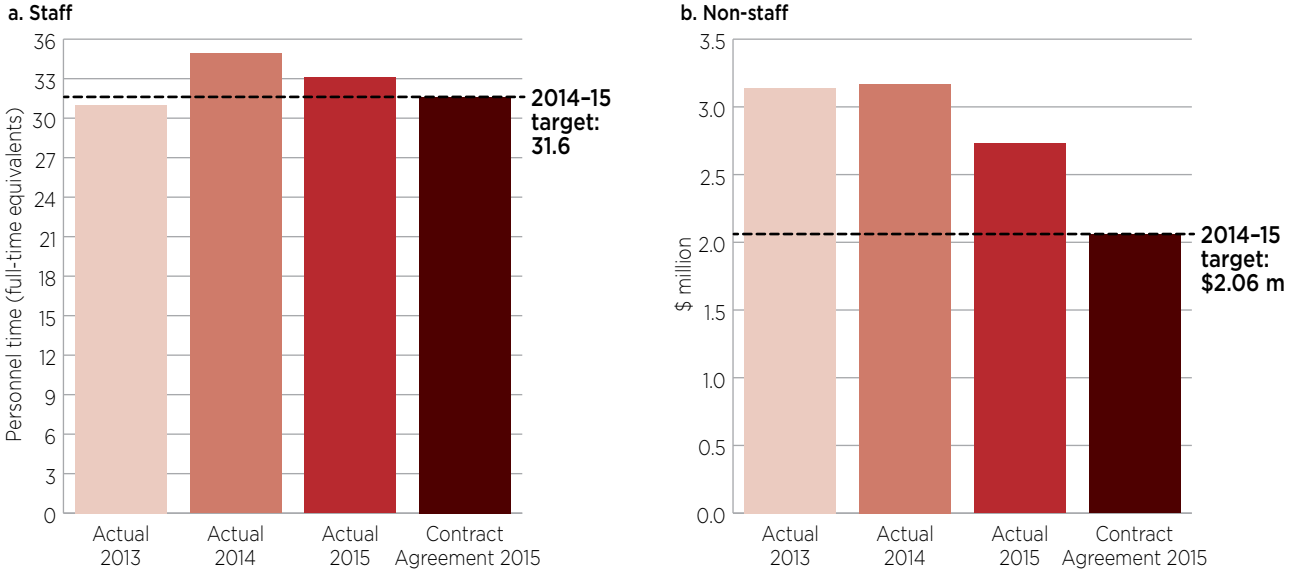


Figure 6 In-kind contributions, staff and non-staff

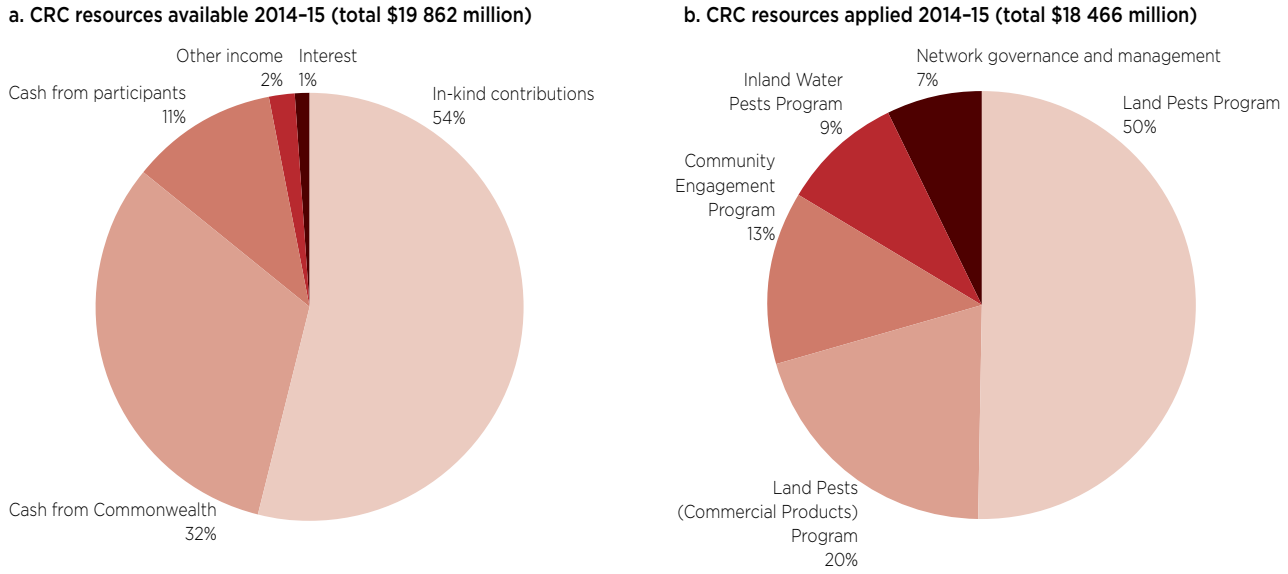


Figure 7 IA CRC resources (a) available and (b) applied, 2014–15

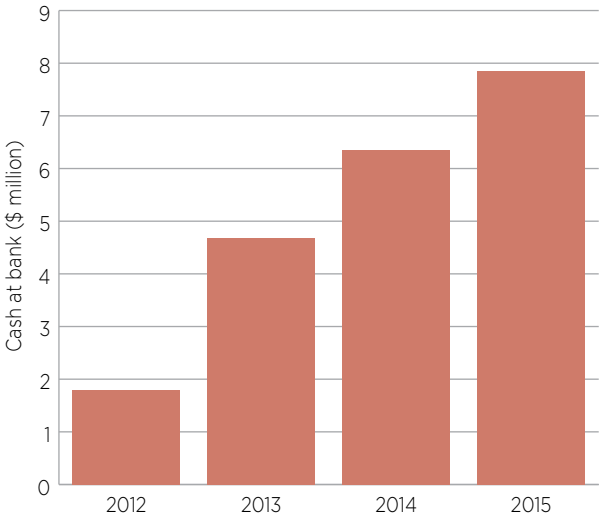
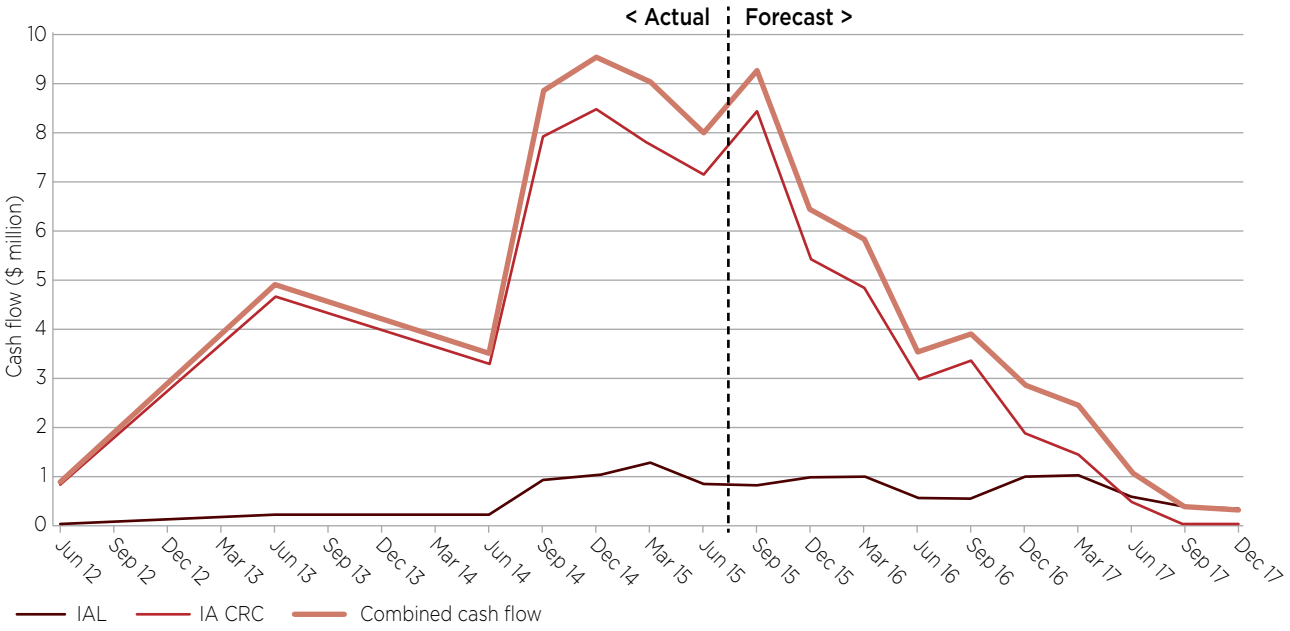


Figure 8 IAL and IA CRC cash at bank

The cash flow forecast (Figure 9) represents the cumulative net position of both IAL and the IA CRC, estimated at a point in time. This represents past financial year results as well as estimates of future income and expenses. Although cash reserves (including bank accounts and term deposits) or 'cash on hand' are highly liquid assets, by themselves they are only a very broad measure of liquidity. The five-year cash flow graph (Figure 9) demonstrates that 2014–15 was the peak funding period for the IA CRC. The following years will see these funds fully invested in CRC resources for the duration of the Commonwealth Agreement.

Information used in compiling these graphs has been derived from the complete audited financial statements, which are available for download from www.invasiveanimals.com.



Note: Actual cash flow shown to June 2015; projected cash flow shown after June 2015

Figure 9 IAL and IA CRC five-year cash flow projections

Other activities and grants

IAL agreed to undertake one new research services contract, funded by the Western Australian Agriculture Authority, entitled 'Increasing stakeholder participation in biosecurity management'. It augments an existing Commonwealth Agreement CRC Community Engagement Program project.

The objectives of the research project are to:

- identify and understand key knowledge gaps in community participation and communications about biosecurity activities in Western Australia
- develop strategies, action plans and tools to underpin implementation, capacity building and integration of multistakeholder engagement and behaviourally effective communications.

IAL also received four new grants during the reporting period:

- North East Wild Dog Facilitator, a project funded by Australian Wool Innovation. This project provides a facilitator position to help key stakeholders work together to reduce livestock predation by wild dogs in northeastern New South Wales.
- National Feral Cat Management Workshop, funded by the Australian Government Department of the Environment, to deliver an expert workshop to review research to date, propose future research and recommend national targets. This information will be used to update the threat abatement plan for predation by feral cats.
- National Wild Dog Metrics, funded by Meat & Livestock Australia, and the Western Australian, South Australian, Queensland and New South Wales state governments, to develop minimum national metrics standards for wild dog management, aligned to national standards under the Intergovernmental Agreement on Biosecurity.
- FeralCatScan, funded by the Australian Government Department of the Environment, to develop a feral cat mobile phone app and national mapping system for feral cat activity, and trial the system.

Performance review

"The panel acknowledges the strong and focused leadership of the CRC, which is clearly appreciated by the participants and end users.

Participants see the existence and value of the CRC, and CISS in the future, as increasingly critical, particularly as funding and capacity in government agencies and publicly funded research continue to decline.

The panel was impressed by the quality and balance of the research being undertaken and its likely impact. It was also impressed by the CRC's development programs for its PhD and professional doctorate students, and the impact this will have on building capacity in the sector."

Independent Third Year Review
Panel Report, June 2015

All CRCs are required to undergo one or more performance reviews during their funding term, in accordance with the CRC Program Guidelines and the CRC's Commonwealth Agreement. The major mid-term performance review of the IA CRC under its current Commonwealth Agreement was undertaken by an independent review panel at the University of Canberra during June 2015.

The IA CRC received an extremely positive performance review, which recognised the strengths of its leadership team, Participant support and engagement, the quality of its R&D program and likelihood for impact, and the quality of its communications and extension program.

The panel's eight recommendations and the CRC's responses are listed in Table 20.

Table 20 Third Year Review Panel recommendations and IA CRC responses

Panel recommendation	Plan of action to address recommendation	Implemented
The CRC should continue to involve suitably qualified independent advisers in the development and testing of the Centre for Invasive Species Solutions (CISS) business plan and should, where possible, seek to leverage participant resources and know-how	Invasive Animals Limited (IAL) will continue to involve suitably qualified independent advisers in the testing of the CISS business plan, as appropriate	Yes (ongoing)
A cautious approach should be taken in any expansion by CISS into weed control in order not to lose its primary focus on invasive animals, and to ensure that it coordinates with other research entities that have a weed control focus to maximise outcomes and avoid duplication	IAL will take a cautious approach to any expansion of scope beyond pest animal management innovation. We will continue to monitor prospective investor interest in expanding the scope of the CISS Innovation Program to include both pest animals and weeds, and only expand our initial scope if invited by investors	Yes (ongoing)

(continued)

Table 20 (continued)

Panel recommendation	Plan of action to address recommendation	Implemented
The CRC should ensure that it has adequate resources to commit to the development of the CISS proposal, and ensure that resourcing for CISS development activities is not at the expense of the CRC's business-as-usual activities	IAL will continue to apply adequate resources to progress and promote the CISS prospectus	Yes
The CRC should ensure that research program 4 (Community Engagement) is fully integrated into the other activities of the CRC with a view to delivering tangible outcomes that are of value and are taken up by the community	IA CRC management will continue to promote collaboration and integration between CRC programs and themes, especially the cross-cutting Community Engagement Program. This will be ensured through regular involvement of the Community Engagement leadership team in other CRC theme meetings, regular communications, and seeking to enhance the community of practice model related to adoption of best-practice pest animal management with Essential Participants, particularly state agencies	Yes (ongoing)
The CRC should encourage the commencement of interdepartmental discussions on streamlining the engagement with, and the obtaining of approvals from, the Australian Pesticides and Veterinary Medicines Authority (APVMA), including investigating whether risk-based, simplified and speedier approaches used in New Zealand are worth consideration; and more generally in reducing red tape	The IA CRC will engage with the APVMA on the benefits of stronger harmonisation of regulatory assessment in product development for invasive species management	No. This issue will be raised at the next IA CRC – APVMA liaison meeting planned for the first quarter of 2016
The CRC should continue to seek the involvement of AQIS and the Department of the Environment in both the CRC's and CISS's activities, including through seeking interdepartmental discussions	The IA CRC will continue to engage with the Department of the Environment and reinvigorate engagement with AQIS around potential technologies that have the opportunity to strengthen border protection, and could be developed through the prospective CISS Innovation Program	Yes (ongoing)
The CRC should ensure that there are regular whole-of-CRC engagement activities for staff, researchers, students and other stakeholders to be aware of the totality of the CRC's activities, and foster relationships and network development between its Participants and personnel	The IA CRC will host the 2017 Australasian Vertebrate Pests Conference on behalf of, and in conjunction with, the Australian and ACT governments. This will provide the final whole-of-CRC event, and a further opportunity to consolidate networks and showcase the CRC's achievements	Yes (ongoing)
In relation to the PhD program, the CRC should take a more proactive role in: assisting PhD students to be introduced to suitable industry supervisors at the outset of the students' candidatures ensuring (including through interacting with the relevant university postgraduate office) that PhD students are not disadvantaged by any disconnect between academic and industry supervisors, or because of the absence or unavailability of supervisors, or because of interpersonal issues between students and supervisors	The leader of the Balanced Researcher Program will continue to actively liaise with students, supervisors and, where possible, the graduate research offices of individual universities, to ensure that each student has readily available access to the industry supervisor on their panel and that that person is actively engaging with the supervisory process. The IA CRC will continue to actively work as needed with students, supervisors and relevant Participant universities to quickly and amicably resolve any issues regarding supervisory participation that are brought to our attention. The CRC will also work with the students to ensure that we are notified of any supervisory-related issues in a timely manner, to minimise delays in having the matter resolved	Yes (ongoing)

Appendix A:
Milestone report — progress against Commonwealth Agreement Schedule 1 milestones

Output/ milestone number	Description	Contracted achievement date	Achieved	Reason/details	Strategies to achieve unmet milestone
Output R1.1	National incursions response system technologies				
R1.1.1	National incursions response system technologies writing group and terms of reference established	30 June 2013	Yes	Terms of reference established	
R1.1.3	Cost-sharing agreements and current incursion response strategies reviewed, and gaps in documentation defined	30 June 2013	Cancelled	IPAC (national sectoral committee under the National Biosecurity Committee) and the Australian Government Department of Agriculture have instructed the National Incursions Response Facilitator to not proceed, as IPAC and the department will complete this action independently	IPAC/Department of Agriculture will complete this action independently
R1.1.6	One pilot incursion response plan for identified priority species produced	30 June 2014	In progress	Due to WA Government staff freeze, a project leader was not appointed until June 2014	Excellent progress made, with concept selected and draft layout complete. Currently under review by stakeholders, and milestone expected to be achieved by 31 October 2015
R1.1.7	Incursion response strategy reviewed and nationally endorsed by Vertebrate Pests Committee	30 June 2014	In progress	Due to WA Government staff freeze, a project leader was not appointed until June 2014	Excellent progress made as the process continues through stages of research, development and collaboration. Milestone will be achieved by 31 July 2015

Output/ milestone number	Description	Contracted achievement date	Achieved	Reason/details	Strategies to achieve unmet milestone
R1.1.8	Incursion response training program developed	30 June 2014	In progress	Due to WA Government staff freeze, a project leader was not appointed until June 2014	Excellent progress made, with the program scoped, conceptualised and well advanced. It will be fully developed once the strategy and plan have been achieved. Training program plan and modules are expected to be achieved by 31 December 2015. Full achievement of the milestone will occur by 30 June 2016
R1.1.10	Two further incursion response plans developed	30 June 2015	In progress	Due to WA Government staff freeze, a project leader was not appointed until June 2014	Structure and outcome of plans are under review. Proposed content is also being reviewed to ensure the plans produce optimum outcomes
R1.1.11	Training programs aligned with activities and functions of the incursion response strategies developed	30 June 2015	In progress	Due to WA Government staff freeze, a project leader was not appointed until June 2014	With delays experienced for milestones R1.1.7 and R1.1.8, training cannot be formally developed or progress. However, the program has been conceptualised
R1.1.12	Two case studies on surveillance data modelling produced	30 June 2015	Yes	Two case studies completed	
R1.1.13	Web mapping and applications for a mobile device(s) produced and tested	30 June 2015	Yes	The Field Guide to Pest Animals of Australia iOS app, and the FeralScan community pest surveillance website, mobile website and mobile apps (iOS/Android) have been produced, tested and rolled out. A prototype for the Field Guide to Pest Fish of Australia iOS app has been developed	
U1.1.1	One incursion response plan and one case study adopted by Vertebrate Pests Committee	30 June 2015	In progress	Due to WA Government staff freeze, a project leader was not appointed until June 2014	Concept selected and draft layout complete. Currently under review by various stakeholders and National Incursions Response Facilitator Steering Committee. Milestone is expected to be achieved by 30 September 2015

Output/ milestone number	Description	Contracted achievement date	Achieved	Reason/details	Strategies to achieve unmet milestone
Output R1.2	Technologies and strategies for long-term Tasmanian fox incursion response				
R1.2.3	Robotic extraction for trace DNA developed and implemented	30 June 2013	Yes	Extraction protocol has now been implemented, although extensive troubleshooting was required to move from development to full implementation	
R1.2.8	Next-generation sequencing approaches for detection of Tasmanian-specific prey from scats developed	30 June 2014	Yes	Protocol developed and preliminary analyses conducted	
R1.2.9	Detection experiments started	30 June 2015	Yes	Achieved by 30 June 2014, one year ahead of schedule	
R1.2.10	Recommendations from risk assessment implemented	30 June 2015	Yes	Recommendations will be implemented in any future incursions where baiting is undertaken	
R1.2.11	Survey of fox and other predator scats completed	30 June 2015	Yes	Survey completed	
U1.2.1	Risk assessment report considered and alternative fox control strategies endorsed by Tasmanian Government	30 June 2015	In progress	Recommendations supported appropriate strategy being considered	Recommendations will be included in an Incursion Response Standard Operating Procedure, which will sit within the Vertebrate Pest Incursion Response Plan. Milestone is expected to be achieved by 31 December 2015
U1.2.2	New DNA detection technologies progressively adopted by Tasmanian Government	30 June 2015	Yes	Accepted and will be adopted in the future	
Output R1.3	RHD Boost: roll-out of new RHDV strains				
R1.3.2	Requirement for a new RHD vaccine for domestic rabbits determined	30 June 2014	Yes	The study has shown that the current vaccine is effective against the new RHDV K5 strain	
U1.3.2	New RHDV strain release protocols agreed and adopted by participating agencies	30 June 2014	Yes	Release protocols agreed	
R1.3.5	RHD Boost RHDV strain(s) released in accordance with national release plan and post-release monitoring commenced at selected sites	30 June 2015	In progress	Registration of K5 is still under assessment by the APVMA. Release will be in accordance with the national release strategy once registration is approved, which is expected between December 2015 and April 2016	Milestone will be achieved by autumn 2016 (pending APVMA approval by December 2015) or autumn 2017

Output/ milestone number	Description	Contracted achievement date	Achieved	Reason/details	Strategies to achieve unmet milestone
R1.3.6	RHD vaccine developed if required	30 June 2015	Yes	Milestone linked to R1.3.2. An IA CRC study has shown that a new vaccine is not required	
R1.3.7	Experiments on virus virulence and resistance concluded	30 June 2015	No	Breeding colonies failed to produce sufficient rabbits for experiments	Extension of serological and genetic testing at the long-term SA Turretfield site. Further support will also be given to challenge experiments with RHDV K5 on wild-caught rabbits during the national K5 monitoring program if/ when K5 is approved for release
U1.3.4	If required, existing and/or new RHDV vaccine promoted to commercial rabbit breeders and pet rabbit owners in advance of RHD Boost strain release	30 June 2015	Yes	Advice is provided to breeders and owners as requested, and at all presentations on the release of RHDV K5	
U1.3.5	Once approved, RHD Boost virus strain released by Vertebrate Pests Committee agency staff in accordance with agreed national release and monitoring plan and protocols	30 June 2015	In progress	Registration of RHDV K5 is still under assessment by the APVMA. Release will be in accordance with the national release strategy and monitoring plan once registration is approved, which is expected between December 2015 and April 2016	Milestone will be achieved by autumn 2016 (pending APVMA approval by December 2015) or autumn 2017
Output R1.4	RHD Accelerator platform technology				
R1.4.2	One rabbit cell line with compromised interferon response established and tested for ability to support RHDV replication	30 June 2013	Yes	A protocol was developed to transiently suppress the interferon response in cultured cells. The RHDV genome was cloned into a plasmid and resulted in expression of viral polyproteins. So far, no signs of viral replication have been observed in cultured cells, regardless of whether the interferon response was compromised	
R1.4.6	Virus passaged in vivo and in vitro (if available) in presence of polyclonal antibodies	30 June 2015	Yes	Passaging completed and now continues	
R1.4.7	Virulence of selected RHDV strains in naive rabbits assessed	30 June 2015	In progress	Delay in trials	Animal Ethics Committee approval has been obtained, and an animal trial is scheduled for November 2015

Output/ milestone number	Description	Contracted achievement date	Achieved	Reason/details	Strategies to achieve unmet milestone
U1.4.1	Recommendations for long-term biocontrol strategic approach submitted to Vertebrate Pests Committee	30 June 2015	In progress	Draft has been prepared and requires Vertebrate Pests Committee/IPAC consideration	Milestone will be achieved by 30 November 2015
Output R1.5	**Strategic wild dog control**				
R1.5.6	Data from year 1 collated, and preliminary analysis completed and reviewed by advisory committee	30 June 2015	Yes	Data collated and preliminary findings discussed/reviewed with advisory committee	
R1.5.7	Stage 3 field study (repeat Stage 1 field study) undertaken	30 June 2015	Yes	Field study undertaken	
R1.5.8	Stage 4 field study (assess management strategies for periurban systems, in consultation with local government members of advisory committee, given ecological data from Stages 1–3 field studies) (repeat stage 1 field study) undertaken	30 June 2015	Yes	Studies and consultation undertaken	
U1.5.3	Third annual update provided to stakeholders	30 June 2015	Yes	Annual update provided	
Output R2.1	**Avicide**				
U2.1.1	Results of Achilles heel search and proof-of-concept study published, and presented and promoted to end users, stakeholders and potential investors	30 June 2014	Yes	Achilles heel review of chemicals that might be useful as an avicide for starlings was completed in parallel with the screening of the US database of chemicals	
R2.1.3	Preferred starling actives formulated and pen efficacy trials completed	30 June 2015	Yes	Trials completed	
Output R2.2	**Rodenticide**				
R2.2.2	Proof-of-concept studies completed with existing options, including microencapsulated sodium nitrite	30 June 2014	In progress	Research plan completed. Project plan approved. Proof-of-concept studies using microencapsulated sodium nitrite have been completed	An optimised formulation of nanoencapsulated sodium nitrite will be tested before September 2015. New active constituents that arise from the mouse genomic and chemical screens will be formulated appropriately, and studies using caged/ penned rodent species will be completed before 30 December 2015

Output/ milestone number	Description	Contracted achievement date	Achieved	Reason/details	Strategies to achieve unmet milestone
U2.2.1	Results of Achilles heel search and proof-of-concept studies (if a promising active exists) published, and presented and promoted to end users, stakeholders and potential investors	30 June 2014	In progress	This milestone is dependent on study outputs and strategy for protecting any intellectual property that could be commercialised. Results of Achilles heel review of house mouse physiology have been communicated to GRDC, ACTA and USDA as key stakeholders	Results will remain commercial-in-confidence until approval received from GRDC to publish the research outputs. Milestone will be achieved by 31 December 2016
R2.2.3	Preferred rodenticide actives formulated and free-choice pen efficacy trials completed	30 June 2015	In progress	Two formulations of sodium nitrite have been tested and found to be not sufficiently effective. New formulations (nanoencapsulation) of sodium nitrite will be tested, as well as any chemical leads from the toxicology screen of databases (USDA/ commercial companies) and independent expert toxicology evaluation	This milestone (including actives that are outputs of the genetic approach to development of new rodenticides) will be achieved by March 2017
Output R2.3	Feral pig management products				
R2.3.1	Nontoxic field trials of feral pig baits in the USA completed	30 June 2013	In progress	Development of a complete HOGGONE® bait formulation that is stable and effective has proven challenging. Solid versus paste baits have recently been tested	Solid versus paste encapsulated sodium nitrite carriers and a pour-on prototype product have recently been tested. The pour-on product appears the preferred option from field and pen studies, and, from a market perspective, requires the least management change by end users. Milestone will be achieved by 30 April 2016
U2.3.1	HOGGONE® and a nitrite concentrate registration package submitted to APVMA in Australia	30 June 2013	In progress	Development of a complete HOGGONE® bait formulation that is stable and effective has proven challenging. Solid versus paste baits have recently been tested	A complete registration application was submitted to the US EPA in March 2015. This registration application will be reformatted and submitted to the APVMA in Australia. Milestone will be achieved by 31 December 2015
R2.3.2	Initial data submission to US EPA to obtain an Experimental Use Permit completed (minimum one year approval process)	30 June 2014	Yes	US EPA submission to approve the testing of prototype products containing sodium nitrite was completed	

Output/ milestone number	Description	Contracted achievement date	Achieved	Reason/details	Strategies to achieve unmet milestone
U2.3.2	Initial feral pig bait (HOGGONE® or similar) registration package submitted 30 June 2014 to US EPA to obtain an Experimental Use Field Trial Permit	30 June 2014	Yes	Registration package submitted	
R2.3.3	Toxic field trials of feral pig baits in the USA started	30 June 2015	In progress	Formulation delivery change requires further consideration by USDA before field trials can commence	Milestone will be achieved by 31 December 2015
U2.3.3	30% of manufactured feral pig bait market share in Australia achieved	30 June 2015	In progress	Requires achievement of U2.3.1	Milestone will be achieved by 30 June 2017
Output R2.4	Fertility control				
U2.4.1	GonaCon™ registration package prepared and submitted to APVMA	30 June 2013	In progress	The GonaCon™ registration packages approved by the US EPA are now available to the project. Under the Australian regulatory system, this product will need to be assessed as an animal drug by the APVMA	Project management team has negotiated access to the US registration application used by the USDA National Wildlife Research Agency to apply for the approval of GonaCon™ for deer and wild horse population control. These applications will be used to prepare an APVMA application so that Gonacon™ can be assessed as a new agricultural product. Milestone will be achieved by 30 November 2015
R2.4.3	Research into potential orally deliverable antifertility formulations by a postdoctoral fellow completed	30 June 2015	Yes	Research completed	
R2.4.4	Research extended, if promising formulations have been discovered	30 June 2015	No	Oral administration was variable but intranasal administration was shown to be positive. While these are very interesting results, avenues for potential orally deliverable antifertility formulations were insufficiently efficacious and the project was consequently closed	While these are very interesting results, avenues for potential orally deliverable antifertility formulations were insufficiently efficacious and the project was consequently closed
U2.4.2	Once approved by APVMA, GonaCon™ launched in Australia	30 June 2015	In progress	Requires APVMA registration submission (see U2.4.1)	Expected to occur once Milestone U2.4.1 is achieved and APVMA considers registration
U2.4.3	GonaCon™ applied by ACT Government as an effective kangaroo fertility control	30 June 2015	In progress	Requires APVMA registration	Expected to occur once Milestone U2.4.2 is achieved

Output/ milestone number	Description	Contracted achievement date	Achieved	Reason/details	Strategies to achieve unmet milestone
Output R3.1	Genetic tools for detection of pest fish at low densities				
R3.1.8	Evaluation of two eDNA detection methods completed	30 June 2015	In progress	The digital PCR instrument has had a recent product change that alters the assay significantly and potentially improves this methodology	Milestone will be achieved by 31 December 2015
R3.1.9	Development of high-throughput detection system started	30 June 2015	Yes	University of Canberra has linked with Trace and Environmental DNA Laboratory at Curtin University in Western Australia to commence next-generation sequence metabarcoding for assessing multiple species from environmental samples	
U3.1.1	Queensland Department of Agriculture and Fisheries use of eDNA tilapia detection technique to delineate tilapia range in the state started	30 June 2015	Yes	Due to Queensland Department of Agriculture and Fisheries staff redundancies, this milestone has been implemented through other bodies, such as the Fitzroy Basin Association. They have used, and are using, the method in their catchments via the department's ties with James Cook University (JCU). The technology has been taken up by JCU and is being offered as a service through TropWater. The Fitzroy Basin Authority and Reef Catchments have both taken advantage of the service to survey for tilapia	Milestone achieved through regional organisations
Output R3.2	Koi herpesvirus (KHV) evaluation and roll-out				
R3.2.3	KHV susceptibility trials completed	30 June 2014	In progress	The absence of carp (as positive controls for the virus) has delayed milestone achievement	The absence of carp (as positive controls for the virus) and protracted negotiations with the Animal Health Committee have delayed milestone achievement. All trials except for challenge studies on bony bream and one other species of fish (from Western Australia) have been completed. Milestone is on track to be achieved by 30 November 2015

Output/ milestone number	Description	Contracted achievement date	Achieved	Reason/details	Strategies to achieve unmet milestone
R3.2.4	National KHV release, monitoring and evaluation plan prepared (including plans for postrelease carp clean-up)	30 June 2015	In progress	Output delayed to enable findings from overseas fact-finding mission to be incorporated into plan	Milestone will be achieved by 31 December 2015
R3.2.5	Scientific evaluation of KHV concluded	30 June 2015	In progress	Slight delay in finalising the full scientific evaluation of KHV due to the additional selected nontarget species studies	Milestone will be achieved by 31 December 2015
U3.2.2	KHV registration package submitted to government regulators	30 June 2015	In progress	Registration package under review	Milestone will be achieved by 31 October 2015
Output R4.1	Facilitate collective action				
R4.1.6	One peer-reviewed journal paper submitted and two practitioner publications published	30 June 2015	Yes	One journal paper and two publications published	
U4.1.1	Research findings incorporated by end users, including IA CRC Participants, in design and delivery of regional pest animal control programs	30 June 2015	In progress	Online toolkit has been deployed. Implementation via training program, and development of vocational education and training modules in collaboration with NSW Department of Primary Industries is under way	Additional tools are still under development and will progressively be made available during 2015–16
Output R4.2	Triggers for effective action				
R4.2.4	Working paper on impediments to behavioural change published or peer-reviewed journal paper submitted	30 June 2015	Yes	Journal article submitted in April 2015, with additional papers to be submitted in 2016	
R4.2.5	Workshop on behavioural change held	30 June 2015	In progress	Online workshop of online communications audit tool with partners in Victoria and Queensland, and IA CRC communications staff, held May 2015	Workshop on behaviourally effective communications is currently under preparation and scheduled for second half of 2015
R4.2.6	Strategies for behaviourally effective communications developed	30 June 2015	Yes	Behaviourally effective communication strategies have been developed, with further strategies for other groups/situations being developed. A Facebook group site has also been developed to increase engagement, and membership is growing	

Output/ milestone number	Description	Contracted achievement date	Achieved	Reason/details	Strategies to achieve unmet milestone
U4.2.1	Preliminary research findings incorporated by end users, particularly IA CRC Participants involved in project, in new extension materials and programs	30 June 2015	In progress	Tasmanian Cat Management research findings were presented at National Feral Cat Management Workshop, Canberra, April 2015. Findings to be integrated into recommendations to Australian Government	Milestone will be achieved by 31 December 2015
Output R4.3	Reduction of legal and institutional impediments				
R4.3.2	One PhD student enrolled	30 June 2013	Yes	PhD student Vivek Nemane enrolled through University of New England	
R4.3.4	Technical report on how relevant stakeholders perceive and respond to invasive animal control institutional arrangements published	30 June 2014	In progress	Additional problem-solving/scenario-based institutional reform workshops with community are required to obtain a credible response and subsequent report	Workshops will be held in early 2016, and the technical report will be finalised by 31 March 2016
R4.3.5	Two peer-reviewed journal papers on directions for legislative reform and institutional arrangements for invasive animal control submitted	30 June 2015	Yes	Two journal papers submitted	
R4.3.6	Workshop report on challenges and strategies for the improvement of invasive animal control institutions completed	30 June 2015	In progress	Due to the delay with milestone R4.3.4, the workshop report is delayed	Milestone will be achieved by 31 May 2016
Output R4.4	Balanced Researcher Program				
No outcomes because no students have graduated					
Output R4.5	Vocational education and training (VET)				
U4.5.2	Complementary market analyses of training needs and likely utilisation undertaken in NSW Department of Primary Industries in conjunction with Tocal College, and other state pest management agencies	30 June 2013	In progress	Results have been analysed. Working closely with NSW Department of Primary Industries and Tocal College to develop training material to support delivery of the revised training package	Results have been analysed. Report and milestone will be achieved by 31 December 2015
R4.5.4	VET Certificate and Diploma units packaged into courses for pest managers completed	30 June 2015	In progress	Milestone linked to U4.5.2	Milestone will be achieved by 31 January 2016

Output/ milestone number	Description	Contracted achievement date	Achieved	Reason/details	Strategies to achieve unmet milestone
U4.5.3	Revised national competencies for Certificate and Diploma level training in pest animal management endorsed by Vertebrate Pests Committee and accredited nationally	30 June 2015	In progress	Milestone linked to U4.5.2	Milestone will be achieved by 31 January 2016
Other milestones					
O1.3	Operational performance of rabbit warren fumigator determined under field-simulated conditions	30 June 2013	In progress	Engineering of a working prototype is complete. Carbon monoxide emissions consistently meet or exceed an operating specification of approximately 5%. Other exhaust emissions that might adversely affect animal welfare outcomes are below acceptable standards. Delivery of prototypes for field testing is contingent on legal negotiations over project intellectual property ownership and commercial arrangements for market delivery	Completion of a working prototype has been more complex than first anticipated, and completion dates provided were not able to be met. The working prototype is expected to be delivered for field testing before November 2015
O1.4	National APVMA registration package for rabbit warren fumigator submitted	30 June 2013	In progress	Comprehensive submission was made to the APVMA late in 2014. Follow-up discussions were held in March 2015 to confirm APVMA requirements, and obtain advice on requirements, for field trial permits and the APVMA registration package. Milestone delayed by engineering challenges in developing working prototype	Milestone will be achieved by March 2016
T.1.4	Transition plan revised and submitted to Commonwealth	30 June 2015	Yes	Transition plan submitted	

ACTA = Animal Control Technologies Australia; APVMA = Australian Pesticides and Veterinary Medicines Authority; eDNA = environmental DNA; GRDC = Grains Research and Development Corporation; IA CRC = Invasive Animals Cooperative Research Centre; IPAC = Invasive Plants and Animals Committee; KHV = koi herpesvirus; NSW = New South Wales; PCR = polymerase chain reaction; RHD = rabbit haemorrhagic disease; RHDV = rabbit haemorrhagic disease virus; SA = South Australia; USDA = United States Department of Agriculture; US EPA = United States Environmental Protection Agency; VET = vocational education and training; WA = Western Australia

Appendix B: Publications

1 Formal publications

Publication type	Number
1.1 Book	0
1.2 Book chapter	6
1.3 Article in scholarly refereed journal	52
1.4 Conference paper — refereed proceedings	1

2 Publications and reports for end users

Publication type	Number
2.1 Conference paper — non-refereed proceedings	19
2.2 Report	7
2.3 Guide/fact sheet	19
2.4 Multimedia product	0
2.5 Newsletter	1
2.6 Other IA CRC-related publications and reports	1

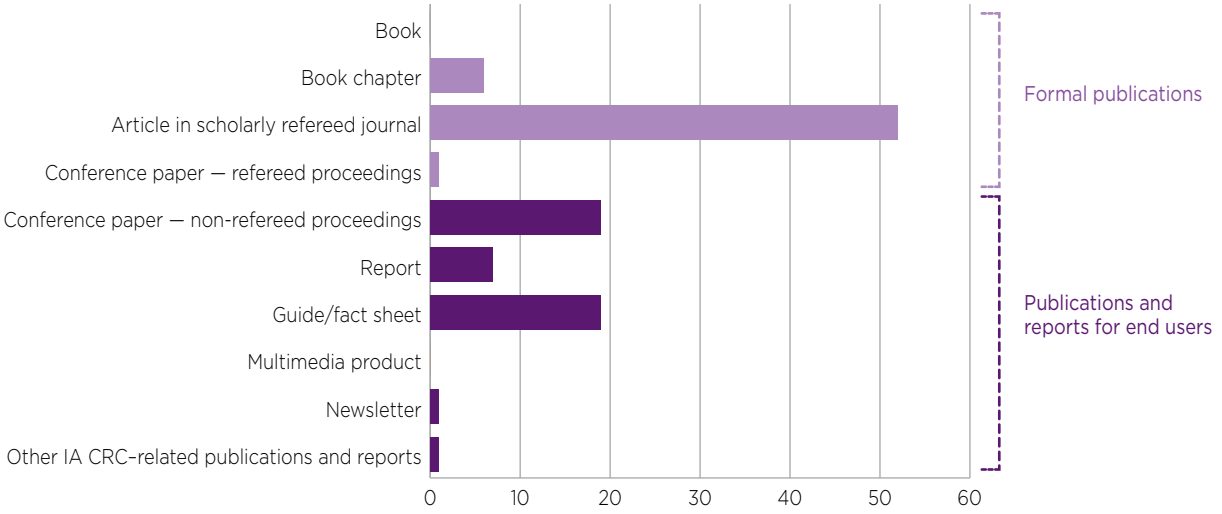


Figure B1 IA CRC publications, Jul 2014 – Jun 2015

Table B1 Outcome 1: No new vertebrate pests established in Australia

Publication date	Title	Publication	Authors	Output
1.2 Book chapter				
2014	Knowledge management, context and public policy: developing an analysis framework	In: A Örtenblad (ed). *Handbook of research on knowledge management: adaptation and context*, Edward Elgar, Cheltenham, UK, pp 208–233	Blackman D, Moon K, Harris S & Sarre SD	1.L.21
2015	The biogeography of avian invasions: history, accident and market trade	In: J Canning-Code (ed). *Biological invasions in aquatic and terrestrial systems: biogeography, ecological impacts, predictions and management*	Cassey P, Vall-Llosera Camps M, Dyer E & Blackburn TM	1.L.4
1.3 Article in scholarly refereed journal				
Jul 2014	Creating new evolutionary pathways through bio-invasion: the population genetics of brushtail possums in New Zealand	*Molecular Ecology* 23(14):3419–3433 http://dx.doi.org/10.1111/mec.12834	Sarre SD, Aitken NA, Adamack A, MacDonald AJ & Gruber B	1.L.21
Oct 2014	Range-wide multilocus phylogeography of the red fox reveals ancient continental divergence, minimal genomic exchange and distinct demographic histories	*Molecular Ecology* 23(19):4813–4830 http://dx.doi.org/10.1111/mec.12898	Statham MJ, Murdoch J, Janecka J, Aubry KB, Edwards CJ, Soulsbury CD, Berry O, Wang ZH, Harrison D, Pearch M, Tomsett L, Chupasko J & Sacks BN	1.L.21
Nov 2014	Defining specificity in DNA detection of wildlife: response to Gonçalves et al. 'The risks of using "species-specific" PCR assays in wildlife research: the case of red fox (*Vulpes vulpes*) identification in Tasmania'	*Forensic Science International: Genetics* 13:206–207 http://dx.doi.org/10.1016/j.fsigen.2014.08.006	Sarre S, MacDonald A, Berry O, Barclay C, Saunders G & Ramsey D	1.L.21
Dec 2014	Understanding the biological invasion risk posed by the global wildlife trade: propagule pressure drives the introduction and establishment of Nearctic turtles	*Global Change Biology* 21(3):1078–1091 http://dx.doi.org/10.1111/gcb.12790	García-Díaz P, Ross JV, Ayres C & Cassey P	1.L.4
Jan 2015	Escaping captivity: the biological invasion risk from vertebrate species in zoos	*Biological Conservation* 181:18–26 http://dx.doi.org/10.1016/j.biocon.2014.10.023	Cassey P & Hogg CJ	1.L.4
Jan 2015	Inferring the distribution and demography of an invasive species from sighting data: the red fox incursion into Tasmania	*PLoS ONE* 10(1): e0116631 http://dx.doi.org/10.1371/journal.pone.0116631	Caley P, Ramsey DL & Barry SC	1.L.24
Feb 2015	An examination of the accuracy of a PCR-based test used to detect the incursion of an invasive species: the case of the red fox in Tasmania	*Journal of Applied Ecology* 52(3):562–570 http://dx.doi.org/10.1111/1365-2664.12407	Ramsey DSL, MacDonald A, Quasim S, Barclay C & Sarre S	1.L.24
Feb 2015	Long after the event, or four things we (should) know about bird invasions	*Journal of Ornithology,* February 2015 http://dx.doi.org/10.1007/s10336-015-1155-z	Blackburn TM, Dyer E, Su S & Cassey P	1.L.4

(continued)

Table B1 (continued)

Publication date	Title	Publication	Authors	Output
Feb 2015	The influence of numbers on invasion success	*Molecular Ecology* 24(9):1942–1953 http://dx.doi.org/10.1111/mec.13075	Blackburn TM, Lockwood JL & Cassey P	1.L.4
Mar 2015	Inferential and predictive modelling to evaluate options for controlling invasive mammals on islands	Submitted to *Ecological Applications*	Anderson D, Byrom A, McMurtrie P, Edge K-A & Baxter P	1.L.2
Mar 2015	Degradation and detection of fox (*Vulpes vulpes*) scats in Tasmania — evidence from field trials	*Wildlife Research* 41(8):681–690 http://dx.doi.org/10.1071/WR14152	Brown W, Ramsey DSL & Gaffney R	1.L.22
Mar 2015	Quantifying the impact of *Gambusia holbrooki* on the extinction risk of the critically endangered red-finned blue-eye	*Ecosphere* 6(3):41 http://dx.doi.org/10.1890/ES14-00412.1	Nicol S, Haynes T, Fensham R & Kerezsy A	1.L.11
Apr 2015	Ecological and economic benefits to cattle rangelands of restoring an apex predator	*Journal of Applied Ecology* 52(2):455–466 http://dx.doi.org/10.1111/1365-2664.12378	Prowse T, Johnson C, Cassey P, Bradshaw C & Brook B	1.L.4
May 2015	Going cheap: determinants of bird price in the Taiwanese pet market	*PLoS ONE* 10(5): e0127482 http://dx.doi.org/10.1371/journal.pone.0127482	Su S, Cassey P, Vall-Llosera Camps M & Blackburn TM	1.L.4
Jun 2015	On the island biogeography of aliens: a global analysis of the richness of plant and bird species on oceanic islands	*Global Ecology and Biogeography* http://dx.doi.org/10.1111/geb.12339	Blackburn TM, Delean S, Pyšek P & Cassey P	1.L.4
2.1 Conference paper — non-refereed proceedings				
Jul 2014	Monitoring freshwater fish communities using eDNA metabarcoding	Poster presentation at the Genetics Society of AustralAsia annual conference 2014, Sydney, Australia, 6–9 July 2014	Bylemans J, Furlan E & Gleeson D	1.W.2
Jul 2014	How robust is species detection using environmental DNA?	Plenary address: Genetics Society of AustralAsia annual conference 2014, Sydney, Australia, 6–9 July 2014	Gleeson D	1.W.2
Jul 2014	Species from faeces: predator scat metabarcoding in Tasmania	Genetics Society of AustralAsia annual conference 2014, Sydney, Australia, 6–9 July 2014	MacDonald AJ, Gleeson D and Sarre SD	1.L.21
Jul 2014	Who is eating who from poo? Predator–prey interactions in Tasmania inferred using next-generation sequencing of predator scat	Australian Mammal Society, Melbourne	Modave E, Campbell CD, MacDonald AJ, Gruber B, Harris S, Dewar E & Sarre SD	1.L.21
Jul 2014	The Great Poo Hunt: a comprehensive DNA-based predator scat survey in Tasmania.	Australian Mammal Society. Melbourne	Campbell CD, Dewar E, Modave E, MacDonald AJ, Gruber B, Harris S & Sarre SD	1.L.21

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Table B1 (continued)

Publication date	Title	Publication	Authors	Output
Aug 2014	Creating new evolutionary pathways through bio-invasion: identification of a hybrid zone among invasive Australian possums in New Zealand	Invasion Genetics: The Baker and Stebbins Legacy Symposium, Asilomar, California	Sarre SD, Aitken N, MacDonald AJ, Adamack A, Gruber B & Cowan P	1.L.21
Dec 2014	Enhancements to the feralscan community pest animal mapping resource	Proceedings of the 27th Australasian Wildlife Management Society Conference, Brisbane www.awms.org.au/assets/docs/Proceedings/awms14proceedings_brisbane.pdf	West P	1.L.5
Jun 2015	Species detection using eDNA; applications for environmental law	Society for Wildlife Forensics Conference, Missoula, USA, 22–26 June 2015	Gleeson D, Furlan E & Duncan R	1.W.2
Jun 2015	DNA detection probabilities for the remote sampling of wildlife: the controversial case of foxes in Tasmania.	Society for Wildlife Forensics Conference, Missoula, USA, 22–26 June 2015	Sarre SD, MacDonald AJ & Ramsey DSL	1.L.21
2.6 Other IA CRC–related publications and reports				
June 2015	Monitoring the spread of the invasive redfin perch (*Perca fluviatilis*, L. 1758) in Blakney Creek (NSW) using environmental DNA	End-user report	Bylemans J, Furlan E & Gleeson D	1.W.2

Table B2 Outcome 2: Improved prediction and control of emerging outbreaks

Publication date	Title	Publication	Authors	Output
1.3 Article in scholarly refereed journal				
Sep 2014	Parenteral administration of GnRH constructs and adjuvants: immune responses and effects on reproductive tissues of male mice	*Vaccine* 32(43): 5555–5563 http://dx.doi.org/10.1016/j.vaccine.2014.07.075	Sharma S, McDonald I, Miller L & Hinds L	2.C.12
Dec 2014	Prospects for immunocontraception in feral horse population control: exploring novel targets for an equine fertility vaccine	*Reproduction, Fertility and Development* http://dx.doi.org/10.1071/RD14280	Swegen A & Aitken RJ	2.C.13
Dec 2014	Investigation of the stallion sperm proteome by mass spectrometry	*Reproduction* 149:235–244 http://dx.doi.org/10.1530/REP-14-0500	Swegen A, Curry BJ, Gibb Z, Lambourne SR, Smith ND & Aitken RJ	2.C.13
1.4 Conference paper — refereed proceedings				
Aug 2014	Citizen surveillance of mouse outbreaks in grain-growing regions of Australia	Proceedings of 5th International Conference on Rodent Biology and Management, Zhengzhou, China, 24–29 August 2014 http://icrbm.csp.escience.cn/dct/page/1	Henry S, West P, Cruz J, Byrom A, Hinds L, Brown P & Pech R	2.C.3
2.1 Conference paper — non-refereed proceedings				
Nov 2014	The potential for citizen surveillance of invasive species	New Zealand Ecological Society, Palmerston North, 16–20 November 2014	Byrom A, Brown P, Cruz J, Henry S, Hinds L, Pech R & West P	2.C.3
Feb 2015	Can Twitter inform early detection of upcoming mouse plagues?	SSAI Young Statisticians Conference 2015, Adelaide, 5–6 February 2015 https://ysc2015.files.wordpress.com/2014/07/ysc-2015-full-program7.pdf	Welvaert M	2.C.3
Jun 2015	Can we use dynamic occupancy models to predict large fluctuations in mouse abundance?	SEEM (Statistics in Ecology and Environmental Monitoring) 2015 Conference, Queenstown, New Zealand, 22–26 June 2015 www.maths.otago.ac.nz/SEEM2015/programme.php	Cruz J, Pech R, Anderson D, Byrom A, Brown P, Hinds L & Henry S	2.C.3
Aug 2015	Electrophilic aldehydes increase free radical production and modify surface proteins in horse spermatozoa	Annual scientific meeting of the Endocrine Society of Australia and the Society for Reproductive Biology, Adelaide, 23–26 August 2015	Hall S, Nixon B & Aitken RJ	2.C.13

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Table B2 (continued)

Publication date	Title	Publication	Authors	Output
2.3 Guide/fact sheet				
July 2014	Forum proceedings: tilapia in Australia — state of knowledge	Invasive Animals CRC www.pestsmart.org.au/tilapia-forum-proceedings	Fulton W & Hall K	
Dec 2014	Electrofishing control of Mozambique tilapia in the Herberton weirs	Invasive Animals CRC www.pestsmart.org.au/electrofishing-control-of-mozambique-tilapia-in-the-herberton-weirs	Invasive Animals CRC	
Dec 2014	Pest fish exclusion screens: Mareeba–Dimbulah Water Supply Scheme	Invasive Animals CRC www.pestsmart.org.au/pest-fish-exclusion-screens	Invasive Animals CRC	
Dec 2014	Pest fish exclusion screens: Boondooma–Tarong pipeline	Invasive Animals CRC www.pestsmart.org.au/pest-fish-exclusion-screens-boondooma-tarong-pipeline	Invasive Animals CRC	
Dec 2014	Queensland's first attempt at tilapia eradication	Invasive Animals CRC www.pestsmart.org.au/queenslands-first-attempt-at-tilapia-eradication	Invasive Animals CRC	
Dec 2014	Eradication of Mozambique tilapia at Bullyard Creek, Qld	Invasive Animals CRC www.pestsmart.org.au/eradication-of-mozambique-tilapia-at-bullyard-creek-qld	Invasive Animals CRC	
Dec 2014	Eureka Creek tilapia infestation — a threat to western drainages	Invasive Animals CRC www.pestsmart.org.au/eureka-creek-tilapia-infestation	Invasive Animals CRC	
Jan 2015	IA CRC product status update	Invasive Animals CRC www.pestsmart.org.au/iacrc-product-status-update	Invasive Animals CRC	2.C.4
Apr 2015	Mallee recovery project	Invasive Animals CRC www.pestsmart.org.au/mallee-recovery-project	Invasive Animals CRC	2.C.11e
Jun 2015	Glovebox guide for managing feral pigs	Invasive Animals CRC www.pestsmart.org.au/glovebox-guide-for-managing-feral-pigs	Koichi K & Halliday D	2.C.11e
Jun 2015	Feral pigs: a field guide to poison baiting	Invasive Animals CRC www.pestsmart.org.au/feral-pigs-a-field-guide-to-poison-baiting	Wishart J	2.C.11e

Table B3 Outcome 3: Recovery of key land and water regions from rabbits, wild dogs and carp

Publication date	Title	Publication	Authors	Output
Rabbits				
1.3 Article in scholarly refereed journal				
Jul 2014	Comparative quantitative monitoring of rabbit haemorrhagic disease viruses in rabbit kittens	*Virology* 11:109 http://dx.doi.org/10.1186/1743-422X-11-109	Matthaei M, Kerr PJ, Read AJ, Hick P, Haboury S, Wright JD & Strive T	3.L.4
Aug 2014	Rabbit haemorrhagic disease: virus persistence and adaptation in Australia	*Evolutionary Applications* 7(9):1056–1067 http://dx.doi.org/10.1111/eva.12195	Schwensow N, Cooke B, Kovaliski J, Sinclair R, Peacock D, Fickel J & Sommer S	3.L.5
Sep 2014	Increased virulence of rabbit haemorrhagic disease virus associated with genetic resistance in wild Australian rabbits (*Oryctolagus cuniculus*)	*Virology* 464-465:415–423 http://dx.doi.org/10.1016/j.virol.2014.06.037	Elsworth P, Cooke BD, Kovaliski J, Sinclair R, Holmes EC & Strive T	3.L.4
Sep 2014	The Australian public is still vulnerable to emerging virulent strains of West Nile virus	*Frontiers in Public Health: Epidemiology* 2:146 http://dx.doi.org/10.3389/fpubh.2014.00146	Prow NA, Hewlett EK, Faddy HM, Coiacetto F, Wang W, Cox T, Hall RA & Bielefeldt-Ohmann H	3.L.1
Dec 2014	Distribution and prevalence of the Australian nonpathogenic rabbit calicivirus is correlated with rainfall and temperature	*PLoS ONE* 9(12):e113976 http://dx.doi.org/10.1371/journal.pone.0113976	Liu J, Fordham D, Cooke B, Cox T, Mutze G & Strive T	3.L.1
Jan 2015	Timing and severity of immunizing diseases in rabbits is controlled by seasonal matching of host and pathogen dynamics	*Journal of the Royal Society Interface* http://dx.doi.org/10.1098/rsif.2014.1184	Wells K, Brook B, Lacy R, Cassey P, Mutze G, Peacock D, Sinclair R, Schwensow N, O'Hara R & Fordham D	3.L.2, 3.L.5
Mar 2015	Recovery of South Australian rabbit populations from the impact of rabbit haemorrhagic disease	*Wildlife Research* 41(7):552–559 http://dx.doi.org/10.1071/WR14107	Mutze G, Bird P, Jennings S, Peacock D, de Preu N, Kovaliski J, Cooke B & Capucci L	3.L.2, 3.L.5
May 2015	How Australia controls its wild rabbits: the use of two diseases and the search for another biocontrol agent	*The Wildlife Professional* http://wildlife.org/how-australia-controls-its-wild-rabbits/	Peacock D	3.L.5
May 2015	Book review: Australia's war against rabbits: the story of rabbit haemorrhagic disease	*Australasian Journal of Environmental Management* http://dx.doi.org/10.1080/14486563.2015.1023688	Cox T	3.L.1
Jun 2015	Expression and partial characterisation of rabbit haemorrhagic disease virus non-structural proteins	*Virology* 484:69–79 http://dx.doi.org/10.1016/j.virol.2015.05.004	Urakovaa N, Fresea M, Halla R, Liua J, Matthaeia M & Strive T	3.L.4
Jul 2015	Comparative phylodynamics of rabbit haemorrhagic disease virus (RHDV) in Australia and New Zealand	*Journal of Virology* http://dx.doi.org/10.1128/JVI.01100-15	Eden J, Kovaliskic J, Duckworth J, Swain G, Mahara J, Strive T & Holmes E	3.L.2, 3.L.3, 3.L.4

(continued)

Table B3 (continued)

Publication date	Title	Publication	Authors	Output
2.1 Conference paper — non-refereed proceedings				
Jul 2014	Evidence of increased virulence in rabbit haemorrhagic disease virus associated with genetic resistance in rabbits	16th International Congress of Virology, Montreal, Canada, 28 July – 1 August 2014	Strive T	3.L.4
Oct 2014	Biological control of vertebrate pests in Australia: past, present and future	Centre for Research into Therapeutic Solutions, University of Canberra	Strive T	3.L.4
2.2 Report				
Sep 2014	RHD-Boost: import and evaluate new rabbit haemorrhagic disease virus (RHDV) variants to strengthen rabbit biocontrol	Invasive Animals CRC www.pestsmart.org.au/rhd-boost	Invasive Animals CRC	3.L.1
Wild dogs				
1.2 Book chapter				
2014	Management of wild canids in Australia: free-ranging dogs and red foxes	In: A Glen & C Dickman (eds). *Carnivores of Australia: past, present and future*, CSIRO Publishing, Melbourne, pp 105–150	Fleming P, Allen B, Allen L, Ballard G, Bengsen A, Gentle M, McLeod L, Meek P & Saunders G	3.L.11
2014	Camera traps, sand plots and known events: what do camera traps miss?	In: P Meek, P Fleming, G Ballard, P Banks, A Claridge, J Sanderson & D Swann (eds). *Camera trapping in wildlife management and research*, CSIRO Publishing, Melbourne, pp 189–202	Ballard G, Meek P, Doak S, Fleming P & Sparkes J	3.L.11, 2.C.5
2014	Putting contemporary camera trapping in focus	In: P Meek, P Fleming, G Ballard, P Banks, A Claridge, J Sanderson & D Swann (eds). *Camera trapping in wildlife management and research*, CSIRO Publishing, Melbourne, pp 349–356	Meek P, Fleming P, Ballard G, Banks P, Claridge AW, Sanderson J & Swann DE	3.L.11, 2.C.5
1.3 Article in scholarly refereed journal				
Aug 2014	Recommended guiding principles for reporting on camera trapping research	*Biodiversity and Conservation* 23(9):2321–2343 http://dx.doi.org/10.1007/s10531-014-0712-8	Meek P, Ballard G, Claridge A, Kays R, Moseby K, O'Brien T, O'Connell A, Sanderson J, Swann DE, Tobler M & Townsend S	3.L.11, 2.C.5
Aug 2014	Does lethal control of top-predators release mesopredators? A re-evaluation of three Australian case studies	*Ecological Management and Restoration* 15(3):191–195 http://dx.doi.org/10.1111/emr.12118	Allen B, Lundie-Jenkins G, Burrows N, Engeman R, Fleming P & Leung L	3.L.13
Sep 2014	Sympatric prey responses to lethal top-predator control: predator manipulation experiments	*Frontiers in Zoology* 11:56 http://dx.doi.org/10.1186/s12983-014-0056-y	Allen B, Allen L, Engeman R & Leung LK-P	3.L.13

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Table B3 (continued)

Publication date	Title	Publication	Authors	Output
Sep 2014	The (non)effects of lethal population control on the diet of Australian dingoes	*PLoS ONE* 9(9):e108251 http://dx.doi.org/10.1371/journal.pone.0108251	Allen BL & Leung K-P	3.L.13
Oct 2014	Range-wide multilocus phylogeography of the red fox reveals ancient continental divergence, minimal genomic exchange and distinct demographic histories	*Molecular Ecology* 23(19):4813–4830 http://dx.doi.org/10.1111/mec.12898	Statham MJ, Murdoch J, Janecka J, Aubry KB, Edwards CJ, Soulsbury CD, Berry O, Wang Z, Harrison D, Pearch M, Tomsett L, Chupasko J & Sacks BN	*
Oct 2014	Camera traps can be heard and seen by animals	*PLoS ONE* 9(10):e110832 http://dx.doi.org/10.1371/journal.pone.0110832	Meek P, Ballard G, Fleming P, Schaefer M, Williams W & Falzon G	3.L.11
Dec 2014	Effects of sex and reproductive state on interactions between free-roaming domestic dogs	*PLoS ONE* 9(12):e116053 http://dx.doi.org/10.1371/journal.pone.0116053	Sparkes J, Körtner G, Ballard G, Fleming P & Brown W	3.L.11
Feb 2015	Interactions between two naturalised invasive predators in Australia: are feral cats suppressed by dingoes?	*Biological Invasions* 17(2):761–776 http://dx.doi.org/10.1007/s10530-014-0767-1	Allen BL, Allen LR & Leung K-P	3.L.13
Feb 2015	Resolving the value of the dingo in ecological restoration	*Restoration Ecology* 23(3):201–208 http://dx.doi.org/10.1111/rec.12186	Newsome T, Ballard G, Crowther M, Dellinger, J, Fleming P, Glen A, Greenville A, Johnson C, Letnic M, Moseby K, Nimmo D, Nelson M, Read J, Ripple W, Ritchie E, Shores C, Wallach Arian, Wirsing A & Dickman C	3.L.11
Feb 2015	The history of wildlife camera trapping as a survey tool in Australia	*Australian Mammalogy* 37(1):1–12 http://dx.doi.org/10.1071/AM14021	Meek P, Ballard G, Vernes K & Fleming P	3.L.11
Feb 2015	The pitfalls of wildlife camera trapping as a survey tool in Australia	*Australian Mammalogy* 37(1):13–22 http://dx.doi.org/10.1071/AM14023	Meek P, Ballard G & Fleming P	3.L.11
Mar 2015	More buck for less bang: reconciling competing wildlife management interests in agricultural food webs	*Food Webs* 2 (March 2015):1–9 http://dx.doi.org/10.1016/j.fooweb.2014.12.001	Allen BL	3.L.13
Mar 2015	Dingoes are a major causal factor for the decline and distribution of sheep in Australia	*Australian Veterinary Journal* 93(4):90–92 http://dx.doi.org/10.1111/avj.12311	Allen BL & West P	3.L.13
Jun 2015	Canine rabies in Australia: a review of preparedness and research needs	*Zoonoses and Public Health* 62(4):237–253 http://dx.doi.org/10.1111/zph.12142	Sparkes J, Fleming P, Ballard G, Scott-Orr H, Durr S & Ward M	3.L.11

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Table B3 (continued)

Publication date	Title	Publication	Authors	Output
2.1 Conference paper — non-refereed proceedings				
Jul 2014	Helminth infections in peri-urban wild dogs and foxes	Zoonoses Conference 2014, Brisbane Exhibition Centre www.asid.net.au/resources/zoonoses-posters-and-presentations/posters	Harriott L, Gentle M, Traub R, Soares Magalhaes RJ & Cobbold R	3.L.13
Dec 2014	Defining patterns, grazing density and vigilance behaviour of macropods using camera traps	Proceedings of the 27th Australasian Wildlife Management Society Conference, Brisbane www.awms.org.au/assets/docs/Proceedings/awms14proceedings_brisbane.pdf	Morgan H, Ballard G, Fleming PJS & Vernes K	3.L.11
Dec 2014	Distribution and density of water mice along the Maroochy River system of south-east Queensland, Australia	Proceedings of the 27th Australasian Wildlife Management Society Conference, Brisbane www.awms.org.au/assets/docs/Proceedings/awms14proceedings_brisbane.pdf	Kaluza J, Donald RL, Gynther I, Leung LK-P, Allen BL	3.L.13
2.3 Guide/fact sheet				
Aug 2014	FAQ: Wild dog impacts	Invasive Animals CRC www.pestsmart.org.au/pestsmart-wild-dog-impacts-faq	Invasive Animals CRC	3.L.14
Aug 2014	FAQ: Wild dog behaviour & ecology	Invasive Animals CRC www.pestsmart.org.au/pestsmart-wild-dog-ecology-faq	Invasive Animals CRC	3.L.14
Mar 2015	FAQ: Wild dog biology, behaviour & ecology (revised)	Invasive Animals CRC www.pestsmart.org.au/pestsmart-wild-dog-ecology-faq	Invasive Animals CRC	3.L.14
Mar 2015	FAQ: Wild dog home ranges and movements	Invasive Animals CRC www.pestsmart.org.au/faq-wild-dog-home-ranges-and-movements	Invasive Animals CRC	3.L.14
Mar 2015	FAQ: Wild dogs and poison baiting	Invasive Animals CRC www.pestsmart.org.au/faq-wild-dogs-and-poison-baiting	Invasive Animals CRC	3.L.14
Apr 2015	FAQ: PAPP for wild dog and fox control (revised)	Invasive Animals CRC www.pestsmart.org.au/papp-for-wild-dog-and-fox-control	Invasive Animals CRC	3.L.14
Jun 2015	Wild Dog Alert	Invasive Animals CRC www.pestsmart.org.au/wild-dog-alert	Invasive Animals CRC	3.L.11

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Table B3 (continued)

Publication date	Title	Publication	Authors	Output
European carp				
1.3 Article in scholarly refereed journal				
Aug 2014	Characteristics of cyprinid herpesvirus 3 in different phases of infection: implications for disease transmission and control	*Virus Research* 188:45–53 http://dx.doi.org/10.1016/j.virusres.2014.03.024	Sunarto A, McColl K, Crane M, Schat K, Slobedman B, Barnes A & Walker P	3.W.1
Mar 2015	Expression of immune-related genes of carp (*Cyprinus carpio*) during cyprinid herpesvirus 3 infection	*Diseases of Aquatic Organisms* 113:127–135, doi:10.3354/dao02824	Sunarto A & McColl KA	3.W.1
2.2 Report				
Jul 2014	Review of the literature on cyprinid herpesvirus 3 (CyHV-3) and its disease	Invasive Animals CRC www.pestsmart.org.au/literature-review-cyhv3	McColl K	3.W.1
Jul 2014	Cyprinid herpesvirus 3 (CyHV-3): its potential as a biological control agent for carp in Australia	Invasive Animals CRC www.pestsmart.org.au/cyhv3-potential-as-a-biological-control-agent-for-carp-in-australia	McColl K & Crane M	3.W.1
Oct 2014	Forum proceedings: carp management in Australia — state of knowledge	Invasive Animals CRC www.pestsmart.org.au/forum-proceedings-carp-management-in-australia-state-of-knowledge	Fulton W & Hall K (eds)	3.W.1
Apr 2015	Effectiveness of carp removal techniques: options for local governments and community groups	Invasive Animals CRC www.pestsmart.org.au/effectiveness-of-carp-removal-techniques	Norris A, Hutchison M, Chilcott K & Stewart D	
Other				
1.3 Article in scholarly refereed journal				
Sep 2014	Dying to be clean: pen trials of novel cat and fox control devices	*International Journal of Pest Management* 60(3):166–172 http://dx.doi.org/10.1080/09670874.2014.951100	Readab J, Gigliotti F, Darby S & Lapidge S	
Sep 2014	Assessing risks to non-target species during poison baiting programs for feral cats	*PLoS ONE* 9(9):e107788 http://dx.doi.org/10.1371/journal.pone.0107788	Buckmaster T, Dickman C & Johnston, M	4.E.21
Dec 2014	Do fecal odors from native and non-native predators cause a habitat shift among macropods?	*Wildlife Society Bulletin* 39(1):159–164 http://dx.doi.org/10.1002/wsb.509	Cox T, Murray P, Bengsen A, Hall G & Li X	*
Jan 2015	Cats (*Felis catus*) are more abundant and are the dominant predator of woylies (*Bettongia penicillata*) after sustained fox (*Vulpes vulpes*) control	*Australian Journal of Zoology* 63(1):18–27 http://dx.doi.org/10.1071/ZO14024	Marlow N, Thomas N, Williams A, Macmahon B, Lawson J, Hitchen Y, Angus J & Berry O	*
Mar 2015	How many are there? The use and misuse of continental-scale wildlife abundance estimates	*Wildlife Research* 41(6):473–479 http://dx.doi.org/10.1071/WR14059	Hone J & Buckmaster T	

Table B4 Outcome 4: Social networks and institutional 'architecture' strengthened around pest animal control

Publication date	Title	Publication	Authors	Output
1.3 Article in scholarly refereed journal				
Jul 2015	Applying behavioral theories to invasive animal management: towards an integrated framework	*Journal of Environmental Management* 161:63–71 http://dx.doi.org/10.1016/j.jenvman.2015.06.048	McLeod L, Hine D, Please P & Driver A	4.E.2
May 2015	Dimensions of local public attitudes towards invasive species management in protected areas	*Wildlife Research* 42:60–74 http://dx.doi.org/10.1071/WR14122	Ford-Thompson A, Snell C, Saunders G & White P	
2.1 Conference paper — non-refereed proceedings				
Apr 2015	Tasmanian cat management	National Feral Cat Management Workshop, Canberra	McLeod L	4.E.4
2.2 Report				
Aug 2014	Understanding the capacity of NRMs to manage invasive animal impacts: results from the 2013 National NRM Survey	Invasive Animals CRC www.pestsmart.org.au/2013-national-nrm-survey	Marsh J & Brown A	4.E.12
Nov 2014	Victorian Rabbit Management Collaboration Initiative	Invasive Animals CRC www.pestsmart.org.au/community-led-action-for-rabbit-management-in-victoria	Adams L	4.E.6
2.3 Guide/fact sheet				
Apr 2015	Behaviourally effective communications for invasive animals management: a practical guide	University of New England & Invasive Animals CRC www.pestsmart.org.au/behaviourally-effective-communications-for-invasive-animals-management	Hine DW, Please P, McLeod L & Driver A	4.E.2
2.6 Other IA CRC–related publications and reports				
	Online Toolbox for Community Engagement	Pennsylvania State University http://aese.psu.edu/research/centers/cecd/engagement-toolbox	Shufstall B, Whitmer W, Thompson L & Alter T	4.E.4
	Online audit tool for invasive animals communication	Software development	Driver A & Hine D	4.E.4
Quarterly — 3 issues	NRM Notes Newsletter	Invasive Animals CRC www.invasiveanimals.com/media-centre/newsletters	Marsh J	4.E.12

Acronyms and abbreviations

ACTA	Animal Control Technologies Australia
APVMA	Australian Pesticides and Veterinary Medicines Authority
CISS	Centre for Invasive Species Solutions
CRC	cooperative research centre
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CyHV-3	cyprinid herpesvirus 3
eDNA	environmental DNA
IA CRC	Invasive Animals Cooperative Research Centre
IAL	Invasive Animals Limited
IP	intellectual property
NSW DPI	New South Wales Department of Primary Industries
PAPP	para-aminopropiophenone
R&D	research and development
RD&E	research, development and extension
RHD	rabbit haemorrhagic disease
RHDV	rabbit haemorrhagic disease virus
SME	small-to-medium enterprise

Together, create and apply solutions

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