



Established and supported under the  
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# Annual Report

Invasive Animals Cooperative Research Centre

2007-2008







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Any views or opinions expressed do not represent the official view of the Invasive Animals CRC.



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## Guide to this report

'Year in review' provides the Chair and CEO's perspective on the past year and outlook for the future. Within this section, key events is a brief summary of defining moments of the past year – both achievements and challenges.

'About us' provides a snapshot of who we are, our role and functions, operating environment, organisation, the people who work for us and whom we work with. The organisational chart, information on our research program structure and aims, and detail on collaborations and links with other organisations is included in this section.

Under 'Research and education performance', we summarise the year's activities against the key goals identified in our Strategic Plan and which broadly fall within our research program structure.

The IA CRC also manages a number of demonstration sites around the country, whose role to boost uptake of our work (as well as fostering collaboration, providing trial sites/research opportunities and showcasing best practice management). For this reason, demonstration site projects (which are classed under goal 10 but have cross-program/other goal applications are reported on in a sub-section. Feral cats (goal 6) are likewise dealt with in a number of program areas.

'Business performance' contains information about our communications strategy and indicators of success, our commercialisations arrangements and intellectual property protection. Here you can find detail on products, services or other forms of technology transfer we have produced or provided. Our performance against project milestones follows.

'Financial information' is where you can find detail on the grants we received, and how we applied our funding.

Appendices to the report contain a glossary and a full publications list.

Additional information:

You can obtain contact information for staff involved in the projects and activities described in this report from our Communication Manager on:

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An electronic version of this report and other IA CRC publications can be accessed from our website at [www.invasiveanimals.com](http://www.invasiveanimals.com)

# Year in review



## Chair's Foreword

This CRC is led by a terrific Board with a wealth of valuable knowledge and experience. I would like to thank the directors for their strong commitment, and in particular the retiring Prof Joan Dawes for her incredible dedication and quality leadership to both this CRC and its predecessor. My thanks also to the CEO and staff for their commitment and assistance to the Board – a quality management team is integral to our success.

There is a lot to be proud of over the past year. The Vertebrate Pests Conference in Darwin was a huge success. It brought together most of the scientific and policy talent in Australia and epitomises the collaborative spirit being fostered by the CRC. The Board has been also very impressed with the quality of research being conducted. Building on the science from the PAC CRC we have delivered our first product in the field. The student cohorts are going well with three theses now submitted.

We have acquired new talents – Andreas Glanznig, with a wonderful management team, is taking on new challenges and Tom Heinsohn has become a good mentor to students. We continue our social and political influence, evidenced most recently by the Savannah Cat importation ban. Indeed, through achieving good media coverage, our social projects and demonstration sites, we have raised the profile of invasive vertebrate issues across the board.

The early indications from the new Australian Government are promising. The emerging framework for the new Caring for Country initiative recognises that effective national responses to invasive animals are central to conserving our biodiversity and natural icons.

There have also been a fair number of challenges, which have been impacting on our operating environment. These have included the ongoing drought and financial crisis for our industry end users. The experience in getting PIGOUT to market has also highlighted that streamlining of commercialisation/registration processes for new products needs to be a policy goal for the new government.

The CRC needs to succeed in delivering real solutions that result in on-ground reduction in invasive vertebrate impact. This depends on community and stakeholder engagement and remains a strategic challenge for our participants and program leaders. Real and timely outcomes will show that integrated approaches to invasive animal control are fundamental to both production and conservation landscapes.

For the year ahead, the Board will spend a great deal of energy on our third year review outcomes – the challenge is how we will balance process, outcomes and resources to generate a real and lasting legacy for the CRC in our remaining four years.

So let us keep our eye on the legacy, focusing on what we might summarise as 4 Ps:

Promise: the promise of good science

People: synergies among and between participants, end-users and the public policy makers – the team is definitely greater than the sum of the parts

Processes: new processes including education, interagency and landscape management

Pests: greatly decreased pest impacts – that's our promise



Above: Board Chair Helen Cathles.  
Below: Bilby at Scotia



Below: Bilby diggings, Scotia.  
Bottom: CEO and Board members visit Australian Wildlife Conservancy's sanctuary, Scotia Centre: Board member Atticus Fleming of AWC.  
Images by Tony Peacock.



## CEO's comment

The IA CRC has invested considerable resources to develop a more target-specific and humane means of baiting for pigs. This year we delivered against our goal to 'reduce the impact of feral pigs nationally by 15%', by launching PIGOUT® feral pig bait. This world first factory produced, shelf-stable product enhances the ability of land managers to reduce the significant damage caused by feral pigs – costing Australia's economy around \$106M annually. The product will be valuable should large numbers of pigs have to be controlled at short notice, such as in an exotic disease outbreak. This work was supported by Australia's red meat industries through Meat and Livestock Australia and was a collaborative effort with a range of state agencies across Australia – that is a major success story for the cooperative research centres model.

We have established a new international partnership, with US Company Senestech Inc., to trial a chemical infertility product to control rice field rats in Indonesia. The technology accelerates the natural reproductive ageing process in the rat resulting in sterility, and is an environmentally safe alternative to poison. If successful, this technology will result in increased food supplies globally, and an improved quality of life for hundreds of millions within a few years.

One of our researchers, Tanja Strive, has recently discovered a non-pathogenic 'RHDV-like' virus existing in some Australian rabbit populations, which gives a level of immunity. This discovery has important implications for management – explaining the patchy success of RHDV, and highlighting that reintroductions of the virus may need to be carried out more frequently in areas where the endemic virus is prevalent. A new freeze-dried RHDV product being developed by the CRC will assist with this.

Gains have been made against our goal of having nationally agreed and adopted codes of practice (COPs) for the humane control of feral animals. The Australian Animal Welfare Strategy managed by DAFF was jointly developed by national, state and territory governments, industry and the community. The Vertebrate Pests Committee commissioned us to identify impediments to adoption of these COPs across states and jurisdictions, and to refine the COPs to facilitate acceptance. We received funding from AAWS to run a workshop in Melbourne, develop a Regulatory Impact Statement for Humane Vertebrate Pest Control, manage the consultative process and revise the COPs.



*Professor Tony Peacock*

This year has also seen the development of a national system for up-to-date information on the distribution, abundance and impacts of invasive animals throughout Australia. The project was jointly funded by the IA CRC, the National Land and Water Resources Audit and NSW Department of Primary Industries (DPI). For the first time, we have a set of nationally agreed, standardised protocols for monitoring and reporting and maps (available on our website) of the distribution and abundance of 10 key pest animals.

Along with team members from the Bureau of Rural Sciences in the Australian Department of Agriculture, Fisheries and Forestry, and from Western Australia's Department of Food and Agriculture, the CRC has also developed and refined risk assessment models to help protect Australia and New Zealand from new exotic species establishing.

We also met an important education goal this year, by providing scholarships for stakeholders to attend a training project developed under our capacity-building objective through NSW DPI's Tocal College. The course offers vertebrate pest control officers nationally-recognised certification in Conservation and Land Management with a vertebrate pests speciality and credits prior learning and work experience. The first graduates received their certificates in March 2008.

The IA CRC also sponsors a module of six coursework units towards the Diploma in Conservation and Land Management through the University of Canberra College. Our first intake to this course was early 2008.



## Key events

Formation of the Rabbit Management Advisory Group (July 07)

Science meets Parliament: Brisbane (August 07)

Codes of Practice and Standard Operating Procedures for humane invasive animal control finalised (August 2007)

Launch of a new pest bird management guide (September 07)

Increasing rabbit numbers confirmed by IA CRC study (September 07)

National Wild Dog Management Facilitator appointed (October 07)

IA CRC Program Leader wins prestigious national science award (Dec 07)

Our new website is launched (February 2008)

Alien fish monitoring techniques report published (February 08)

Launch of a world first purpose-made feral pig bait: PIGOUT® (March 08)

First graduates from IA CRC-sponsored conservation management course (March 2008)

Benign endemic virus similar to calicivirus discovered in rabbits (April 08)

IA CRC hosts wildlife and exotic disease preparedness workshop (April 08)

National invasive vertebrate distribution and abundance maps produced (June 08)

CRC brings national focus onto issue of hybrid animal importations (June 08) leading to a draft risk assessment

Senestech partners with IA CRC to trial infertility control for rice field rats in Indonesia (June 08)

Updated risk assessment models for exotic vertebrate pests produced (June 08)

### First commercial product for the IA CRC

Launch of PIGOUT® at 'Majura Vale', Sutton NSW, on 31 March 2008.



(Top): Prof Staples hands the first PIGOUT® royalty cheque to Prof Tony Peacock. (Middle L to R): Quentin Hart, (BRS); Dr Colin Grant (BRS), Mr David Palmer (MLA), Dr Tony Peacock (IA CRC), Prof Linton Staples (ACTA). (Bottom): invited guests at 'Majura Vale'. Images courtesy of Kerryn Molloy, IA CRC.

## Major achievements

### Commercialisation/utilisation

#### Launch of a world first purpose-made feral pig bait: PIGOUT®

The IA CRC has invested considerable resources to improve control by developing a more target-specific bait for pigs. This commercial, shelf-stable bait, PIGOUT®, was launched on 31 March 2008. This product enables land managers to reduce the impact of feral pigs and will be of considerable benefit when large numbers of feral pigs have to be controlled at short notice, such as in an exotic disease outbreak. This work is supported by Australia's red meat industries through Meat and Livestock Australia and is a collaborative effort with a range of state agencies across Australia and the Commonwealth's Bureau of Rural Sciences (BRS). The pig bait development project links closely with our demonstration sites within the Uptake Program.

#### SenesTech partners with IA CRC to trial fertility control for rice field rats in Indonesia

A new chemical fertility control technology could substantially reduce the devastating impacts of rodents on rice production in developing countries. SenesTech, Inc., an Arizona US based corporation, has recently signed an international agreement with the IA CRC to enable the product to be trialled in Indonesia. The technology accelerates the natural reproductive ageing process in the rat, resulting in sterility or reproductive 'senescence', and is an environmentally safe alternative to poison. If successful, this technology will result in increased crop yields, an increase in food supplies globally, and an improved quality of life for hundreds of millions of people. CSIRO is leading this project.

#### Codes of Practice and Standard Operating Procedures for humane invasive animal control finalised

The Australian Animal Welfare Strategy (AAWS) was jointly developed by the Commonwealth, state and territory governments, industry and the community. One of its goals is to 'Achieve an enhanced national approach and commitment to ensure high standards of animal welfare...'. The Animals in the Wild Working Group of the AAWS identified implementation of nationally accepted Codes of Practice (COPs) for pest animal control as a top priority action.

NSW Department of Primary Industries (DPI) and Department of Environment, Heritage, Water and the Arts (DEWHA) had already developed some model COPs, adopted by the Commonwealth for management of land under its control. The Vertebrate Pests Committee (VPC) commissioned us to identify impediments to adoption of these COPs across states and jurisdictions, and to refine the COPs to facilitate acceptance nationally. We received funding from the Australian Animal Welfare Strategy to run a workshop in Melbourne, develop a Regulatory Impact Statement (RIS) for Humane Vertebrate Pest Control, manage the consultative process and revise the COPs. The RIS and revised COPs is presently with the VPC for consideration. The revised model COPs are available on our website.



PIGOUT®

*First pallet shipped to Queensland by ACTA (left).  
Pail showing rear label (right).  
Courtesy Paul Crock.*





## National invasive vertebrate distribution and abundance maps delivered

The IA CRC is taking part in a national-scale initiative that aims to improve monitoring and reporting on invasive animals, and develop a national system for up-to-date information on the distribution, abundance and impacts of key invasive animals throughout Australia. The project has been running since July 2005, and is jointly funded by the IA CRC, the National Land and Water Resources Audit (NLWRA), Land and Water Australia and NSW DPI.

The project has resulted in the first set of nationally agreed, standardised protocols for monitoring and reporting on invasive animals. It has also produced national maps (hosted on our website) that show the distribution and abundance of 10 key pest animals. Data-rich datasets of invasive species, maps of the potential range of these species, and case studies on a variety of their impacts have been produced. These outcomes will provide a benchmark from which managers can prioritise and monitor pest control activities, and make us better able to predict and respond to existing or emerging pest animal issues, including potential for disease outbreak.

## Strengthened biosecurity risk assessment models

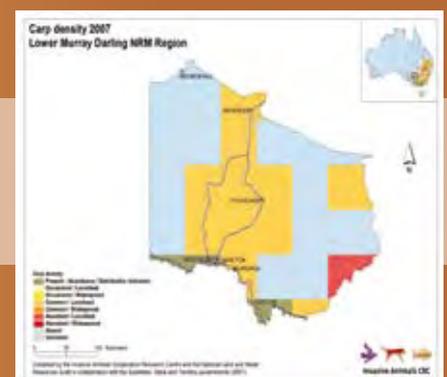
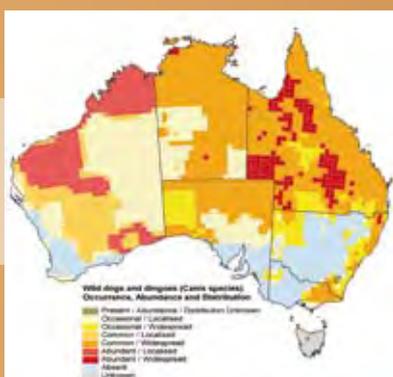
Along with team members from BRS in the Department of Agriculture, Fisheries and Forestry (DAFF) and the Western Australia's Department of Food and Agriculture, the CRC has developed and refined risk assessment models to help protect Australia and New Zealand from new exotic species establishing.

## Launch of a new pest bird management guide

Many bird species cause significant losses to the horticulture and viticulture industry in Australia. There was, however, very little objective management advice available to growers. Land managers particularly needed information on the increasing social, environmental and legal restrictions affecting available control techniques, particularly where native species were involved.

The IA CRC supported the development of national guidelines for managing pest birds. Titled, 'Managing bird damage to fruit and other horticultural crops', the guidelines were produced with funding from the BRS and launched by former Minister Eric Abetz in September 2007. This new reference provides growers with the most comprehensive compilation of Australian bird pest information available. The consultative process was extensive with support provided by NSW DPI, SA Department of Water, Land and Biodiversity Conservation, Horticulture Australia Ltd, the Grape and Wine Research and Development Corporation and the National Grape and Wine Industry Centre and the IA CRC.

*Invasive animal distribution and abundance maps have been produced at the (left) national; (middle) state; and (right) Natural Resource Management Region level.*



## Major achievements cont'd

### Alien fish monitoring techniques report published

The national Vertebrate Pests Committee (VPC) has recently become responsible for providing coordinated policy and planning solutions for exotic fish. The NLWRA has developed various indicators and standards for monitoring resource condition, under the National Monitoring and Evaluation Framework. The VPC has recommended that fish be included in the scope of the Australian Pest Animal Strategy, and the NLWRA agreed to produce a scoping study to identify issues and recommendations for monitoring and measurement procedures for fish distribution, abundance and impacts. The resulting report 'Review of alien fish monitoring techniques' produced with support by the IA CRC presents results from this scoping study.

### Major scientific breakthrough

#### Benign endemic virus similar to calicivirus discovered in rabbits

Scientists have known for some time that the effectiveness of the Rabbit Haemorrhagic Disease (RHD) virus was patchy, having less impact in the more humid and comparatively cooler regions of south-east Australia. One of our researchers, Tanja Strive of CSIRO, has recently confirmed suspicions that a non-pathogenic 'RHDV-like' virus exists in Australian rabbit populations, and which gives a level of immunity. She has identified a new calicivirus from wild rabbits using a universal lagovirus PCR test.

This discovery has important implications for management, for example, reintroductions of RHDV may need to be carried out more frequently in the areas where the endemic virus is prevalent. A new freeze-dried RHDV product being developed by the CRC will assist with this.

### Education

#### First graduates from IA CRC-sponsored conservation management course

The IA CRC provided eight scholarships to officers from Rural Lands Protection Boards, NSW Dept of Environment and Climate Change, ACT Environment and the Wild Dog Destruction Board to attend a skills recognition training project developed under our stakeholder capacity-building objective through NSW DPI's Tocal College. The course offers vertebrate pest control officers nationally-recognised certification in Conservation and Land Management with a Vertebrate Pests speciality. The objective of this training mode is to accredit people who have been practicing strategic management of vertebrate pests so that their work experience and knowledge is acknowledged at the appropriate level. Each candidate is independently assessed against common national criteria, and their Certificate can be used for career progression. Additional training needs and units for individual candidates can also be identified during their assessment.



*(Left): Diploma course (through University of Canberra College) participants – 1st intake 2008. Course developer Steven dalla Costa (IA CRC) is in the foreground right.*

*(Right): L to R: Ken Ryall, Tony Cathcart and Peter Fleming at Scotia (property of our participant Australian Wildlife Conservancy). Ken & Peter are RPL assessors from NSW DPI.*





The first graduates received their certificates in March 2008. All candidates were very impressive in their pest management roles and achieved competency in all units they undertook.

The IA CRC is also sponsoring a module comprising six out of the ten coursework units towards the Diploma in Conservation and Land Management through the University of Canberra College. Our first intake was early 2008.

## Fostering collaboration

### National Wild Dog Management Facilitator appointed

In October 2007, we sponsored the appointment of a position, operating out of the Queensland Department of Primary Industries and Fisheries office at Toowoomba, with the role of facilitating wild dog management nationally.

The appointee, Mr Greg Mifsud, has responsibilities for identifying current training programs, promoting the development of standardised and integrated strategic management plans, documenting successful and unsuccessful management case studies and highlighting priority areas for management and research for dingo conservation.

Greg works closely with staff involved in our north-east NSW and south-east Qld wild dog management demonstration site. He meets with industry groups, local Councils and dog advisory groups as an advocate for 'best practice' management. The first strategic wild dog management plans are currently being drafted.

### Formation of the Rabbit Management Advisory Group

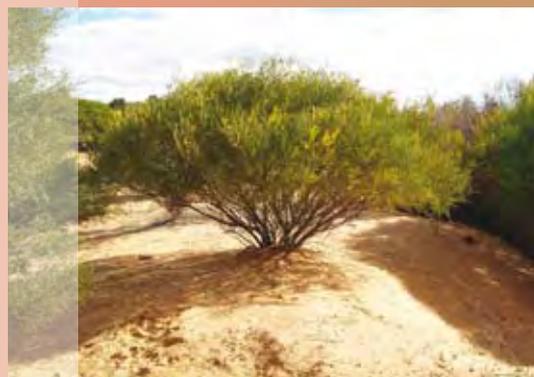
Following on from the work of Dr Brian Cooke, which confirmed that rabbit numbers were again increasing because of developing resistance to infection with RHD virus, the IA CRC along with Australian Wool Innovation Limited and Meat and Livestock Australia supported the establishment of a new Rabbit Management Advisory Group (RMAG). The group's brief is to align project design with research outcomes and farming practice. RMAG members, who include landholders, as well as industry and government representatives, also act as advocates, promoting projects and motivating farmers and industry to adopt newly-developed control technologies.

At present, RMAG is also seeking funding to support research for future biological control agents for rabbits.



*(Left): David Lord, Chair of RMAG on a ripped warren at his Broken Hill property. Image courtesy of David Lord.*

*(Right): Rabbit damage to acacia and understory, courtesy of Brian Cooke.*



## Major achievements cont'd

### Awards



Tarnya Cox with her UniQuest Trailblazers award

### IA CRC PhD candidate wins two student prizes

Tarnya Cox was the winner of a 2008 Society for Conservation Biology prize, in the best student presentation category. Tarnya received her award at the Vertebrate Pests Conference in Darwin in June.

Tarnya presented on her project 'carnivore odours as repellents – evolutionary, taxonomical and dietary effects'. This project is investigating whether repellent products that have been developed in the USA and Europe are applicable to vertebrate pest species. In particular, Tarnya has evaluated the effectiveness of eutherian (Tiger and Lion) and marsupial (Tasmanian Devil) carnivore odours in repelling goats and kangaroos. She is also evaluating dingo odours.

This achievement was followed by a UniQuest Trailblazer Award, in the student category. This prize is given for 'original, innovative early-stage research and entrepreneurial ideas' by the University of Queensland. Tarnya works out of the University of Queensland's School of Animal Studies at Gatton and is supervised by Peter Murray, Graham Hall, Andrew Tribe and Xiuhua Li.

### IA CRC Program Leader wins prestigious national science award

Dr Glen Saunders, leader of our Terrestrial Program, based at the Vertebrate Pest Research Unit (NSW DPI) at Orange, was the 20th Anniversary recipient of the Australian Wildlife Management Society's 'Caughley' Award.

Dr Saunders has made an outstanding contribution to many aspects of wildlife management in Australia, primarily in the field of pest animal management. His contribution to the field spans high level research, supervision of Masters and PhD students, policy development, advocacy and promoting best practice management of invasive animal damage.

Dr Saunders has been highly influential in setting national and state policy for best practice management of pest animals. He is Australia's foremost expert on foxes and their management, and was senior author on the recently published 'Improving Fox Management Strategies in Australia', supported by NSW DPI, the IA CRC and BRS. Glen was also a member of the team that reviewed fox management in Tasmania, and senior author of the resulting IA CRC report, 'Foxes in Tasmania: a report of an incursion by an invasive species', which was instrumental in spurring the development of an urgent action plan for eradication of the pest in that State. Dr Saunders also has extensive input into Australia's preparedness for managing exotic animal diseases and into setting policy and practice for the humane treatment of feral animals.



Dr Glen Saunders (left) receives his award from AWMS President Dave Forsyth



## The challenges

Our stated operational targets are very ambitious and rely on success at both research and adoption levels. Our response to this risk area is to ensure that every project established has strong and meaningful links to end-users and the project is targeted to achieving outcomes in a reasonable timeframe.

We changed our investment policy from a rolling three-year plan to a two-phase R&D strategy. This enables us to make better judgements about research progress and also take into account new developments. These include:

- the recent adoption of the Australian Pest Animal Strategy and the Australian Animal Welfare Strategy
- the increasing importance of Catchment Management Authorities (CMAs)/Natural Resource Management Boards (NRMBs) in pest animal management.

In relation to the former, animal welfare issues have been highlighted by our Board as potential risks to a number of our projects. We participated at the 2nd National Australian Animal Welfare Strategy Workshop held in October 2007 in Melbourne. We also had a representative on the Animals in the Wild Working Group, and committed resources to improving the national adoption of Codes of Practice for the humane control of feral animals. We continue to work closely with the Vertebrate Pests Committee and stakeholders to have these COPs adopted nationally.

In relation to the latter, we developed a unit to liaise with CMA/s/NRMBs and appointed a National Wild Dog Management Facilitator and a NRM liaison officer working out of the Vertebrate Pest management Unit in NSW DPI.

The continuing drought in much of Australia has impacted many of the IA CRC's participants. Obviously it is difficult for producers to participate in projects or adopt new technologies or methods during the constraints imposed by drought. Levies to participating R&D corporations were generally down, making it hard for them to provide financial support.

Funding constraints on several of our participants impacted the CRC. We were able to source additional cash and in-kind support to maintain or exceed our undertakings to the Commonwealth. However, a number of planned projects were adjusted to reflect changes in funding priorities. This led to implications for the selection and timing of the final set of projects for our 2nd phase investment strategy, and the development of a policy to 'share the pain' across our programs.

The IA CRC knew and planned for some of the reduced funding, but the continuing drought cut into some participant's income further during the reporting period.

Another impediment has been the regulatory hurdles that had to be passed before our first product, PIGOUT®, could be registered by the Australian Pesticides and Veterinary Medicine Authority. This process took longer than expected, but was ultimately successful. The CRC launched the product in March 2008 (see page 37). We did not anticipate that the State Pest Control Order would not be signed by the relevant NSW Minister until after the reporting period. Our impact was therefore reduced in 2007-08 through loss of a season's uptake in that state.

There was also a financial risk associated with the project EC470 'Development of Baits with Enhanced Canid Specificity'. The project is an exceptionally difficult one in terms of animal use approvals. Consequently, it fell significantly behind schedule and the CRC Board elected to invest more core funds and directly manage the project through our Commercialisation Manager. By year's end, the Board was satisfied that the project will deliver major outcomes to industry. However, these will be 2-3 years behind original targets.

Additionally, a number of CRC researchers were required to participate in the emergency response to equine influenza during the year. As a result, several CRC projects were impacted.

The Murray Darling Basin Commission's (MDBC) Native Fish Program also strengthened its work on invasive fish species (eg. MDBC appointed a full-time Pest Fish Manager) and this highlights the need for increased coordination. An independent review of our Program was conducted and also recommended closer links.

# About us





## Our major goals

Invasive animals are a huge problem all over the world, particularly in Australia. These animals cause at least \$720 million damage to Australia every year. About half the damage is to our farms and half to our environment. For example, Australia has the highest mammal extinction rate in the world, with invasive animals a major impact. The purpose of the Invasive Animals Cooperative Research Centre is to counteract the impact of invasive animals through the application of new technologies and by integrating approaches across agencies and jurisdictions.

For us, an 'invasive' animal is one with a backbone, and living in freshwater or on land, including birds. They can be native if a change in the ecosystem has caused their numbers to explode. The species we work on depends on the interests of our members.

Australia is particularly vulnerable to many exotic (and endemic) livestock diseases for which widespread populations of invasive animals are important potential sylvatic hosts. Our ability to develop appropriate contingency plans for exotic disease emergencies is directly influenced by the ongoing effectiveness of pest management strategies and knowledge of current distribution and abundance.

We have the following operational goals (to be delivered by 2012):

1. **A benefit of \$29 million p.a. by reducing the impacts of fox and wild dogs by 10%\*.**
2. **A benefit of \$16 million p.a. by reducing feral pig damage by 15%.**
3. **A benefit of \$7 million p.a. by reducing rodent damage by 20%.**
4. **A capacity to deliver improved quality and availability of inland water through reduced impacts and rates of spread of carp and other pest fish species.**
5. **Deliver innovative, practical control measures against cane toads.**
6. **Reduced impact of feral cats over five million hectares.**
7. **Increased agricultural profitability through improved integration of existing biological, conventional and newly developed control options for rabbits.**
8. **Reduced risk of disease transfer from invasive animals to livestock and humans.**
9. **Reduced risks of economic losses, environmental damage and social stress by forecasting and responding to potential, new, expanding or emerging invasive animal problems.**
10. **Growth in Australian invasive animal pest control industries. Through industry collaboration on the registration, marketing, export and community uptake of new products the CRC will enhance control of problem species.**
11. **Increased professional and practical skills base in invasive animal management through education, training and community awareness.**
12. **Established national and local benchmarks for invasive animal impact, density and distribution from which performance on delivery of all outcomes can be assessed; and**
13. **Efficiently manage resources to achieve the CRC's research, education, commercialisation and technology transfer outcomes.**

\* Percentage improvements refer to Australia; benchmarked.

## Our operating environment

The Commonwealth of Australia, by the provision of financial assistance under the Cooperative Research Centres Program, aims to enhance the scientific and technological capabilities of Australia and support linkages between researchers, and between researchers and users of research. As a prerequisite to receiving this funding, the Invasive Animals CRC and 41 participant organisations signed a Participant's Agreement, executed 13 September, 2005.

The Participants' Agreement defines the partnership, the governing structure, general principles and the Activities to be carried out. Activities are structured under Outcomes (which relate to our 13 goals). Milestones to be met by agreed dates are delegated to one of five Program areas. Four of these are concerned with research and commercialisation: Terrestrial Products and Strategies; Freshwater Products and Strategies; Detection and Prevention and Uptake of Products and Strategies. The fifth, our Education Program, manages a portfolio of projects which are undertaken by postgraduate students appointed and supported by the CRC. This Program also provides additional skills training to our postgraduate students and manages the development of modules for stakeholder and school student education.

Under each Program area, projects have been implemented to address each Outcome and its suite of milestones (Figure 1).

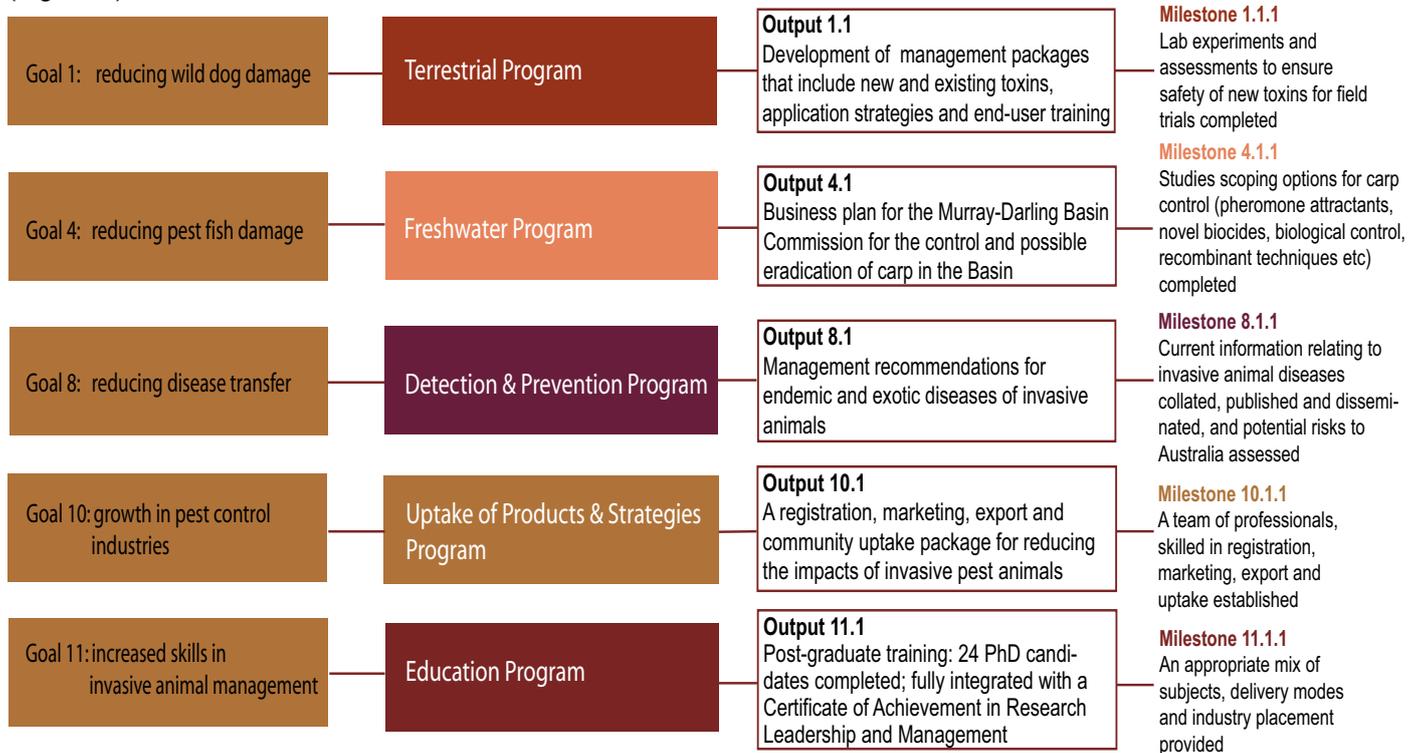


Figure 1: IA CRC goal to project milestone structure

## Australian Government's National Research Priorities

Most of the IA CRC's activities address the National Research Priority 'Safeguarding Australia'. Under this Priority, we directly work towards the goal 'protecting Australia from invasive diseases and pests'. Approximately twenty percent of our activities also contribute to the goal of achieving 'sustainable use of Australia's biodiversity'.

The CRC's research brief mirrors the government's objective of 'counteracting the impact of invasive species through the application of new technologies and by integrating approaches across agencies and jurisdictions'. Reducing the impact of invasive animal pests must be achieved by a combination of technological advances and enhanced on-ground application. This requires partnership between the public and private sectors:



- **The public sector manufactures and markets pest control products and manages our primary production industries.**
- **Public sector research agencies undertake most pest animal research and public sector land management is responsible for almost one quarter of Australia’s land area.**

No individual land manager or agency carries the whole invasive pest animal problem, but all are responsible for making a contribution and a commitment to the solution. State and federal agriculture and natural resource management agencies have a significant role in managing public land and in supporting farmers, graziers, conservation managers and foresters in their efforts to control terrestrial invasive animals. Individual land managers often work to reduce on-site impacts, but the mobility and stealthy nature of these animals makes their local eradication difficult, if not impossible. Similarly, river systems interconnect as do their fish populations. Management of a pest fish in one catchment is meaningless if the pest can quickly recolonise adjacent, unmanaged catchments.

Invasive Animals CRC aims to make an impact via its member organisations. Our members want to improve their innovation rate. They need knowledge in a useable form – synthesized, packaged, and communicated with context. The CRC works at the applied end of the innovation spectrum, providing the ‘glue’ for our members to work together and share information on agreed priority species. We bring members together, provide an environment and resources to be creative, and recognise and reward innovation.

The CRC’s goal is to create new tools and strategies to assist partners in their job. However, the development of tools is not sufficient. The CRC’s aim is adoption and therefore new controls must be:

- Socially acceptable
- Ecologically effective
- Commercially viable

The CRC’s broad membership assembles a unique partnership, creating critical mass to address this national priority — it brings together private and public land managers to integrate approaches to invasive animal management. The CRC is committed to delivering the means to deal with existing high profile invasive animal pests as well as those that have the potential to cause catastrophic impacts in the future.

*Table 1: National research priorities and CRC research*

<b>AN ENVIRONMENTALLY SUSTAINABLE AUSTRALIA</b> – <i>Transforming the way we use our land, water, mineral and energy resources through a better understanding of environmental systems and using new technologies</i>	
Sustainable use of Australia’s biodiversity	20
<b>SAFEGUARDING AUSTRALIA</b> – <i>Safeguarding Australia from terrorism, crime, invasive diseases and pests, and securing our infrastructure, particularly with respect to our digital systems</i>	
Protecting Australia from invasive diseases and pests	80



Who we are

Organisational chart

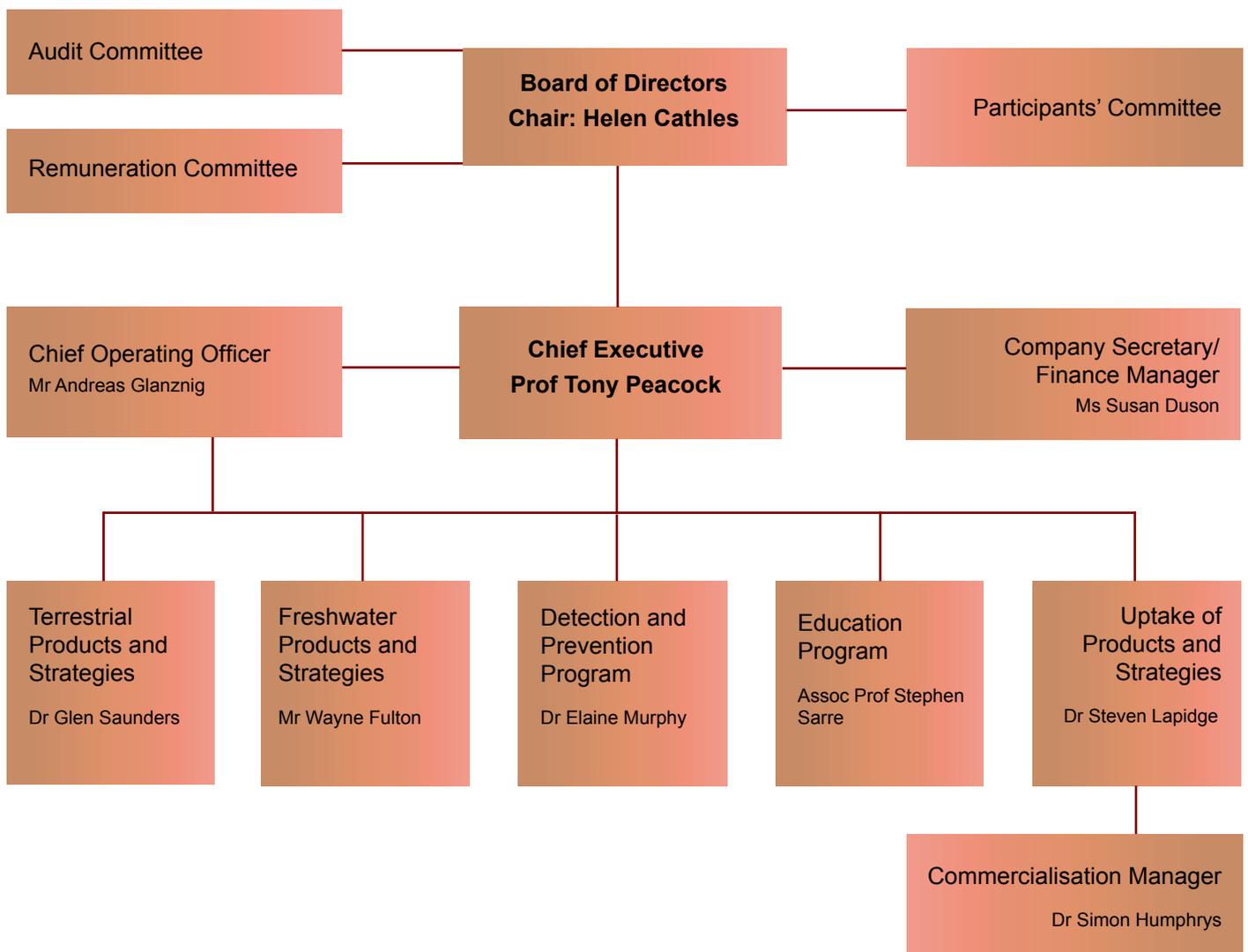


Figure 2: IA CRC organisational chart

## Our partners

Animal and Plant Control Commission of South Australia  
Animal Control Technologies Australia Ltd  
Australian National University  
Australian Veterinary Association Ltd  
Australian Wildlife Conservancy  
Australian Wool Innovation Ltd  
Bureau of Rural Sciences  
Carpbusters Inc  
Cattle Council of Australia  
Central Science Laboratory, UK  
Commonwealth Scientific and Industrial Research Organisation  
Connovation Pty Ltd  
Environment ACT (now under Territory & Municipal Services)  
Grains Research and Development Corporation  
K&C Fisheries Global Pty Ltd  
Landcare Research International Ltd  
Meat and Livestock Australia Ltd  
Murray-Darling Basin Commission  
New South Wales Department of Environment and Climate Change  
New South Wales Department of Primary Industries  
New Zealand Department of Conservation  
Parasitech  
Pestat Ltd  
Queensland Department of Natural Resources and Water  
Queensland Department of Primary Industries and Fisheries  
South Australian Department of Land, Water and Biodiversity  
Conservation  
South Australian Research and Development Institute  
State Council of Rural Lands Protection Boards  
Tasmanian Department of Primary Industries, Water and Environment  
University of Canberra  
University of Minnesota  
University of Newcastle  
University of Queensland  
University of Sydney  
University of Western Australia  
University of York  
ValueMetrics Australia  
Victorian Department of Primary Industries  
Victorian Department of Sustainability and Environment  
Western Australian Department of Environment and Conservation  
World Wildlife Fund



Who we are cont'd

Board

NAME	ORGANISATION	POSITION/ROLE	KEY SKILLS
Ms Helen Cathles	Primary Producer	Chair	Primary production
Dr Dedee Woodside	Consultant	Director, Deputy Chair	Communications, social sciences
Mr Atticus Fleming	Australian Wildlife Conservancy	Director	Conservation
Mr Chris Hancock	Aarnet Ltd.	Director	Business relations, risk analysis
Dr Helen Scott-Orr	NSW Department of Primary Industries	Director	Disease and animal health research
Prof Joan Dawes	Pestat Ltd	Director	Commercialisation
Dr Mark Lonsdale	CSIRO	Director	R&D management, pest animals



## Our people

### Directors

#### **Helen Cathles – Chair**

Helen is a grazier running a 4000 ha property at Wee Jasper, NSW, producing fine/superfine Merinos and Angora goats as well as operating a farmstay business. Helen has previously owned and managed a sheepskin manufacturing and retailing business that supplied both domestic and small export markets. She has taught manufacture of sheepskin techniques in North Korea.

Helen liaises effectively with a range of stakeholders from all levels of Government to local communities. Her skills lie in coordination and bringing people together. She has extensive knowledge of wild dog impacts and their cooperative management, having initiated and chaired a steering committee to establish a south-east NSW and ACT Wild Dog Management Project. This was the forerunner to the Brindabella Wee Jasper Wild Dog and Fox Management Plan.

#### **Dedee Woodside – Deputy Chair**

Dedee has experience in strategic planning, policy development, change, risk and project management. She is also skilled at negotiation and facilitation (cross-sectoral, national and international), as well as training and capacity building. Her experience has included integrated agricultural land use and natural resource management. She has conducted environmental and biodiversity assessment management and planning. Dedee is skilled at communication and education aimed at community, government and business as well as brokering scientific and government policy information to businesses and communities.

Dedee holds a BSc (Hon) Carleton University, Ottawa, Canada and a PhD from ANU. She has also participated in a Post graduate Program for Change Management (AGSM, Sydney) and Executive Management Training, NSW Public Service. She is a Member of the Australian Institute of Company Directors.

#### **Joan Dawes**

Joan has extensive experience in the commercialisation of research and managing the interface between the different cultures of public sector research and the business community. She also has skills in business planning, market analysis, intellectual property management and the assessment of the quality and potential of research programs and personnel.

Joan has worked on developing, leading and managing research programs in the UK, USA and Australia. She has had long-term active involvement with wildlife rescue and rehabilitation, involving in-depth knowledge of Australian wildlife in the urban environment and its interaction with humans, and has a deep understanding of animal ethics issues. Joan holds a BA, MA, DPhil (Oxon).

#### **Atticus Fleming**

Atticus is currently managing the Australian Wildlife Conservancy, a national, non-profit organisation dedicated to wildlife conservation (25 staff, operational budget of \$2.75 million, 12 sites covering 595,000 hectares around Australia). He holds an LL.B and a B.Comm (UNSW) and has extensive experience in strategic planning, financial management, human resource management, implementation of compliance systems and other aspects of administering a national organisation. Atticus also has skills in designing and overseeing the implementation of national environmental policies and programs, and experience in supervising the development and implementation of field-based research programs, including programs dealing with feral animal control.

Atticus has spent a lot of time liaising and negotiating with governments, researchers, industry, land managers and the community on a wide range of environmental issues. He has a comprehensive understanding of biodiversity and natural resource issues, and experience in dealing with relevant legal issues, including environmental and corporate law.



Who we are cont'd

## Directors cont'd

### Chris Hancock

Chris was appointed to the position of Chief Executive Officer, AARNet Pty Ltd at the beginning of 2004. AARNet provides high-capacity leading edge internet services for the tertiary education and research sector communities and their research partners in Australia. Prior to joining AARNet, Chris held the position of Managing Director of the Wholesale Division and prior to that as Managing Director of the Business Division at Optus, Australia's 2nd largest telecommunications provider.

Chris has more than twenty years' experience in senior leadership and executive positions, including the last 14 years in both the media and telecommunications sectors, holding senior executive roles at both Vodafone and the Seven Television Network. He is an active member of the community and sits on other Australian boards with organisations such as the Starlight Foundation, Internet Industry Association and Charles Sturt University.

Chris holds a BA from Charles Sturt University and an Executive MBA from the Australian Graduate School of Management.

### Mark Lonsdale

Mark is currently the Chief of CSIRO Entomology. He has experience in working on biological invasions, ecological implications of GMOs, biosecurity, environmental risk assessment, biological control of weeds, and plant population ecology. He has coordinated CSIRO's research program on ecological implications of GMOs and chaired the Global Invasive Species Program.

Mark is a member of the Editorial Board (Biological Invasions) and the Editorial Board (Journal of Applied Ecology). He has previously also been a member of the Global Change in Terrestrial Ecosystems program.

Mark holds a PhD in plant ecology (1982) and a BSc. Hons in biology (1978) and is also a graduate of the Australian Institute of Company Directors.

### Helen Scott-Orr

Helen is presently the Director of Health Sciences, Strategic Alliances and Education, NSW Department of Primary Industries. She has a wide knowledge and experience of different Australian agricultural industries, and the local, national and international forces that impact on them. She also has an extensive knowledge of corporate governance, legal and financial experience (especially of CRCs) and government budgetary and change management.

Helen also has a background in leadership and management of agricultural and veterinary research, biosecurity, policy, extension, vocational education and information delivery. She is a qualified vet (BVSc.), holds a Dip. Bact. (Lond), and is a Fellow of the Australian Institute of Company Directors.

*Above from left to right: Board Chair Helen Cathles (left), Participant's Committee members; Dr Helen Scott-Orr with previous Chair Dr Peter Allen AM; Deputy Chair Dr Dedee Woodside with ACTA CEO Prof. Linton Staples; Helen Cathles with Terrestrial Program Leader Dr Glen Saunders and IA CRC Finance Manager Susan Duson.*

## Corporate



Prof Tony Peacock	Chief Executive Officer
Mr Andreas Glanznig	Chief Operating Officer
Dr Simon Humphrys	Commercialisation Manager
Ms Susan Duson	Finance Manager/Company Secretary
Ms Kerryn Molloy	Communications Manager
Ms Keryn Lapidge	Science Communicator

L to R (top): Tony Peacock, Andreas Glanznig, Simon Humphrys.  
(Bottom): Susan Duson, Kerryn Molloy, Keryn Lapidge.



## Staff changes

Mr Chris Buller retired as Business Manager/Company Secretary/Deputy CEO in September 2007. Mr Andreas Glanznig was appointed and the position retitled to Chief Operating Officer. Ms Susan Duson (Finance Manager) took over the Company Secretary responsibilities.

## IA CRC program leaders and coordinators

Dr Glen Saunders	NSW Department of Primary Industries, Orange	Program Leader, Terrestrial Products & Strategies; Research Leader, Vertebrate Pest Research Unit
Mr Chris Lane	NSW Department of Primary Industries, Orange	Program Coordinator, Terrestrial Products & Strategies
Mr Wayne Fulton	Victorian Department of Primary Industries, Snobs Ck	Program Leader, Freshwater Products & Strategies, Statewide Leader, Aquaculture & Freshwater Fisheries Sciences, Vic Dept of Primary Industries
Ms Kylie Hall	Victorian Department of Primary Industries, Snobs Ck	Program Coordinator, Freshwater Products & Strategies
Dr Elaine Murphy	New Zealand Department of Conservation	Program Leader, Detection & Prevention Program; Snr Scientist, Research & Development Group
Dr Wendy Henderson	Invasive Animals CRC, Canberra	Program Coordinator, Detection & Prevention Program
Dr Steven Lapidge	Invasive Animals CRC, Adelaide	Program Leader, Uptake of Products & Strategies
Ms Sascha Groeneweg	Invasive Animals CRC, Adelaide	Program Coordinator, Uptake of Products & Strategies
Assoc Prof Stephen Sarre	University of Canberra, Canberra, Applied Ecology Research Group	Program Leader, Education Program Wildlife Genetics Research Team Leader
Dr Thomas Heinsohn	Invasive Animals CRC, Canberra	Program Coordinator, Education Program.

## Our project leaders/scientists

### Invasive fish

Dr Ron Thresher – 4.F.3 – ‘Daughterless’ carp genetic project – CSIRO Marine & Atmospheric Research

Prof Peter Sorensen – 4.F.4 – sensory attractants for carp – University of Minnesota

Dr Dean Gilligan – 4.F.5 – identifying ‘hotspots’ of carp breeding activity in the MDB – NSW DPI

Dr Paul Brown – 4.F.6 – fish movement/tagging project – VIC DPI, Marine & Freshwater Systems

Dr Mark Crane – 4.F.7 – Koi herpesvirus – CSIRO Livestock Industries AAHL

Dr Graeme Allinson – 4.F.9 – fish biocides and delivery options – VIC DPI

Dr John Russell – 4.F.10 – Tilapia management – Qld Department of Primary Industries & Fisheries

Dr Michael Hutchinson – 4.F.11 – validating carp ageing techniques – Qld DPI & Fisheries

Dr Ben Smith – 4.F.12 – Achilles heel exploration of innate carp behaviours – SARDI (push traps)

Dr Simone Rochfort – 4.F.13 – identifying isolating natural environmental attractants – VIC DPI.

Mr Peter West – 9.D.5 – alien fish monitoring techniques – NSW DPI.

### Invasive birds

Mr John Tracey – 9.T.2 – improving pest bird management – NSW DPI Vertebrate Pest Research Unit.

### Cane toads

Prof Rob Capon – 5.T.2 – toad pheromones and toxins – University of Queensland IMB

Prof Rick Shine – 5.T.1 – cane toad ecology – parasite work – University of Sydney ‘Shine Lab’

Prof Peter Koopman – 5.T.3 – ‘Daughterless’ cane toads – University of Queensland IMB.

### Feral Pigs

Prof Iain Gordon – 10.U.6 – control of feral pigs in tropical rainforest – CSIRO sustainable ecosystems

Dr Steven Lapidge – 2.U.1 – rollout of pig control solutions – IA CRC Uptake Program, Adelaide.

### Wild rabbits

Dr Tanja Strive – 7.T.1 – improving effectiveness of RHD virus – CSIRO Entomology

Dr Brian Cooke – 7.T.3, 7.T.5 – biodiversity impact, RHD genetic resistance assessment.

### Wild dogs and foxes

Dr David Dall – 1.T.3 – canid bait trials – Pestat Ltd

Dr Peter Fleming – 1.T.4 – strategic management of canids – NSW DPI VPRU

Dr Stephen Lapidge – 10.U.3 – Tasmanian fox eradication project – IA CRC

Dr Glen Saunders – fox management – NSW DPI VPRU

Dr Oliver Berry – fox DNA mapping/tracking – University of WA

### Rodents

Prof Linton Staples – 3.T.2 – control on islands/intensive crops – Animal Control Technologies Aust.

Dr Chris Hardy – 3.T.3 – chemical fertility control – CSIRO Entomology.

Herbivores

Dr Lyn Hinds – 9.T.1 – oral delivery systems for fertility control – CSIRO Entomology.

### Data modelling

Dr Mary Bomford – 9.D.1 – validating /refining risk assessment models – BRS, DAFF

Mr Peter West – 12.D.1 – mapping the distribution and abundance of feral animals – NSW DPI VPRU

### DNA testing/PCR

Assoc Prof Stephen Sarre – markers for top carnivores, scat analysis – University of Canberra.

### Social science

Dr Gerard Fitzgerald, Fitzgerald Applied Sociology.

### Demonstration sites

Dr Pip Masters – 10.U.2 – island wide eradication project – Kangaroo Island NRM Board

Mr Paul de Tores – 10.U.1 – ‘Western Shield’ feral predator control – WA Dept of Conservation

Dr Andrew Norris – 10.U.8 – Logan/Albert catchment carp control – Qld DPI & Fisheries

Dr Gordon Friend – 10.U.4 – ‘Southern Ark’ fox control – VIC Dept of Sustainability & Environment

Dr Peter Fleming – 1.T.2 – ne NSW/ seQld wild dog strategic management – NSW DPI VPRU

Mr Don Fletcher – 10.U.10 – Mulligan’s flat ACT community engagement – TAMS – ACT govt.

## Our key scientists

The IA CRC draws on a wealth of scientific expertise. Our participant organisations provide personnel with skills across a broad range of sciences including chemistry, biochemistry, ecology and biology. CSIRO’s Marine and Atmospheric Research facilities in Hobart and Animal Health Laboratories in Geelong, as well as their Black Mountain facilities in Canberra all contribute. The University of Queensland’s Institute for Molecular Bioscience and Gatton field stations, the University of Sydney’s Biological Sciences department and Shine lab, and the University of Canberra’s Applied Ecology Research Group are examples of the centres of excellence in science that we are able to draw upon.

Many state governments also provide experts and facilities to the CRC. For example, we depend on the facilities of the Queensland Department of Primary Industries’ Robert Wicks Research Centre at Inglewood, the Victorian Department of Primary Industries fisheries division, and the South Australian government’s SARDI aquatic sciences organisation. Small/medium companies such as Pestat Ltd and Animal Control Technologies Australia are also important providers of expertise, especially in route-to-market.

## Our students

### Cohort 1 students (commenced 2006)

Name	Project	Partner
John Abramyan	'Daughterless' cane toads.	University of Qld
Andrew Bengsen	Control of feral pigs in tropical rainforest.	University of Qld
Tony Buckmaster	The response of feral cats to broad scale fox control measures in East Gippsland.	University of Sydney
Tarnya Cox	Assessing animal attractants and repellants.	University of Qld
Jennyffer Cruz-Bernal	Effects of fox control on abundance, survival and recruitment of the common brushtail possum.	University of Qld
Alex Diment	Interactions between predator reinvasion rates and thresholds of prey species response to fox control in south-eastern Australia.	University of Sydney
Amanda Elledge	Impacts of feral pigs on biodiversity in Australia's wet tropics.	University of Qld
Gwylim Haynes	Population genetics of carp in the Murray-Darling Basin.	University of Sydney
Eve McDonald-Madden	Modelling optimal monitoring techniques.	University of Qld
Maija Marsh	Social organisation of rabbits and the impact of RHDV.	University of York, UK
Carla Meurk	Critical considerations affecting uptake of feral pig management strategies in the wet tropics, North Qld	University of Qld

### Cohort 2 PhD students (commenced 2007)

Katie Doyle	Impact of increased predator presence through stocking on carp populations and the implications for management.	University of Qld
Aaron Elkins	Identifying and isolating natural environmental attractants for common carp control.	Australian National University
Peter Ellsworth	Host-parasite coevolution: Is genetic resistance developing in wild rabbit populations affected by the RHD virus?	University of Canberra
Jess King	Are wildlife and particularly wild canids associated with Neospora abortion in cattle? Investigating the prevalence, life cycle and risk to cattle and wildlife of <i>Neospora caninum</i> .	University of Sydney
Penelope Marshall	Economic and other social impacts of wild dogs and foxes.	University of Canberra
Lindsay McFarlane	Regulation and manipulation of sex in the carp <i>Cyprinus carpio</i> (L) – Exploring RNAi and microRNA pathways.	University of Qld
Tom Newsome	Strategic management of wild dogs: how it affects ecosystems in north-eastern NSW.	University of Sydney
Hayley Pearson	Understanding and mitigating domestic pig and invasive animal interactions.	University of Sydney
Kylie Singh	Conservation benefits resulting from the commercial use of kangaroos, feral goats and feral pigs in the Australian rangelands.	University of Canberra
Danielle Stephens	Improved dog control via DNA-based monitoring systems.	University of WA
Scott van Barneveld	Ecology behaviour and physiology of the highly invasive Australian lizard <i>Lamproholis delicata</i> .	University of Sydney



Our students from top left (Cohort 1): John Abramyan, Andrew Bengsen, Tony Buckmaster, Tarnya Cox, Jennyffer Cruz-Bernal, Alex Diment, Amanda Elledge, Gwylim Haynes, Eve McDonald-Madden, Maija Marsh, Carla Meurk. (Cohort 2, line 2): Katie Doyle, Aaron Elkins, Peter Ellsworth, Jess King, Penelope Marshall, Lindsay McFarlane, Tom Newsome, Hayley Pearson, Kylie Singh, Danielle Stephens, Scott van Barneveld (Cohort 3) Adriana Ford and linked student Megan Barney.

### Cohort 3 PhD students (commenced 2008)

Adriana Ford	People, pests and conflict: community participation in invasive deer management in Australia (social research).	University of York
<b>Linked student</b>		
Megan Barney	Sex differentiation and determination in Carp	University of Tasmania
<b>Honours student</b>		
Melissa Snape	Assessment of the effects of VCD, and of behavioural responses to novel bait items in the brush-tail possums.	Australian National University

## Our structure and management

The daily activities of the CRC are under the control of a full time Chief Executive Officer with responsibility for supervising the research portfolio and projects, preparing and submitting reports on progress and problems to the Board, recommending commercial or partnership opportunities, liaising with participant organisations and assessing priorities.

The Chief Executive Officer leads the Centre's communications, manages research operations and systems, and assists with governance. All company accounting falls under the jurisdiction of our Finance Manager, who also has Company Secretary responsibilities. Intellectual property management, compliance issues (for example, meeting the standards of the Australian Pesticides and Veterinary Medical Authority) and commercialisation is handled by our Commercialisation Manager. These personnel are all full-time employees of the CRC.

Our projects are structured under four research and one education program, each led by a manager (figure 2). Research program leaders (with the exception of our Uptake Program) are jointly employed by the CRC and one of our participant organisations.

Centre staff and equipment complement those of the participants and are deployed on projects at many nodes of research or administration. See 'Where we work' section (page 28) for more information on our sites.

## Research Program aims

### The Terrestrial Products and Strategies Program aims to:

- deliver national control strategies for foxes, wild dogs, herbivores, pest birds and feral pigs
- increase the effectiveness of Rabbit Haemorrhagic Disease
- provide tactical options by supporting research and development to register new management techniques and toxins, and commercial harvesting options for reducing the impact of pest wildlife
- enhance existing control methods
- examine emerging issues
- consider novel strategies and techniques to control pest impacts
- determine welfare-based solutions to pest animal management problems
- deliver national education and management packages.

### The Freshwater Research Products and Strategies Program aims to:

- deliver biocontrols as tools for national carp control, eg. 'Daughterless' technology (biasing sex ratios towards the development of male carp only, eventually leading to long term population control) and Koi herpesvirus (KHV)
- complete and release the CarpSim carp population simulation model for public use, and first generation tilapia population simulation model
- provide tactical options such as biocides
- examine sensory attractants for pest fish with potential applications for control
- develop a coordinated multi-state initiative to assess the ecological, behavioural and physiological weaknesses of invasive fish species, starting with carp, to evaluate best approaches for integrated pest fish control
- examine policy and legislative requirements towards delivering these products and strategies
- deliver national education and management packages.



### The Detection and Prevention Program aims to:

- develop and deliver information systems for early warning of potential or emerging pest species
- deliver information systems for demonstrating the distribution and abundance of key pest species
- inform policy and decision-making on priority management areas
- investigate and report on socioeconomic influences on vertebrate pest management
- update information on the social, economic and environmental impacts of pest animals in Australia.

### The Uptake of Products and Strategies Program:

- bridges the research-to-market gap by coordinating national and international registrations, commercialisation, market research and delivery of IA CRC market ready products to industry partners
- manages a network of demonstration sites to directly engage local communities and showcase new ways of managing invasive vertebrates
- facilitates 'best practice' management across tenures and disciplines.



Figure 2: Top, L to R: IA CRC Research Program Leaders Elaine Murphy, Glen Saunders, Steven Lapidge, Wayne Fulton  
Bottom, L to R: Program Coordinators Wendy Henderson, Chris Lane, Sascha Groeneweg and Kylie Hall.

## Where we work

The Invasive Animals CRC has 41 national and international partners comprising eight universities, two conservation organisations, 17 state or national bodies involved in natural resource management, research bodies and a suite of small-medium enterprises.

We operate or conduct research at numerous sites around Australia and overseas. Some of these sites are shown on the map below. Our international partners include the New Zealand Department of Conservation, Landcare Research (Manaaki Whenua), Connovation (NZ), The University of York and Central Science Laboratories (England), the United States Department of Agriculture and the University of Minnesota.

The IA CRC head office is at the University of Canberra. Other significant administrative nodes are at the New South Wales Department of Primary Industries' Vertebrate Pest Research Unit (Orange, NSW) and the Victorian Department of Primary Industries' Snobs Creek freshwater research centre on Lake Eildon in Victoria.

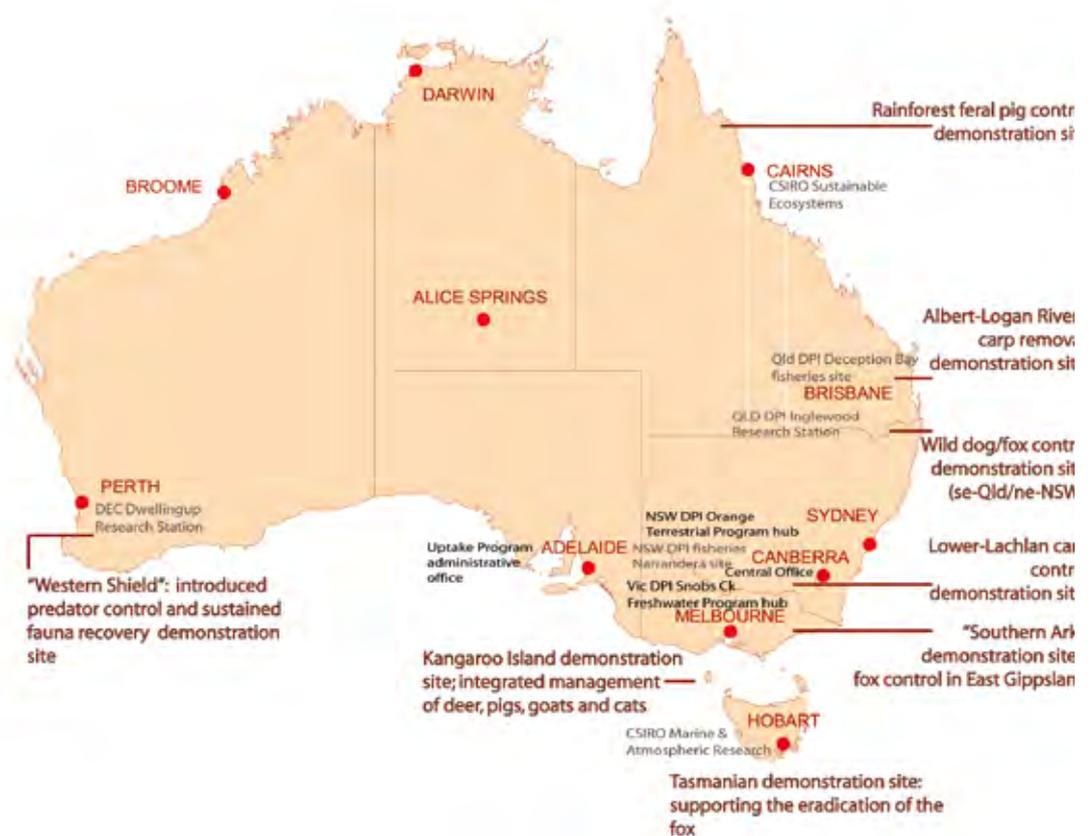


Figure 3: Map showing major IA CRC locations

Images: (top) Feral-proof fence at AWC's Scotia sanctuary, courtesy Tony Peacock; collecting scats in Tasmania, courtesy Steve Lapidge; field site for fish work near Lake Alexandrina, courtesy Roger Pech; feral goat mustering yard on Kangaroo Island, courtesy Steve Lapidge; banana plantation site for rat control in Queensland, courtesy of Michelle Smith; possum trap site in WA, courtesy Jennyffer Cruz-Bernal.

## Whom we work with

Collaborative links across the CRC are a major focus of activities given the very large number of parties involved. A compulsory investment criterion for every project funded is that at least two CRC participants are involved in the project, and at least one of these participants must be a technology end-user. Even when projects have a relatively long time frame and are close to the 'research' end of the 'research and development' spectrum, we believe the direct involvement of end-users is invaluable to achieving outcomes.

More than half the participants in the CRC are end-users of research. In setting up the CRC, the Board took the view that we would have low entry requirements (for example no entry fees) to encourage participation. Thus, our end-users are generally directly involved in many of the projects of interest to them, in an attempt to have a technology transfer process that is as seamless as possible. We believe the end-users improve the research process as well, so that technology or processes developed are more likely to be adopted.

## Summary of collaborations

### **Australian collaborations (including consultancies)**

Australian Animal Welfare Strategy – provided funding for camel research consultancy.  
Australian Hydatids Control & Epidemiology Program.  
Australian Wildlife Conservancy – trial sites.  
CSIRO – sharing of expertise, facilities, computer models.  
DEWHA – workshop development on exotic diseases.  
Desert Knowledge CRC – camel consultancy.  
Douglas Shire Council – participation in demo site trials.  
Kingfisher Research Pty Ltd – production/trial of cages.  
KI NRM board – field trial sites and staff.  
Lachlan & Central West CMAs – integrated wild dog management plans.  
Namoi Catchment – PestPlan workshop (March 2008).  
NLWRA – fish scoping study and invasive animal distribution and abundance mapping project.  
Robert Wicks Pest Animal Research Centre – facilities and animals for trial, shared research.  
SA NRM Boards (2) – establishment of local run trials.  
State Water Corporation (Vic) – access to water reserves.  
TAS DPIW – collaborative development of fox detection program.  
WA DEC – consultancy – community cane toad control report.  
VPC Secretariat – co-hosting a conference.  
WEDPP – co-hosting disease preparedness workshop.  
Wild dog control associations – development of wild dog management plans.  
Wet Tropics Management Authority – feral pig control in the Wet Tropics World Heritage Area.

### **International collaborations**

Central Science Laboratories UK – fertility control research; diagnostics for fox scat identification.  
Connovation NZ – PAPP and HOG-GONE® development.  
University of Minnesota – trialing of sensory attractants for carp.  
IZS (Brescia, Italy) – supplied monoclonal antibodies for ELISAs to confirm indigenous lagovirus.  
Fitzgerald Applied Sociology – social research project.  
INSERM (Nantes, France) – supplied rabbit DNA serology tools.  
Israel National Parks Authority – improving tools for wild pig management.  
Landcare Research NZ – development of new toxicant.  
NZ Department of Conservation – testing of PAPP.  
USDA – supply of GonaCon® for testing in Australian wallabies as a fertility control; testing of PIGOUT® baits; trials of CO fumigator.  
UK Dept of Environment, Food and Rural Affairs – product development and formulation expertise sharing.  
University of York – supervision of PhD candidates.  
SenesTech – agreement signed to enable ContraPest (fertility control for rats) to be trialled in Indonesia.

**Summary information on the major collaborations can be found on the following pages.**



## Whom we work with cont'd

### Collaborations with state government departments and natural resource management bodies

One of the strategic issues identified by the CRC's Board was that an emerging major end-user group was vital to the CRC's success. This was the regional natural resource bodies (catchment management authorities or natural resource management boards) who receive significant Australian Government funds to manage natural resources. All of these 56 bodies now have some degree of planning for feral animal management and are therefore interested in the CRC's activities. We have continued to build closer relationships with these important bodies by involving a few of them directly in projects. For example, our eradication work on Kangaroo Island is directly undertaken by employees of the KI natural resource management board.

This year, new linkages have been made with the Lachlan, Namoi and Central West CMAs, who have been engaged with the CRC through the work of our newly-appointed Natural Resource Management facilitator to work collaboratively on wild dog management plans in north-east NSW and south-east Queensland – see page 34. These CMA's have utilised the CRC's expertise to collaboratively produce vertebrate pest management plans for their regions. A similar arrangement has occurred with a number of Wild Dog Control Associations. Moona/Winterbourne, Niangala and Barnard River collaborated on management plans through our wild dog demonstration site.

The CRC has partnered with the Kangaroo Island NRM Board, and the SA Department of Water, Land and Biodiversity Conservation in the 'Repel the Invaders' project. This is an island-wide demonstration site attempting eradication of feral deer, goats, and potentially pigs and cats. Three Board employees work directly on the project full-time, with the CRC funding two of these. The Board provides an enormous amount of work in eradication efforts and also assists greatly in product development projects for our Uptake Program (feral pig and cat projects). Along with Kangaroo Island National Parks staff, the Board contributes personnel, infrastructure, vehicles and land access.

In the development of enhanced fox management tools, the Uptake Program leader has worked in association with the South Australian South-east and SA Arid Lands NRM Boards. Both Boards directly fund research involving the establishment of local land-holder run trials.

The Robert Wicks Pest Animal Research Centre (QDPIF, near Inglewood in southern Queensland) is the foremost large pest mammal research centre in Australia. This facility has been used for fox, wild dog and feral pig trials in the last year, as well as for rabbit RHD trials. The facilities and animals are provided at cost due to QDPIF being a CRC Participant. As all the CRC research conducted there aligns with the department's goals, it is a win-win collaborative research situation. Furthermore, during trials staff of the Centre greatly assist, which is direct in-kind from the department.

The Department of the Environment, Water, Heritage and the Arts was a collaborator in the Wildlife and Exotic Diseases Preparedness Workshop hosted by the CRC, as were representatives from the Australian Wildlife Health Network (DAFF).

The CRC works closely with the CSIRO on a number of projects. We are able to draw upon the significant infrastructure and resources of this organisation, including scientific and computer modelling expertise, laboratories, and fish and mammal keeping/breeding facilities. In return, the CRC is funding PhD and PostDoc students who provide research expertise and manpower to enable additional or extended research to take place.



We have continued to collaborate closely with the Tasmanian Department of Primary Industries and Water's Fox Eradication Branch throughout the year. The development of our genetic testing capability to allow accurate identification of fox DNA from scats has driven the scaling-up of eradication attempts in that State. The Fox Eradication Branch launched their 'Great Poo Pickup' this year, and collected samples are analysed at the IA CRC Wildlife Genetics lab in Canberra. Over 2,900 scats have been collected. PCR analysis and genotyping on extracted DNA has positively identified 19 samples as fox scat.

In a related project, we are working with the University of Western Australia to genotype over 3500 scat samples collected across Australia. These samples are assessed using 36 microsatellite DNA markers in an attempt to establish the sources of fox incursions into Tasmania. We have determined that foxes in Tasmania result from multiple independent entries (not breeding in situ alone). Population analysis aims to document genetic changes in the island's fox population over time.

Cooperative arrangements with the Desert Knowledge CRC have resulted in our being contracted to conduct an extensive desk-top review of biological, chemical and fertility control options for free-ranging camels in Australia.

State Water Corporation (VIC) is a key member of the Lower Lachlan demonstration site allowing access to water reserves for trial purposes. Carp trap trials also include staff from SA Research & Development Institute (SARDI), the Lachlan CMA, K & C Fisheries, Kingfisher Research and NSW DPI.

The Wet Tropics Management Authority (WTMA) has a strong relationship with our Uptake Program through our Daintree demonstration site which aims to thoroughly assess the social and environmental realities of feral pig management. We are working with the WTMA, Douglas Shire Council, Queensland Parks & Wildlife Service and the traditional owners of the land to quantify the impacts of feral pigs in a tropical rainforest and determine appropriate and potentially more successful management techniques. The research presents a unique opportunity for researchers and land managers alike so the latest management techniques can be trialled and deployed where they are most needed. Australian Wildlife Conservancy is also involved in this project via their Brooklyn Station property.

## Collaboration with national advisory committees

The IA CRC has strong collaborative links with the Vertebrate Pests Committee (VPC), whose role is to provide national coordination in policy, planning and overall strategies to address pest animal problems. We have a representative with observer status at the meetings. Additionally, the IA CRC is represented on the VPC fish working group and a number of state advisory committees including: WA Wild Dog Management Group; NSW Pest Animal Council; Macquarie Island Rodent and Rabbit Eradication Taskforce and the Tasmanian Fox Eradication Steering Committee.

This year, the Australasian Vertebrate Pests Conference was held in Darwin on 10-13 June 2008. This was the 14th in a series recommended by the VPC to showcase the latest research in the field. We played a significant role, working with OnQ conference support to organise and advertise the event, and acted as co-sponsors with the Northern Territory's Dept. of Natural Resources, Environment and the Arts. We also provided speakers, session chairs, media interviewees, an expo booth, graphic design services and produced the Proceedings document. This raised our profile with many of our stakeholders, as there were over 300 delegates in attendance representing international, government, semi-government and private organisations with an interest in vertebrate pest management.



## Whom we work with cont'd

The IA CRC has also supported (and has representatives on) the newly-formed Rabbit Management Advisory Group (RMAG). RMAG is also supported by Australian Wool Innovation Limited and Meat & Livestock Australia. The group's brief is to align project design with research outcomes and farming practice. RMAG members, who include land-holders, as well as industry and government representatives, also act as advocates, promoting projects and motivating farmers and industry to adopt newly-developed control technologies. At present, RMAG is also seeking funding to support research for future biological control agents for rabbits.

## Research exchange with international organisations

Dr Brian Cooke of the CRC travelled to Europe to maintain connections with collaborators on various RHDV projects in Italy, France, Spain, Portugal and Britain. With Dr Tanja Strive, CSIRO Entomology, presentations were given on the developing resistance to RHD virus in Australian rabbits and the isolation of a new non-pathogenic Australian lagovirus — both at the Istituto Zooprofilattico Sperimentale (IZS) in Brescia Italy and at a workshop on RHD in Nantes, France, co-hosted by the Institute National de Sante et Recherche Medical (INSERM) and the Office National de la Chasse (ONCF). Dr Cooke also visited and gave seminars at: Institut scientifique de recherche agronomique (INRA) Biological Control Unit, Sophia Antipolis, Antibes, France; Instituto de Investigación de Recursos Cínicos (IREC), Ciudad Real, Spain; Centre for Biodiversity Studies (CIBIO), Vairo, Portugal.

The IZS is the world reference laboratory for rabbit haemorrhagic disease and has supplied kits for serological analysis in Australia on a collaborative basis for many years. The scientists there, Drs L. Capucci and A. Lavazza, are now working closely with Dr Strive to further analyse and fully understand the properties of the newly discovered RHDV-like virus in Australia. CIBIO in Portugal is collaborating with CRC partners, the Animal and Plant Control Group in South Australia, on monitoring genetic changes to RHDV since its first release in Australia. Modelling of RHD epidemiology carried out in IREC and ONCF have also proved useful in developing ideas on the behaviour and evolution of RHDV in Australia.

The CRC has strong ties internationally with two PhD students based at the University of York in the UK. These students have completed field work in Australia with participant organisations.

Our fertility control research is a major international collaboration involving the Central Science Laboratory (CSL) in the UK, the US Department of Agriculture's Wildlife Research Centre and Landcare Research New Zealand. We have also been working with CSL developing on-site diagnostics for fox scat identification.

Our experience in product development and formulation has seen our Uptake program staff and Animal Control Technologies working collaboratively with the UK Department of Environment, Food and Rural Affairs on oral delivery of a tuberculosis vaccine to European badgers.

This year also saw a collaboration with the Israel National Parks Authority on improved tools for wild pig management.

The United States Department of Agriculture has been testing the CRCs PIGOUT® baits throughout the year for the purposes of delivering a combined pseudo-rabies and anti-fertility vaccine to wild hogs.

A collaboration has also commenced this year investigating the potential for the high-pressure carbon monoxide fumigator (being developed by the CRC for rabbits in Australia) to be used for control of pocket gophers in Mexico.



We enjoy a continuing collaboration with the NZ Department of Conservation on PAPP for feral cats, stoats and wild dogs. Work also continues with Landcare Research NZ on development of a new feral pig toxicant and with Connovation (a NZ small-medium enterprise) on PAPP and HOGGONE® development.

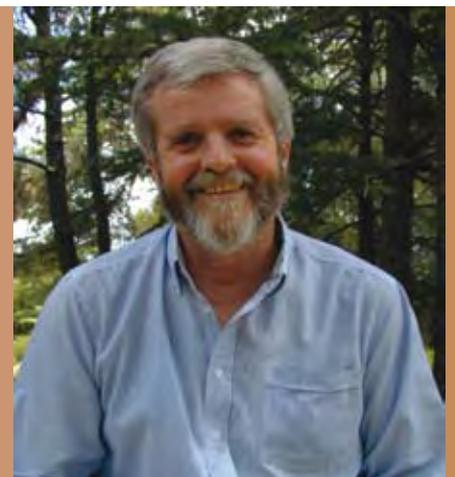
### Links with private research organisations

Kingfisher Research Pty Ltd is helping us produce and trial carp separation cages as part of an IA CRC project investigating 'Achilles heel' behaviours that can be exploited in control programs.

SenesTech's scientific team (a U.S. company) have developed an environmentally safe alternative to poison that can be used to sterilise the rice field rat. The technology accelerates the natural reproductive ageing process in the rat resulting in sterility or reproductive 'senescence'. These scientists, all from Northern Arizona University, have teamed up with Dr. Lyn Hinds from the IA CRC and CSIRO and Dr. Sudarmaji at the Indonesian Centre for Rice Research in Sukamandi to begin assessment of the product in Indonesian-based studies this spring. This collaboration is mutually beneficial, giving the CRC the exclusive rights across Australasia to commercialise a potentially promising technology for fertility control of pest animals (introduced feral and native overabundant species) that will reduce the need for lethal management practices.



*Left: seedling damaged by rabbits within a tree guard, courtesy Dr Brian Cooke.  
Right: Dr Brian Cooke.*



*Images at top L to R: land management workshop Dubbo; Goonoo rangers demonstrate GPS tracking results to Alex Diment; KI NRM Board staff with Education Program Leader Stephen Sarre (centre) and IA CRC PhD Students, courtesy Thomas Heinsohn; Snobs Creek Fisheries netting boat and facilities, courtesy Kylie Hall, Vic DPI; AWC staff member with our product Feralmone, courtesy Tony Peacock; Dr Brian Cooke researching at Hattah-Kulkyne National Park; CSIRO Hobart fish breeding facilities, courtesy Tony Peacock.*



## Whom we work with cont'd

### Collaboration with animal welfare agencies

The need for a national approach for achieving humane vertebrate pest control was identified by the RSPCA Australia at a national seminar, leading to a joint RSPCA/Australian Wildlife Conservancy/Vertebrate Pest Committee workshop in which we were a participant. Dr Glen Saunders, leader of our Terrestrial Program, was a key player and was involved in an initial project to develop draft Codes of Practice and Standard Operating Procedures, published by his organisation, NSW DPI. This association led to the CRC being commissioned by the VPC to work with stakeholders from a variety of state and national organisations to develop a Regulatory Impact Statement (RIS) for Humane Vertebrate Pest Control (see page 8). The RIS and revised Codes of Practice will be presented to VPC for endorsement in September 2008 and transmission to State/Territory authorities for inclusion in legislation. The revised model Codes of Practice are available on our website.

We have also worked with the Australian Registry of Wildlife Health (founded at Taronga Zoo), supporting proposals and other work to build a national information system, including information on wildlife health. The initiative also receives support from the Department of Agriculture, Fisheries and Forestry and the NSW National Parks & Wildlife Service.

### Collaboration with conservation groups

The Australian Wildlife Conservancy (AWC) allows the CRC access to its reserves to trial feral animal control strategies and techniques. One such project is developing operational-scale introduced predator control techniques for the semi-arid bioregions at AWC's Mt Gibson Station. This three-way collaboration includes the WA Department of Conservation's (DEC) recently-acquired adjacent pastoral leases of Karara and Lochada. This work is also supported by Alcoa World Alumina Australia (through WA DEC's Alcoa Forest Enhancement program). Work on feral pig impacts is also taking place on AWC's Brooklyn sanctuary in the Wet Tropics. Non-toxic Curiosity® feral cat baits have also been trialled at AWC's Scotia Sanctuary in western NSW.

The CRC also collaborated with the World Wildlife Fund to capture footage of invasive vertebrates and their impacts in the Top End. This footage helps both organisations in education and outreach activities – graphically underlining the damage caused to our environments by animals such as feral pigs and buffalo.

### Community awareness and attitudes research

As part of an overall goal of increasing the professional and practical skills base of Australia through education and training, the IA CRC is conducting social research into public attitudes to invasive vertebrates. We have contracted our participant organisation Valuemetrics Australia to conduct this survey, which is ongoing for the remaining life of the CRC. The information gained will feed back into communication and education efforts, policy and improved management practices.

We also contracted Fitzgerald Applied Sociology (FAS) to review the literature on public attitudes to, and current and proposed method of controlling, invasive animals. FAS is a New Zealand-based research group that specialises in providing resource managers and decision-makers with socially intelligent answers to questions about people and communities.

The CRC's electronic newsletter 'Feral Flyer' is produced weekly to fortnightly. It enables communication to and between CRC participants through, for example, announcing achievements or position vacancies, carrying requests for information or resources, announcing upcoming activities or events, introducing new personnel, etc.



The fox DNA project established its own e-newsletter 'Fox DNA News' and website ([www.foxDNA.animals.uwa.edu.au](http://www.foxDNA.animals.uwa.edu.au)), that updates participants (including members of the community) with progress on scat collection and analysis. The collection sites of all samples have been plotted via Google Earth maps, allowing participants to 'see' their effort in relation to confirmed fox locations across the whole country (see map below). This project is a collaboration between the CRC, University of Western Australia and BRS's Natural Heritage Trust. It engages people all over the country to become involved by sending in fox scat samples with the ultimate aim of identifying the most appropriate management units for highly dispersed foxes and to potentially ascertain the origins of the Tasmanian fox introduction.

Our Uptake Program produces a further periodical newsletter, which is printed and sent to all participants in our projects involved in demonstration sites. Again, the aim of this communications effort is to keep participants and staff engaged in the projects, by updating findings and progress, providing site/location/team information, and generally highlighting how the collaboration is producing results.

All of these newsletters are available for free download via our website, which has been completely rebuilt over the past year. The new site includes a portal to our project management system that is accessible to all CRC participants and staff.

*Images at top and on p. 31 L to R: vertebrate pest management workshop participants, courtesy Bernadette York NSW DPI; Elaine Murphy (DOC NZ), Pip Masters (KI NRMB) and Tony Peacock at the Vertebrate Pest Conference Darwin; IA CRC cane toad workshop Darwin, Tony Peacock at 'Science meets Parliament', Brisbane; VPC welcome screen; Raoul Cramer speaking at our Bird book launch, review meeting Canberra; visiting US colleagues Stephanie and Stephen Schwiff interviewed by ABC Country Hour at the Vertebrate Pest Conference; USDA colleagues Loretta and Cheryl with Simon Humphrys, IA CRC; all courtesy of Kerryn Molloy.*

Figure 4: Map showing fox scat collection sites plotted via Googleearth, courtesy Oliver Berry.



## Whom we work with cont'd

### End-users

End-users are intimately involved with all CRC projects. They must be consulted during development and actively involved during the conduct of projects. We believe this level of involvement shortens the time from 'idea to impact'.

Table 2: End-user involvement in CRC activities

End-user name	Relationship with CRC (e.g. Industry, Participant, International)	Type of activity and end-user location	Nature / scale of benefits to end-user (e.g. exports increase, productivity, employment)	Actual or expected benefit to end-user (\$ terms)
Animal and Plant Control Commission of SA	Core participant	Integrated feral pig, deer, cat control in SA	Improved land-use management	Not yet quantified
Animal Control Technologies Australia Pty Ltd	Core participant	Rodent control research. Manufacturer of new feral pig bait, fox bait and wild dog bait nationwide	License to market new fox, dog, feral pig control products. Enlarged market. Export opportunities	Increased/ new product sales est. \$500 000 p.a. by 2009
Murray-Darling Basin Commission	Core participant	Invasive fish control, user of new tools/techniques, throughout Murray-Darling Basin	Improved river condition to deliver environmental and social benefits	Not yet quantified
NSW Department of Primary Industries	Core participant	Collaborative research into new tools and techniques for fox, wild dog, feral pig, rabbit control. Research node in Orange, field activity throughout NSW	Improved land-use management. Reduced negative impacts of fox and wild dog attacks and cost of controls. Improved conditions for graziers	\$15.5m p.a. on-farm impact reduction by 2012
NSW Department of Environment & Conservation (now Environment and Climate Change)	Core participant	Collaborative research into new tools and techniques for fox, wild dog, feral cat control. Field sites throughout NSW	Improved land-use management. Reduced negative impacts of fox and wild dog attacks and cost of controls	Not yet quantified
Parasitech	Core participant	Collaborative research into new tools and techniques for fox, wild dog control. Based in ACT	Increased research opportunity and service provision	Not yet quantified
Pestat Ltd	Core participant	Collaborative research into new tools and techniques for fox, wild dog control. Based in ACT	Increased research opportunity and service provision	Not yet quantified
Qld Dept of Natural Resources, Mines and Energy (now Qld Dept of Natural Resources & Water)	Core participant	Collaborative research into new tools and techniques for fox, wild dog, feral pig, rabbit control. Research node in Toowoomba, field activity throughout Qld	Improved land-use management. Reduced negative impacts of fox and wild dog attacks and cost of controls. Improved conditions for graziers	\$15.5m p.a. on-farm impact reduction by 2012
South Australian Research & Development Institute	Core participant	Invasive fish control, develop and employ new tools/ techniques	Improved river condition to deliver environmental and social benefits	Not yet quantified

# Research and education performance



**Improving the environment for business and biodiversity...**





## Our projects



Goal 1: a benefit of \$29 million p.a. by reducing the impacts of fox and wild dogs by 10%\*



This year, the CRC was a co-supporter, along with our participant organisations, Meat and Livestock Australia and Australian Wool Innovation Ltd, of the book 'Improving Fox Management Strategies in Australia', published by the DAFF's Bureau of Rural Sciences. The book was authored by Dr Glen Saunders, Leader of our Terrestrial Program, and Lynette McLeod. Both authors also work with the New South Wales Department of Primary Industries' Vertebrate Pest Research Unit at Orange.

Over the past decade there has been a dramatic increase in the use of 1080 fox baits. This has been largely driven by government agencies and landowner groups promoting regional approaches to fox management. While the continuing trend toward coordinated regional baiting is encouraged, it is important to ensure that such baiting is conducted in the most effective manner. This requires employment of correct bait type, placement and timing, tailored to the local situation. The book provides a comprehensive review of fox management strategies, along with impacts and monitoring techniques and is an important new tool for land managers.

The CRC's project identifiers form a matrix – the first number refers to the CRC's goal, the middle letter identifies the research program and the third number is the project in sequence. Thus, **1.T.2** indicates that the project addresses our goal 1 (to reduce the impact of foxes and wild dogs by 10%); falls within the Terrestrial Program (T) and is the second project that specifically addresses this goal.

### Project 1.T.2 Facilitating strategic management of wild dogs throughout Australia

Another initiative has been the appointment by the CRC of a National Wild Dog Management Facilitator, Mr Greg Mifsud. Greg operates out of the Queensland Department of Primary Industries' office at Toowoomba. His responsibilities include:

- raising the profile of wild dog management across the country
- highlighting the importance of integrated and strategic management of wild dogs on a regional and local scale
- documenting a series of successful and unsuccessful case studies for wild dog management
- identifying priority areas for management, research and dingo conservation
- promoting the development of communication networks between wild dog management groups, managers and researchers within and across states
- identifying current training programs for the control of vertebrate pests including wild dogs
- promoting the development of a nationally-accredited training scheme which provides a standardised approach to vertebrate pest control across the country.

Greg has met with industry groups in Queensland as well as attending various wild dog advisory group and local government meetings throughout Queensland and interstate and the first coordinated strategic wild dog management plans are being developed.



### Project 1.T.3 Development of baits with enhanced canid specificity

This project has steadily progressed the development of PAPP-based canid-targeted control products over the past twelve months, with several critical thresholds required for future APVMA registration approval successfully bridged.

The project has managed the completion of:

- an extensive non-target risk assessment and written report
- environmental fate and environmental toxicity analyses
- dose determination, dose presentation and dose confirmation studies in foxes
- the PAPP new active approval application (and its submission to the APVMA)
- the first ever field trial (showing FOXOFF® containing PAPP could reduce activity indices of foxes at a population scale).

PAPP-bait-delivered wild-dog studies have also been initiated.

The sensitivity of fifteen Australian native species (rodents, phalangerids, dasyurids, macropods, peramelids, larids, corvids and monitors) to PAPP toxicosis has been determined and the risk profiles of these animals interpreted and reported to the IA CRC.

The capacity of PAPP to remain within or move through different soil profiles, its breakdown and degradation in water and its toxicity to earthworms was also determined. The results of these analyses were unremarkable and sufficient data now exists to satisfy the environmental data package required by the Australian Pesticides and Veterinary Medicines Authority (APVMA) for the registration evaluation of PAPP as a vertebrate pesticide.

The project has developed a very solid understanding of the dose and presentation of PAPP formulations required to humanely and rapidly kill foxes. This information was used to critical effect in the first ever demonstration that PAPP-based baits could effectively reduce fox abundance at a population level (Melbourne Water Treatment Site, Werribee, Victoria). Fox pen study data has already been used to accelerate the planned wild-dog studies and the first five dogs have been successfully treated with PAPP with 100% efficacy.

At the beginning of September the new active approval application for PAPP was submitted to the APVMA. This is a critical starting point for the registration of PAPP-based products and will accelerate the review of PAPP-based products for foxes and wild-dogs during 2009.

*Images top L to R: fox courtesy Lee Allen, two wild dogs courtesy B. Morris, scavenger fox courtesy NSW DPI, dog biting roo courtesy Dave Jenkins. Opposite page: dead lamb at Mt Barry courtesy Ben Allen.*



Goal 1: a benefit of \$29 million p.a. by reducing the impacts of fox and wild dogs by 10%\*

#### Project 1.T.4 Towards best practice for wild canid and felid management

Best practice optimises a combination of techniques, target specificity, areas of application and time of year to achieve cost effective control. An IA CRC sponsored stakeholder workshop was held in Adelaide in October 2005 (Fleming 2006) to set priorities with best practice objectives in mind. This project was then developed in line with the top priorities determined at that workshop, which were:

1. Improved and validated monitoring systems for use in wild dog, red fox and feral cat management plans.
2. A collaborative approach to technology and data sharing to enable robust experimental designs for movement studies of wild canids and felids.
3. Predictive models of spotted tailed quoll populations under wild dog and fox control management to inform critical control decisions. This tool to provide for greater certainty when planning control programs for agricultural and environmental protection in quoll-inhabited terrain.
4. Testable hypotheses for future quoll population management.

Each subproject has a number of collaborators including NSW DPI, Vic DSE, WA DEC, NSW DECC, University of WA, University of Canberra and Landcare Research NZ. Subproject 2 has many synergies with our Uptake Program's demonstration sites and other CRC projects, and involves collaboration between government and university stakeholders as well as Parasitech P/L. Subproject 3 has majority funding from NSW DECC and has collaboration between Vic DSE, NSW DPI, NSW DEC, and QNR&W.

Subproject 1 aims to use remotely-sourced DNA to aid the estimation of population abundance for feral cat, fox and wild dog projects in the CRC. Buccal cells, hair follicle cells and gut lining cells in faeces all provide possible sources of DNA and various methods are being trialled to capture specimens of these cells in the field. Thus far, proof of concept testing has shown that remotely-sourced individual DNA has potential for all three species. Feral cat DNA is being collected by Roger Pech and Grant Norbury in New Zealand, Dave Algar in WA, and Tony Buckmaster (IA CRC PhD student) in Victoria, for analysis at Steven Sarre's laboratory at the University of Canberra. Alex Diment (another PhD student, Victoria) and the participants in our demonstration site in south-west WA (Project 10.U.1) are collecting red fox DNA, which is successfully being analysed by Oliver Berry at UWA (Project 10.U.3 offshoot). Danielle Stephens (PhD student) has identified individual wild dogs from remotely-sourced DNA, which is assisting Guy Ballard and Tom Newsome (PhD student) to determine control effectiveness at our wild dog demonstration site in northern NSW (Project 10.U.5). The next phase is to undertake mark-recapture analyses of individuals identified from remote-sourced DNA when sufficient samples have been collected and time series have been established at the field sites.

Collaboration has been initiated between CRC partners undertaking GPS studies of wild dog movements (subproject 2, Fleming and Jenkins 2007). Data from studies in Queensland, northern NSW, southern NSW and Victoria, Sydney Catchment and central Australia is being drawn together to find similarities and differences in movement behaviour of wild dogs. Better targeted control to prevent livestock losses and conserve dingoes will result from this collaboration. The workshop proceedings document is available on our website.

Two preliminary models of spotted-tailed quoll population dynamics (subproject 3) have been constructed by Charles Todd (Vic DSE) and Steve McLeod (NSW DPI) using part of a collaborative data set obtained from known studies of marked populations of quolls. The data set has been amalgamated from published studies and collaborators including Gerhard Koertner (UNE), Andrew Claridge (NSW DECC), Jenny Nelson (Vic DSE), Stephanie Meyer-Gleaves (Griffith University), Al Glen (WA DEC), Peter Cremasco (Qld DPI&F) and Debby Andrew (NSW DECC). Preliminary appraisal of the available data sets identified short time series as an impediment. Additional funding from NSW Dept of Lands and NSW DECC has been deployed to extend the time series of quoll data at Gerhard Koertner's study area, which is in the wild dog demonstration site (Project 10.U.5), and this work is being undertaken by Gerhard and Guy Ballard. The full data set is yet to be constructed and finalised.

Header image: feral dogs, courtesy John Cutmore



## Goal 2: a benefit of \$16 million p.a. by reducing feral pig damage by 15%\*

### Project 2.U.1 Roll-out of feral pig control solutions

We made significant progress in achieving this goal over the past year, through the development and registration of PIGOUT® feral pig bait. This product is significant because:

- feral pigs cost Australia an estimated \$106M annually in lost agricultural production, damaged infrastructure and management costs
- up to 40% of lambs are taken by pigs in some areas of Australia
- feral pigs carry many diseases – it is important to reduce their interaction with humans and livestock. An outbreak of foot and mouth disease in Australia would be rapidly spread by wild pigs, and could cost around \$3B in lost exports. This product greatly improves our ability to knock down numbers rapidly in the event of a disease outbreak
- many of our already threatened species (81 in NSW alone) are impacted by pigs – they are a listed key threatening process under the EPBDC Act
- their trampling, rooting and wallowing behaviour destroys fragile habitats and fouls water bodies.

PIGOUT® makes targeted baiting programs much easier – is shelf-stable, no need for messy field preparation or burying of baits and can be aerially-deployed. The matrix is tough and very difficult for animals without the large jaws of pigs to open. A patented poison core is contained in the centre of the baits, thus dramatically reducing the likelihood that any other animal could manage to take a lethal dose of the toxin.

**PIGOUT® is a huge step forward in ensuring that we can effectively target pigs, while significantly reducing the likelihood that native species will be affected.**

The product has been extensively field tested in a number of different environments and under varying climatic conditions.

Remote motion sensing digital cameras, radio tracking collars and indirect measures of pig activity carefully assessed efficacy during every trial. This photography allowed precise assessments of the risks to other animals in all situations, and clearly showed that this was very low.

The stringent conditions set by the Australian Pesticides and Veterinary Medicines Authority have been met, ensuring that no unsatisfactory chemical residues remain in the environment, further reducing any unwanted effects from baiting programs.

PIGOUT® is available for sale through Animal Control Technologies Australia.

**PIGOUT® - a revolutionary new delivery system – the world's first purpose-made feral pig bait.** Developed through a partnership between the Invasive Animals CRC and Animal Control Technologies Australia Ltd with support from Meat and Livestock Australia and the Bureau of Rural Sciences (DAFF).

The matrix is tough and very difficult for animals without the large jaws of pigs to open. A patented poison core is contained in the centre of the baits, thus dramatically reducing the likelihood that any other animal could manage to take a lethal dose of toxin.

The product is relatively long-lasting (shelf-stable) and does not require baits to be buried as a deterrent. It is therefore a huge step forward in ensuring that we can effectively target pigs, while significantly reducing the chances of any native species being affected.

PIGOUT® has been extensively field tested.



Header image: pigs at waterhole, courtesy Steve Lapidge; Pigout pail courtesy Paul Crock.

Goal 3: a benefit of \$7 million p.a. by reducing rodent damage by 20%

### Project 3.T.3e Chemical fertility control of the rice field rat in Indonesia

A new chemical fertility control technology that could substantially reduce the devastating impacts of rodents on rice production in developing countries has been developed by SenesTech, Inc., an American corporation, based in Arizona. The technology will be trialed to target the fertility of rice field rats in Southeast Asia. If successful, this technology will result in increased crop yields, an increase in food supplies globally, and will improve the quality of life for hundreds of millions within a few years.

'It is impossible to overstate the importance of this technology,' says Dr. Loretta P. Mayer, one of the company's founders and inventors of the technology. 'One fifth to one third of the world's food supply never reaches the table due to the deleterious impacts of rodents. They damage crops both pre- and post-harvest by not only eating the grain but damaging it with urine and faeces pollution. They also spread many debilitating diseases. While this problem has persisted for centuries, it is possible that we may be able to start reversing this process.'

**Research shows that just a ten percent reduction in the rice rat population can feed over 380 million people.**

Dr. Mayer, along with Dr. Cheryl Dyer, and Dr. Timothy Vail, SenesTech's scientific team, have developed this environmentally safe alternative to poison that can be used to sterilize the rice field rat. The technology accelerates the natural reproductive aging process in the rat resulting in sterility or reproductive 'senescence'. These scientists, all from Northern Arizona University, have teamed up with Dr. Lyn Hinds from the IACRC and the Commonwealth Scientific and Industrial Research Organisation (CSIRO) in Australia and Dr. Sudarmaji at the Indonesian Centre for Rice Research in Sukamandi, Indonesia to begin assessment of the product in Indonesian-based studies this spring. 'I am dedicated to addressing starvation with this technology and changing the livelihoods of the rural poor,' said Everett Hale, CEO. Hale was recruited by the company to lead the international effort and build on the company's core technology. 'I never knew the extent to which governments had to use poison to prevent famine. A percentage of poison in any food supply is not acceptable. We are losing lives and the environment. Through our technology, we can now change the world and help feed its people.'

For additional information on ContraPest<sup>(TM)</sup> contact Everett Hale at [ehale@senestech.com](mailto:ehale@senestech.com) or visit [www.senestech.com](http://www.senestech.com). ContraPest<sup>(TM)</sup> is projected to be available for commercial use in the Autumn of 2010.





## Goal 4: reduced impacts and rates of spread of carp and other pest fish species (improved water quality)

### Project 4.F.5 Carp reproduction hot spots

A previous project undertaken by our predecessor, the Pest Animal Control CRC, proved effective in demonstrating that carp reproductive activity is not widespread throughout NSW, with specific areas being identified as the origin of huge numbers of carp larvae. Larval sampling identified the Gwydir wetlands, Namoi wetlands, the lower Boomi River, Barmah-Millewa Forest, Hume Dam and Lake Wyangala as 'hot-spots' of carp recruitment in their respective catchments. However, some NSW river systems were not sampled under that project and continuation of the sampling program to cover these and extend the research to enable complete coverage of all river systems in the Murray Darling Basin was considered important.

The aim of this project was therefore to sample at 26 locations in Queensland, 33 in Victoria, 10 in South Australia and the Culgoa, Paroo, Castlereagh, Macquarie, Bogan and Lachlan catchments in NSW.

Five catchments were sampled in the 2005/06 breeding season: the Murrumbidgee, mid Murray, Macquarie, Kiewa and Gwydir. During the 2006/07 breeding season only two catchments were sampled (due to flooding events); the Border Rivers in NSW and the Paroo, both in Queensland and NSW. A high number of native fish were sampled, suggesting that the sampling strategy was functioning effectively. Consequently, the absence of carp larvae in the data is likely to be a true reflection of poor carp reproduction over the sampling period.

During the 07/08 breeding season, nine sampling trips were undertaken, with three rivers being sampled for the first time since the project began. In comparison to previous sampling years there was an increase in sampling and a larger data set was able to be collected due to the higher rainfall in a number of catchments.

All samples collected have been checked, identified and collated with no large numbers of carp larvae found. The Warrego River was the only catchment where moderate numbers of larval carp were caught.

All project milestones have now been met and the final report is due for submission. Each state agency has been resourced with the equipment necessary to apply carp larval sampling during any suitable sampling opportunity that may arise in catchments that have not been sampled during the life of the current project. NSW DPI is committed to applying the larval sampling strategy to fill in the remaining gaps within NSW catchments.

This project is assessing the technical feasibility of using Koi Herpes Virus (KHV) as a biological control agent for carp in Australia, based on information gathered from controlled experiments in a secure laboratory environment. UK, USA



*Left: Medaka (Japanese rice fish); Right: CSIRO fish breeding facilities, Hobart. Courtesy Tony Peacock. Far left: mice in silo, single house mouse, courtesy Paul Crock; cane field rat, courtesy Dario Rivera.*





## Goal 4: reduced impacts and rates of spread of carp and other pest fish species (improved water quality)

### Project 4.F.7 Koi Herpesvirus biocontrol potential

and Indonesian isolates of KHV), along with the cell-lines necessary for culturing these viruses, have been imported into the secure area of the Fish Diseases Laboratory at the Australian Animal Health Laboratory. All of these reagents have been tested by a series of KHV-specific polymerase chain reaction (PCR) assays in order to confirm the presence of KHV in the virus samples, and demonstrate the absence of virus in the uninfected cell lines. In addition, these reagents have all been innocuity-tested, i.e. to make sure that they are pure and contain no unexpected pathogens.

Procedures for the isolation of KHV in cell culture and molecular methods for the detection and identification of KHV by PCR have been established, and aliquots of virus have been stored for future use. Experimental infectivity trials have demonstrated that carp sourced from Australian waters are susceptible to infection by KHV and succumb to disease and die within 1-2 weeks following exposure to the virus. These experiments also demonstrate that our experimental model can be used to investigate the susceptibility of non-target native fish species (eg. Murray cod, golden perch, silver perch, and possibly trout cod).

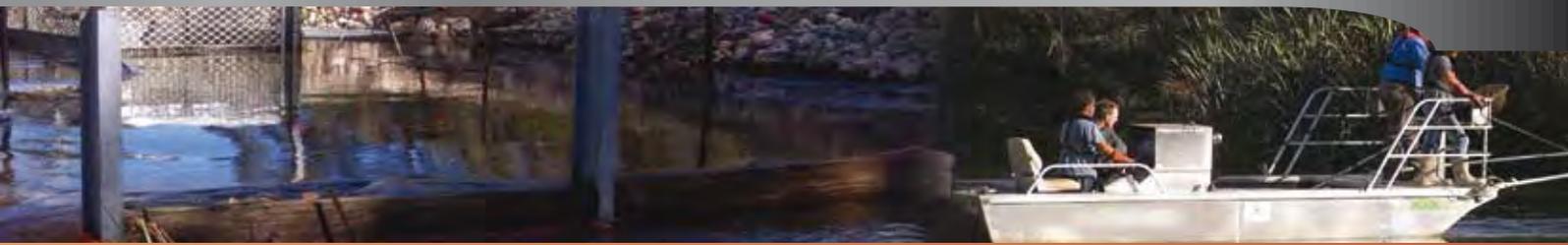
Over the next year, a number of native species will be tested for susceptibility to KHV. In addition, the susceptibility of carp of different age-classes sourced from Australian waterways needs to be confirmed. The issue concerning development of a carrier state at different temperatures will also be investigated.

Piscicides represent a potentially highly effective control option for aquatic species and are a standard fisheries management tool in North America. They are an essential component of any integrated pest management system, and

### Project 4.F.9 Biocides review

would be a primary tool in any rapid incursion responses against new pest populations. Research and development of new piscicides has been limited and most countries still rely upon the non specific fish poisons, rotenone and antimycin. Three literature reviews have been undertaken:

1. A summary of the legislative and regulatory framework for the registration of chemicals as piscicides for use in Australia and New Zealand, which identifies the scientific data and administrative processes required to enable the registration of rotenone & antimycin in Australian and New Zealand freshwater environments.
2. A summary of the range of candidate compounds known to be lethal to selected invasive fish of concern in Australia and New Zealand, eg. carp and tilapia; an identification of a suite of biocides for further evaluation and the scientific data required for evaluation.
3. A summary and identification of pharmacological products, and/or compounds known to be lethal to and/or to disrupt physiological or metabolic pathways in invasive freshwater species in Australia/ New Zealand. An assessment has been made of the unique traits, physiological or metabolic pathways of target organisms, and/or compounds that could be used to selectively target and control invasive freshwater fish species in Australia, including detailed discussion of biological differences between invasive species and native and



valued introduced fish species in Australasia that may make these invasive species (particularly carp) vulnerable to specialised toxin delivery systems.

Tilapia were introduced into Queensland in the late 1970s, and over the last 5 years have spread significantly throughout

#### **Project 4.F.10 Management strategies for the control and eradication of feral tilapia populations**

that state and have the potential to invade the Murray-Darling Basin. A project was set up to collect critically-needed ecological and life-history data to inform a coordinated management program. This project will use computer modelling to evaluate a range of management scenarios, and make recommendations on appropriate strategies for use in Queensland.

Monthly sampling was conducted at two impoundments (Tinaroo and Herberton), in an unregulated river (Mulgrave), an urban canal (Kewarra) and a set of artificial lagoons (Paradise Palms). Sampling techniques used included netting, electrofishing and trapping. Over a 15 month period 5,500 tilapia were caught.

Some 500 gonads were sectioned and stained for histological examination – confirming the extended reproductive seasonality of both species of invasive Tilapia (*Oreochromis mossambicus* and *Tilapia mariae*). Preliminary data analyses have shown some big differences in life history and population parameters to what has been previously documented in the literature. There were also some variations between local populations. For example, the average batch fecundity of a 'stunted' population of *O. mossambicus* was found to be 300 eggs per fish compared to a normal population that had over 2,000 eggs per fish. Conversely, for *T. mariae*, eggs counts of more than double that documented in the literature have been recorded.

Three thousand otoliths were also examined for data on growth and population age structure. The results of this experiment indicate that the opaque banding on the otoliths of both species is laid down annually, ie. is a relatively reliable indicator of age.

We are using this knowledge to adapt the CARPSIM 2.0 software for use with tilapia. This model has been successfully populated using parameters from a north Queensland *O. mossambicus* stock. A number of management scenarios for this population have already been tested. Efforts are being concentrated on modifying the model for use on stocks of *T. mariae*. A number of areas where the CARPSIM software could be modified to make it more useful as a tilapia management tool have been identified. These include simulating the impacts of predator introductions and the ability to model the outcomes of multiple, simultaneously applied control measures. These enhancements are currently being considered by the software developers.

## Goal 4: reduced impacts and rates of spread of carp and other pest fish species (improved water quality)

### Project 4.F.12 Spawning migrations and attractant flows: Achilles' heel exploitation of innate carp behaviours

In temperate lowland rivers, carp are allied with two important habitats: a shallow well-vegetated spawning habitat, preferably in off stream wetlands; and a deep over-wintering habitat in the main river channel. The shallow wetland habitat enables spawning and the replenishment of populations via recruitment. The deep habitat is thought to provide refuge from flow and maintain stable temperatures in comparison with shallow surface waters. Movement between these two habitats is annually predictable, and results in localised accumulations of carp (spawning and over-wintering aggregations). Carp aggregations are vulnerable to targeted removal programs and allow focussed, effective carp management efforts.

This project is identifying methods of exploiting carp spawning aggregations at wetland inlets by evaluating:

- the migratory (and jumping) ecology of carp through wetland inlets
- the application of existing carp separation cage (CSC) technology for trapping and removing carp at wetland inlets
- modifications to the existing CSC design, including the incorporation of a 'pushing' trap component and trash racks to collect floating debris
- physical (current-flow) and chemical (food odours, other chemical stimuli) attractants to optimise the uptake of carp into traps.

*Far right: Ben Smith of SARDI with carp collected through a separation cage trap.*

*Right: Carp separation cage. Images provided by SARDI.*



Existing CSC technology has proven effective in trapping migrating carp by exploiting their jumping behaviour. However, field and laboratory observations have shown that carp prefer to push their way under barriers rather than to jump over them. Modifications to existing CSCs to incorporate a gated, spring-tensioned or weighted pushing mechanism therefore have considerable potential to further increase trapping effectiveness by exploiting this behaviour.

Field sampling was undertaken during late summer and early autumn 2007 within the main lake region of the Torrens River in central Adelaide to indirectly determine the pushing power of carp via pulling measurements made by line hooked individuals. Carp pulling power exhibits a strong linear relationship with both fish length and fish weight, with carp typically pulling (pushing) at least twice their body weight. The results of these measurements were used for the development/manufacture of wetland CSCs incorporating a pushing component (in a 'cat-flap' configuration). Two of these traps are currently being tested on Banrock Station, with promising results. Our partner in this work, SARDI, has also recently secured funding from the Murray-Darling Basin Commission's Native Fish Strategy to trial traps and carp exclusion screens at a number of wetland inlets. A new honours student has commenced work on the 'push traps' study and two associated PhD projects are continuing.

Project researchers also took the opportunity for further study when the Banrock Station wetland was drained in mid-February 2007. Lateral movements of carp and native fish were evaluated, confirming that native fish were quick to leave a drying wetland, while carp stayed and even swam further into the water body, against the out-flowing water. Water samples were taken from the wetland, the outlet creek and the river, and are undergoing chemical analysis. It is suspected that current flow, amino acid content, water temperature and/or sound may play a role in carp behaviour.



## Goal 5: deliver innovative, practical control measures against cane toads

### Project 5.T.2 Cane toad toxic venoms and pheromones

The two years of this project have generated significant baseline knowledge relating to cane toad chemical ecology. This has been achieved by the creation of a strong intellectual and infrastructure commitment to cane toad chemical research at the University of Queensland (UQ), supported by key multi-disciplinary networking and collaboration.

In the course of this study UQ observed and questioned much of the dogma of 'cane toad venoms' and the prevailing (but untested) view of cane toads as a menace. The team considers it essential that all interested parties (the scientific community, the public and government) be provided, where possible, with considered, unbiased and objective evidence based on analysis of unequivocal scientific data. Such sound data will provide focus and quality control to research and control effort, considered particularly important given the scarcity of resources available.

While adding to our understanding of cane toad chemical ecology, the project has also revealed additional substantial gaps in our knowledge. Key project findings to date:

- **Alarm pheromones** – the only reproducible pheromone behavioural response that has been reported for the cane toad is the tadpole alarm pheromone. Preliminary investigations suggest that this alarm pheromone can be isolated and identified, and assessed as a potential cane toad control strategy.
- **Bufadienolides** – studies have confirmed that the distribution of bufadienolides across the glands, organs and tissues of the Australian cane toad is quantitatively and qualitatively different from those reported in overseas cane toads. Bufadienolides clearly play an important role in the poisoning of Australian predatory species, and continued studies into their distribution, chemistry, ecology and biology is of great value.
- **Alkaloids** – cane toad alkaloids are fast acting hallucinogens that target the central nervous system, and are very likely the true defensive chemicals deployed by adult cane toads, capable of confusing and distracting predators. The qualitative and quantitative distribution of cane toad alkaloids has received only cursory attention in the scientific literature, with no serious published analysis of their occurrence in Australian cane toads. The team believes (see below) that cane toad alkaloids are a critical element in the defensive strategy, and play a pivotal role in the interactions between cane toads and Australian predators.
- **Microbiology** – the team have found microbes within the parotoid gland that are capable of rapidly bio-transforming bufadienolides. It is speculated that cane toad eggs enjoy a 'microbial factor' that either protects from microbial infection and/or synthesizes and/or bio-transforms bufadienolides to meet ecological objectives.
- **Sex pheromones** – no compelling experimental evidence exists (yet) for a cane toad sex pheromone. In the absence of a reproducible sex pheromone behavioural assay this line of research lacks direction.
- **Peptides** – no compelling evidence exists (yet) for cane toad peptides having a role in cane toad behaviour, or being deployable in cane toad control.

*Image right: cane toad showing toxin exudation, courtesy of the Kimberley Toad Busters Inc.*





## Goal 7: improved integration of existing biological, conventional and newly-developed control options for rabbits

### 7.T.7 Research project funded by AWI and MLA: rabbits and biodiversity

Rabbit numbers are presently controlled by a combination of biological control (Myxomatosis and RHDV, also known as calicivirus) and physical measures such as warren ripping and fumigation. Despite this, we are still seeing significant damage (estimated to be around \$113M per year) to our agricultural and pastoral industries. The research of Dr Brian Cooke has recently confirmed long-held suspicions of land managers that numbers have begun increasing again despite these controls. The CRC set up a number of research sites to investigate this, improve the efficacy of RHDV, and provide tools for assessing impacts and damage levels.

Firstly, Dr Cooke was commissioned to assess the impact of rabbits at current densities on biodiversity in pastoral lands and farmlands, including on road reserves, stock routes and public amenities. He derived a simple method of scoring rabbit abundance to estimate densities that is independent of seasonal variation in rabbit numbers or plant growth. He then developed a means of scoring biodiversity 'risk' using damage indices and quantified the relationship between rabbit abundance and risk to natural biodiversity.

Of 106 sites surveyed in southern Queensland, NSW, ACT, Victoria and SA there were 54% with no rabbit impact on biodiversity, 19% where minor impact was apparent and 27% where impact is reducing biodiversity.

A handy field guide was produced: 'Rabbits: a threat to conservation and natural resource management – how to rapidly assess a rabbit problem and take action'. This booklet was published by BRS, with support from the CRC, Australian Wool Innovation Ltd and Meat and Livestock Australia. This resource gives information on how to monitor, scoring abundance, assessing damage levels, and information on how to remove rabbits. Available from BRS.

### 7.T.5 RHD genetic resistance project

A second project aimed to confirm that resistance to RHDV is indeed a cause of increasing rabbit numbers. Mr Peter Ellsworth, an IA CRC PhD student, has conducted challenge testing of wild rabbits from nine sites across Australia. Rabbits from most (not all) sites have been found to be more resistant to oral infection with Czech-strain virus than domestic rabbits used as experimental controls. Rabbits from different sites had different levels of resistance, possibly related to the past frequency of RHD outbreaks.

There is therefore good evidence that rabbits may be developing resistance to infection, but the final outcome in terms of maintaining RHDV as a useful biological control agent may depend on whether or not the RHD virus itself is changing genetically. Associated studies are being carried out in South Australia by the Animal and Plant Control Group (APCG) that aim to determine this. The next stage of this project will test field virus strains against the initially released Czech-strain to see if apparent changes in genome sequence are reflected in virulence changes. Australian Wool Innovation Ltd is a major sponsor of this work, and support is received from the APCG, the Western Australian Department of Agriculture, New South Wales' and Victorian Departments of Primary Industries, and the Queensland Department of



Natural Resources and Water. IZS of Brescia, Italy has supplied monoclonal antibodies for ELISA studies and INSERM of Nantes, France is analysing rabbit DNA samples.

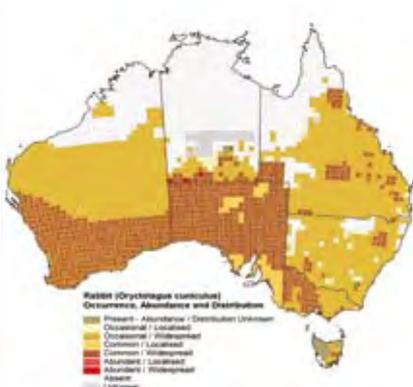
### 7.T.1 Endemic RHDV virus discovered

There was also evidence that the effectiveness of RHDV is patchy—more effective in arid regions than humid/wetter and comparatively cooler ones. Another avenue we investigated is whether rabbits showing resistance might have been exposed to an endemic calicivirus that produced antibodies but was not pathogenic.

Project Leader Dr Tanja Strive of CSIRO has successfully produced a diagnostic test for avirulent rabbit caliciviruses in Australia and then a diagnostic test that distinguishes RHDV from avirulent caliciviruses in rabbits. Using this methodology she has made a significant discovery – confirming the existence of an endemic calicivirus in Australian wild rabbit populations using a universal lagovirus PCT test.

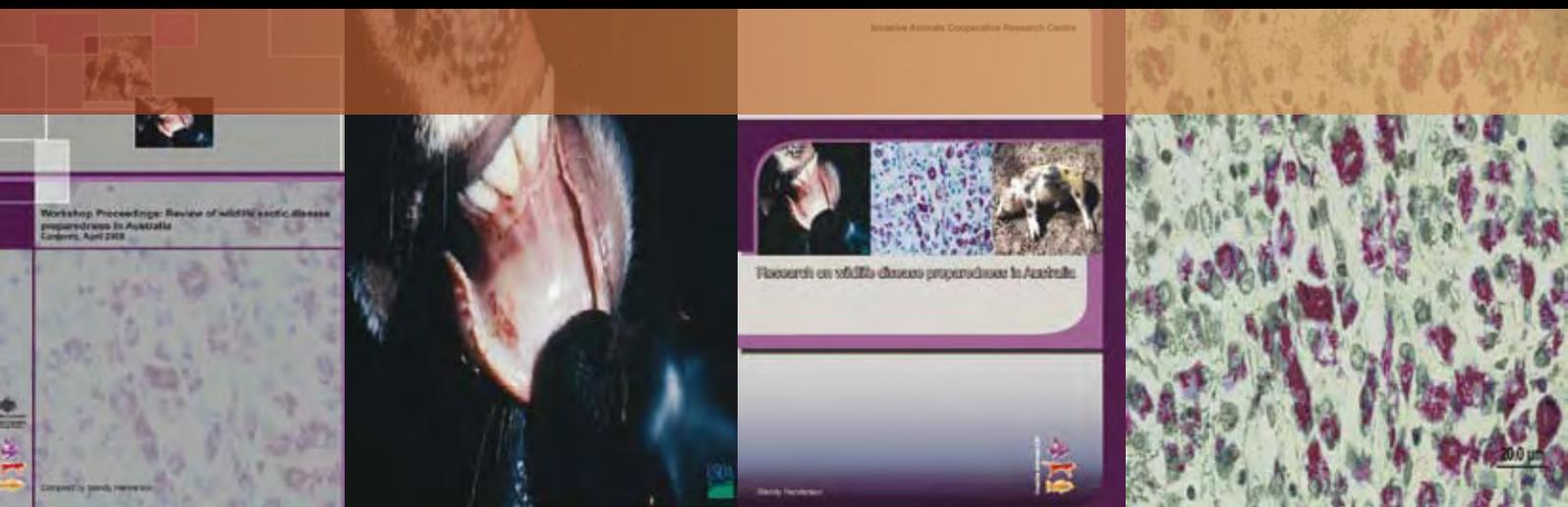
This discovery has important implications for management, for example, reintroductions of RHDV may need to be carried out more frequently in the areas where the endemic virus is prevalent. A new freeze-dried RHDV product being developed by the CRC will assist with this.

Tanja's team includes Dr Greg Mutze of the South Australian Department of Water, Land and Biodiversity Conservation (SA DWLBC), Dr Glen Saunders of NSW DPI, and technical officers John Kovaliski (SA DWLBC) and John Wright (CSIRO). The project also receives support from Dr Brian Cooke and Steve McPhee of the Victorian DPI. The team is now investigating how this new knowledge can be applied to make the delivery of RHD more effective in reducing rabbit impacts.



*Left: rabbit distribution and density in Australia, courtesy of the NLWRA. Available on our website [www.invasiveanimals.com](http://www.invasiveanimals.com) and at higher resolution from BRS. Produced by Mr Peter West as part of an IA CRC supported mapping project. Right: Dr Tanja Strive performing a rabbit autopsy as part of an IA CRC supported project to identify endemic lagoviruses (caliciviridae family). Header: all images by Brian Cooke.*





## Goal 8: reduced risk of disease transfer from invasive animals to livestock and humans

### Project 8.D.2 – review of wildlife and exotic disease preparedness in Australia

The Detection and Prevention Program hosted a workshop, with funding from the Wildlife Exotic Disease

Preparedness Program (WEDPP) of DAFF. It was attended by delegates from all states, from departments of agriculture and environment, universities, the Australian Wildlife Health Network (AWHN), Australian Registry of Wildlife Health, the IA CRC and the Australian Biosecurity CRC. Two representatives from New Zealand's Department of Conservation and Landcare Research also attended.

Priorities identified for research include:

- targeted disease surveillance
- basic wildlife ecology including population distribution and contact rates
- identifying and prioritising diseases of native species
- impacts of climate / land-use change on emerging diseases
- a cross-sectoral approach for managing the ecology of emerging wildlife diseases
- enhanced modelling for contingency planning.

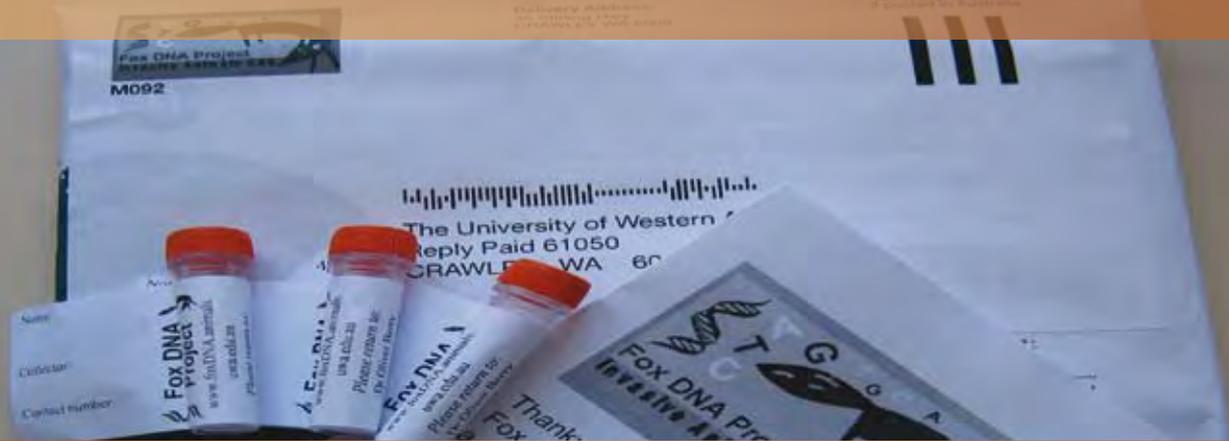
The development of a prioritisation system to identify high-risk diseases and species involved was considered essential to be able to prioritise research and funding. Priorities for training and preparedness include:

- immediate review and updating of AUSVETPLAN's Wild Animal Response Strategy
- compiling and distributing a list of key personnel
- regular field and desk exercises for preparing for an emergency outbreak
- review of animal welfare guidelines
- review of legislation relevant to wildlife health and disease outbreak.

It was agreed that the continuation and expansion of the future-proofing that WEDPP and AWHN provides is important: a structure is needed that supports research, and follows up with evaluation and implementation into policy, training and response strategies.

### Research on wildlife disease preparedness in Australia

Dr Wendy Henderson of the IA CRC then reviewed the recent research. Three resultant reports summarised and critiqued projects currently funded by WEDPP (from 1999 to 2007) and described the major diseases of concern to Australia, particularly those in which invasive animals are implicated. IA CRC and Australian Biosecurity CRC's current relevant research was also summarised. Conclusions were that WEDPP has had useful input to a wide range of projects relevant to disease preparedness in Australia, but the projects were relatively small due to constraints put on funding and duration of research. The need for practical and generic implications of the research to be clearly stated and incorporated into policy was highlighted. The reports '*Research on wildlife disease preparedness in Australia*' and '*Workshop Proceedings: Review of wildlife disease preparedness in Australia*' can be downloaded via our website.



## Goal 9: reduced risks of economic losses, environmental damage and social stress by forecasting and responding to potential, new, expanding or emerging invasive animal problems

### Project 9.D.1 Refining, developing and validating invasive vertebrate risk assessment models

Risk assessment models have been developed and validated for established exotic vertebrates in Australia and New Zealand. Risk models for the import and keeping of exotic animals in Australia have been developed and tested.

This project is assessing the risk of exotic species establishing in Australia and other countries. To assess the risk models, the team, with members from the Bureau of Rural Sciences in DAFF, and from Western Australia's Department of Food and Agriculture (DAFWA), has looked at different species' establishment success and their preferred habitat climate match and actual distribution.

The models have been tested for exotic birds and mammals introduced to New Zealand, and for exotic freshwater fin fishes introduced to nine other countries (Italy, Britain, Czechoslovakia, Morocco, Japan, Thailand, Germany, France and Mexico). Introduction success for exotic reptiles and amphibians introduced to the United Kingdom and two states of the United States (California and Florida) has also been tested against the models. A range of species were assessed in each case, including some species that successfully established in the test country, and others that failed.

The following factors were assessed to obtain an Establishment Risk Score for the models:

- climate match
- introduction success elsewhere
- overseas range size and taxonomic group (genus and family).

For birds, whether or not the bird species is migratory was also used. A key component of all the models was climate matching between origin and release sites based on rainfall and temperature data. Potential species' ranges were predicted using a 'climate envelope' approach, in which a species' geographic range elsewhere in the world (including both its native and introduced ranges) was mapped and the climatic attributes measured, and then locations with matching climate attributes were determined and mapped for the jurisdiction being tested.

Overall, very good discrimination between successful and failed species was observed when the above factors were used to rank species' establishment risk: the higher the score, the more likely that species was to have successfully established in the tested country. The observation that a variety of introduced species fit these models means that they can be expected to provide accurate tools to measure establishment risk. DAFWA is currently running 40 potential pest species through the models to validate them across a range of species and risk levels.

The validated models will allow for more accurate predictions of whether an exotic animal species could become invasive in Australia. The models will be used to guide the Australian and state governments in their decisions to import, trade or keep exotic vertebrates in Australia. The report 'Risk assessment models for establishment of exotic vertebrates in Australia and New Zealand' will be available soon.

## Goal 9: reduced risks of economic losses, environmental damage and social stress by forecasting and responding to potential, new, expanding or emerging invasive animal problems

### Project 9.T.2 Improving the management of Australia's pest birds

Bird damage is a significant problem in Australia, with over 60 bird species known to cause damage to horticultural crops. Growers are also faced with increasing social, environmental and legal issues that further restrict the techniques that can be used to reduce bird impacts. New types of horticultural crops are being pioneered, growing practices are changing, values for horticultural products are increasing and the geographical range of production is expanding. These factors often result in expansion of the range and impact of pest birds.

Many control techniques are available, but they are often expensive. In 2000 a survey of 30 local grape growers by Sydney University in the Central Ranges of New South Wales found that bird control was costing on average \$500 per hectare per year, with most techniques failing to adequately protect crops. Without reliable information on the movement of pest birds, it was difficult for growers to know the best timing for and amount of effort they should make. Growers also needed advice on how to assess bird damage in their crops (species involved, severity and cost of damage), information on the various control strategies available, and a guide on implementing 'best practice' strategic management. The book 'Managing Bird Damage to fruit and other horticultural crops' was produced by the BRS with our support to address this need and launched in September 2007 by Senator Abetz, then Minister for Fisheries, Forestry and Conservation. It includes case studies and factsheets, and represents a real step forward in empowering horticulturalists to address this problem. Available from BRS.



(L to R): Brian Lukins measuring grape damage courtesy B. Mitchell; silvereyes damaging pomegranates, courtesy of John Tracey, NSW DPI; Bird book authors with Minister Abetz who opened the launch event, from left – John Tracey, Minister Abetz, Mary Bomford, Ron Sinclair, Quentin Hart and Glen Saunders.

### Project 9.D.5 Invasive fish scoping study

In Australia, the number and abundance of pest fish species in freshwater rivers and wetlands has risen significantly in recent years. There are estimated to be up to 34 established pest fish species on mainland Australia. Many more identified 'risk' species are in captivity that have potential for significant negative triple-bottom-line consequences if released into the wild.

There are currently no Australian standards or a consistent approach specifically designed for measuring and monitoring the distribution and abundance of these pest freshwater fish, nor for their impacts. However, there were many techniques and tools available for detecting and measuring fish populations, and two recommended monitoring protocols.

The VPC recently became responsible for providing coordinated policy and planning solutions for exotic fish. The National Land and Water Resources Audit (NLWRA) was also developing various indicators and standards for monitoring resource condition, under the National Monitoring and Evaluation Framework. The VPC recommended that fish be included in this invasive species policy, and the CRC (with support from the NLWRA) undertook a scoping study.

The report: 'Review of alien fish monitoring techniques' presents results from this scoping study and is available on our website. It summarises and reviews available techniques, outlines current research programs and management activities and contains recommendations for appropriate monitoring and reporting procedures.

## Goal 10: Growth in Australian invasive animal pest control industries. Through industry collaboration on the registration, marketing, export and community uptake of new products and services the CRC will enhance control of problem species

### Project 10.T.2 Can commercial use of pest wildlife contribute to pest management?

This project tests the idea that commercial use of pest animals is a method of reducing pest impacts whilst providing an economic gain, in regions where kangaroos and feral goats are commercially harvested. The extent to which commercial use reduces pest impact on both agricultural production and conservation values is being examined.

The benefits of pest control can be broadly classified as environmental or economic. In the context of commercial use of kangaroos and goats, environmental benefits include the conservation of biological diversity and ecosystem function while economic benefits include the promotion of agricultural productivity. Furthermore, commercial harvesting of kangaroos must be done in compliance with the Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act). Under the EPBC Act the Commonwealth has responsibility for providing for the protection of the environment, promoting ecologically sustainable development and the conservation of biodiversity. This project is the first attempt to measure the degree of compliance between the commercial use of kangaroos and the Act.

The project is also attempting to define the conditions under which commercial use can successfully be integrated with conventional pest control activities. Multiple objective optimisation and bio-economic modelling is being utilised to optimise the sustainable use of rangelands for extensive grazing enterprises, balancing the often opposing goals of profit maximisation while minimising the harmful effects of herbivore grazing (both domestic stock and wildlife) on conservation values.

Conservation benefits are measured by indices of biological diversity (including flora and fauna) in areas subjected to different intensities of commercial use, ranging from high harvest rates to areas that have not been harvested. Comparing indices across gradients of harvest intensity will indicate if commercial use can have beneficial (or detrimental) impacts on biological diversity. Additionally, the measurement of agricultural production across the gradients will indicate if agricultural yields are improved by the commercial use of kangaroos.

Sites north of Broken Hill were sampled in July and again in December 2007, which has finalised the field work in that area. Other sites include areas north of Wentworth in NSW, east of Broken Hill and north-west of Port Augusta in South Australia. These sites were sampled in the winter period June-September 2008 and will again be sampled in summer (December 2008-February 2009).

Data collected during the field trips are being collated and preliminary analyses have begun. In addition to the intensive fieldwork mail surveys and phone interviews are being conducted to provide data to examine the relationship between harvest rate and agricultural yield. Surveys and interviews will continue into 2009.

A workshop to promote adoption of the project's findings to key stakeholders, including pastoralists, managers of natural resources, government policy makers and researchers is expected to be held in the latter half of 2009 as the project is finalised.

Project 2.U.1 (see pages 60-61) also delivered against the goal this year.

*Kangaroos can become over-abundant when humans influence the natural availability of food and water. Images courtesy Wendy Henderson.*





## Goal 11: Increased professional and practical skills base in invasive animal management through education, training and community awareness

### Our Education Program

#### Certificate III – Recognition of prior learning

It is recognised that many land management practitioners have extensive management in the field, but may not have undertaken any formal training course in the past. Vocational training in Australia can now recognise 'prior learning' for accreditation towards achieving formal qualifications, so we developed a project to enable stakeholders to obtain credits toward a Diploma of CLM by participating in a program run out of DPI's Tocal College. Participants can achieve nationally-recognised certification at Certificate III, IV and diploma levels depending on experience. Each candidate is independently assessed against common national criteria, and their Certificate can be used for career progression. Additional training needs and units for individual candidates can also be identified during their assessment.

To launch the project, the Invasive Animals CRC provided eight scholarships to officers from Rural Lands Protection Boards, NSW Dept of Environment and Climate Change, ACT Environment and the Wild Dog Destruction Board. Additional candidates from Australian Wildlife Conservancy's Scotia Reserve joined the program. All candidates were very impressive in their pest management roles and achieved competency in all units they undertook. The first graduates were awarded their Certificates in March 2008. Interest in the program is increasing and more candidates will be assessed on an ongoing basis.

#### Balanced Scientist program – Kangaroo Island camp

The Education Program of the CRC is also contributing to the skills base through additional training and development of our postgraduate students. 'Balanced Scientist' is a special program of extra courses and professional work experience placements run for the Invasive Animals CRC PhD students. Its aim is to produce balanced and exceptional graduates, who in addition to their specialised PhD research experience, also emerge with broad skills in areas such as research leadership and management, effective communication, stakeholder and community engagement, and innovation and product development, with formal recognition of the program facilitating rapid uptake into professional career paths. A significant component of the Balanced Scientist program is a week-long annual training camp where specialist facilitators and IA CRC staff run intensive courses and workshops. These are augmented by field study excursions regarding land management issues in local natural resource management areas (NRMs). Our graduates also benefit from the social opportunities presented at the camps and develop networks of contacts that will likely benefit their future careers and their contribution to the industry.

This year's annual PhD gathering was held from 5 to 11 May at K.I. Lodge, American River, on Kangaroo Island, South Australia, with the KINRMA (Kangaroo Island Natural Resource Management Area) as the backdrop. Twenty students from five states and territories attended and took part in leadership and communication courses covering

topics such as R&D Leadership, Effective Team Building, Project Management, Stakeholder Analysis & Engagement, Ethical Considerations, Communication Skills, the Groupthink Phenomenon, and Media Awareness. Specific group activities included Action Learning Projects where teams of students had to develop and present a hypothetical Invasive Animals project proposal to the full group and staff, and a creative sculpture competition where the same teams had to utilise found materials such as flotsam and jetsam to produce thematic sculptures and 'art spin' explanations – with all being presented on the Thursday special dinner night for judging by a panel, and prize presentation by CEO Professor Tony Peacock.

Field excursions included a morning fishing trip on a chartered boat for the several students with interests in fisheries biology, an evening guided tour of a managed urban Little Penguin colony at Penneshaw, and a day-long excursion to the wilder western part of the island to study management issues associated with over-abundant introduced koalas, feral cat, goat, pig and fallow deer monitoring and control programs, and managed tourist viewing platforms for Australian Sea Lions and New Zealand Fur Seals. This full day excursion was guided by KINRMA scientist Dr. Pip Masters with assistance from Koala Project Manager Dr. Robyn Molsher and feral animal control officer Brenton Florance with specially prepared in-situ presentations and demonstrations. One overriding theme was that of the need for enhanced biosecurity measures, especially to maintain the island's current fox and rabbit free status.

### **Feral Focus – ready for launch**

The period July 2007 to June 2008 saw the completion of the Feral Focus teachers' resource pack, which is due to be launched in the second semester of 2008. This kit provides teachers with a complete and up-to-date resource which addresses the complexities of effective pest animal management. This resource dispels the myth that a feral animal should be eradicated at any cost using any means available. Instead, students learn and appreciate the complexities involved in addressing pest problem issues. They are brought to an understanding that the aim of pest animal management is to reduce pest damage to an acceptable level using an economically sustainable approach and employing animal welfare and environmentally sensitive techniques.

Due to the serious, and at times sensitive, nature of pest animal management this resource has been developed for high school students – specifically years 8, 9 and 10. A list of activities, interactive scenarios and detailed research projects present teachers with strong links to current curriculum profiles. To reinforce student understanding, each activity comes with a list of further reading points and relevant websites which provide up to date information and allows the student to be fully informed when undertaking the activity.

### **Other Industry training**

We also ran a 3-day workshop for wildlife and fisheries managers on the use of genetics in management. The training was conducted by Dr Oliver Berry and Dr Jason Kennington of the University of Western Australia, assisted by Prof Fred Allendorf (University of Montana). It was attended by approx 20 people from WA and SA.



*Kangaroo Island workshop and field trip and header images by Tom Heinsohn, IA CRC*



Goal 12: established national and local benchmarks for invasive animal impact, density and distribution from which performance on delivery of all outcomes can be assessed

Project 12.D.1 – mapping the invasive vertebrates of Australia

This project is a national-scale initiative that aims to improve monitoring and reporting of invasive animals, and develop a national system for up-to-date information on the distribution, abundance and impacts of invasive animals throughout Australia. It has been running since July 2005, and is jointly funded by the IA CRC, the NLWRA, Land and Water Australia (Research and Development Corporation) and NSW DPI. Peter West from NSW DPI is the national coordinator.

The successful collaboration between the NLWRA and all states and territories was vital – allowing agreement on and implementation of a national work plan, including identifying a priority list of species and a National Monitoring Protocol. Information from all state and territory government agencies on the occurrence, abundance, distribution, trend and underlying data quality (at a 0.5 degree scale) for the identified pest species was collected, collated and aggregated. Data was obtained from a wide variety of sources including aerial surveys, spotlight count data, field sampling, control activities, community groups and landholder questionnaires. Information on additional species including feral horses, feral donkey, one-humped camel, water buffalo and red-eared slider turtles was also collated where available.

This resulted in the production of national, state and natural resource management region maps that show the distribution and abundance of 10 key pest animals: feral pigs, feral goats, rabbits, foxes, feral cats, wild dogs and dingoes, common carp, starlings, cane toads and feral deer. These maps can be viewed on our website in the 'regions' section.

The project has also resulted in the first set of nationally agreed, standardised protocols for monitoring and reporting on invasive animals. Data-rich datasets of invasive species, maps of the potential range of these species, and case studies on a variety of their impacts have also been produced. These outcomes will provide a benchmark from which managers can prioritise and monitor pest control activities.

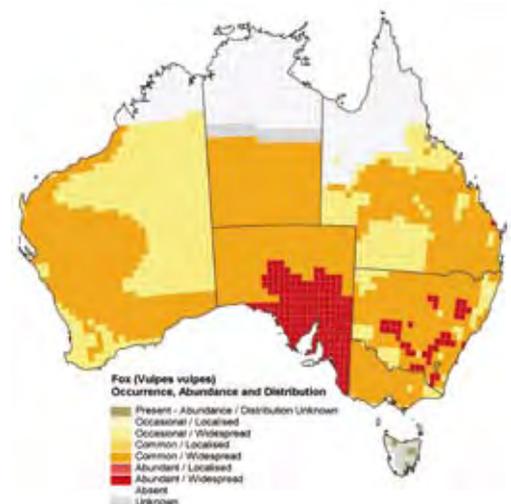
Some predictive modelling has also been done (through a partnership with the BRS of DAFF) to forecast the potential range of three pest species if they continue to spread throughout the country. Future work will produce better quality maps at a finer scale, and for more species.

Images right: maps have been produced at the national, state and NRM region level – shown here national and Victorian fox distribution and abundance maps.



Above: project leader Peter West of NSW Department of Primary Industries, Vertebrate Pest Research Unit, Orange, NSW.

**'Australia is now better prepared for potential exotic disease events involving feral and wild animals. This resource will improve our detection of, and response to, existing pest animals, emerging pest species, and disease'.**





## Project 12.D.6 – Measuring the environmental, economic and social costs of vertebrate pests

This project has been done in collaboration with NSW DPI, Victoria DPI, University of New England and Fitzgerald Applied Sociology (New Zealand). It aims to assess a range of economic, environmental and social impacts attributable to invasive animals throughout Australia identified using a variety of contemporary and innovative techniques; to address direct, indirect and induced impacts. The project has produced:

1. Review of 'Counting the cost' report (from the Pest Animal Control CRC) and identification of gaps from social, economic and environmental perspectives.
2. Review of existing economic and social frameworks and methods for valuation of impacts.
3. Design of alternative methods based on principles of welfare economics and appropriate social methodology.
4. Estimates of measures of production impacts.
5. Estimates of measures of environmental impacts.
6. Estimates of measures of social impacts.

Costs of production losses, expenditure on control and expenditure on research were included, although data was difficult to obtain in many cases. The total losses in agriculture were estimated from the impact on producers and consumers of agricultural commodities, and based upon the abundance and distribution of pest animals.

Production impacts were broken down by industry and by key pest animal. Horticulture and beef industries were the most impacted industries. Rabbits and birds (combined species) were the pests that incurred the greatest losses to production. The agricultural loss versus expenditure on pests suggests that too little money is being spent on pest animal research and control.

The cost of invasive animals on the environment was restricted to estimating the loss of one environmental asset class – listed threatened species – in New South Wales. Although producing a conservative estimate, the methodology represents a breakthrough approach and the value may provide a useful tool for further analyses and funding leverage.

A framework for measuring social costs was developed and a geographically-based case study was undertaken in the Upper Hunter Valley of NSW. Most of the social impacts of pest animals in the Upper Hunter seem to flow out of the economic changes and impacts (such as when farm household incomes are reduced or compromised) or the environmental impacts (such as when carp invade a fishery). Nevertheless, some informants recognise that direct social impacts do occur, for example, the psychological distress to farmers caused by wild dog attacks on their stock, or the distress and injuries to motorists when they collide with feral animals. Intra-community conflicts can result from attempting to implement pest control programs in the context of changing land-use patterns and the migration into rural communities of people with different sets of values. The range and extent of the various social and economic impacts can be expected to vary considerably across the nation, so the case study results could not be directly used for extrapolation to a national level. However, the data obtained did highlight key social impacts experienced by different community members.

Reports from this project are currently being finalised for publication. The information obtained from these analyses will allow leverage for further resources for pest management. It will also allow animal management policy-makers to more completely take account of social and environmental costs of pest species.

This project also contributes to Output 9.4: The development of information systems that will improve coordination and evaluation of effort on a national, regional and local level.



## Our demonstration sites

### Project 10.U.3 Supporting the eradication of foxes in Tasmania

The Fox Eradication Branch (Tasmanian Dept Primary Industries & Water) launched their 'Great Poo Pickup', a carnivore scat collection survey from areas of suitable fox habitat across Tasmania. Samples are sent to the IA CRC Wildlife Genetics lab in Canberra for species identification by DNA analysis. Phase 1 of the survey was carried out 3rd March – 6th June 2008 involving some 2900 hours of survey or 6300 linear kilometres searched on foot by thirteen DPIW staff and five volunteers on private and public land in the north-east portion of Tasmania. Approximately 2500 scats were collected during phase 1, plus 250 scats collected during a trial survey carried out in October 2007.

Over 2,900 scats have been screened for fox DNA since January 2007. Of these, 19 have tested positive for fox DNA, which includes two scats collected during the trial survey and two scats collected during the Phase 1 survey. Three of these survey scats were collected from two areas with no other recent hard evidence of foxes. The other scat corroborates an existing hotspot of fox activity. Trials of DNA profiling of scats have also commenced.

### Project 10.U.3a The molecular ecology of wild canids in Australia

Dr Oliver Berry's (UWA Post-doc) genetic analysis has demonstrated that foxes in Tasmania result from multiple independent entries (not breeding in situ alone). Other results from these studies include:

#### Fox DNA Project

Over 3500 samples have now been collected by the public in an Australia-wide study of population structure in foxes. These samples have been genotyped with 36 microsatellite DNA markers and analysis indicates a major division of foxes in Australia between the eastern and western sides of the continent (preliminary results only). Fine scale limits of movement in different regions of Australia – ranging 7-12 km different sites have also been detected (preliminary results only).

#### Trace DNA sample capture-recapture work

Over 400 hair and scat samples have been remotely collected from four main study sites and genotyped with a panel of microsatellite markers developed for the purpose. This process has succeeded in identifying recaptures within and between sessions.

#### Trace DNA identification of predators

Over 100 predation events on native species monitored on WA demo sites have been analysed using trace DNA for species of predator. We have demonstrated that field assessments of predator responsible are correct ~60% of the time. Foxes, cats and native predators can all be correctly identified from trace DNA.

We have acquired a significant increase (>\$100K) in budget for Danielle Stephens' PhD project (IA CRC 10.U.5 student). This has enabled us to initiate a large scale sampling and genotyping of wild dogs and dingoes in the WA pastoral zone and remote parts of the interior of WA. Over 500 samples have already been collected for this.



### **Project 10.U.4 'Southern Ark' – benefiting the biodiversity of East Gippsland through fox control**

IA CRC PhD student Alex Diment is investigating fox dynamics in response to lethal control. Progress has been satisfactory, with some components affected by lack of trapping success (despite intensive trapping effort) and some components working even more smoothly and successfully than expected. Theoretical models of species recovery for some species (Potoroos and one bandicoot species) have been constructed and developed and are now being further tested and refined. 30 remote cameras have provided almost 5000 camera-nights of detection since they were deployed. The data is invaluable, and has already provided remarkable insights into the habits of foxes, dogs, cats and other animals, especially at bait stations. The uptake of FOXOFF® baits during free-feeding was investigated at 30 bait stations over a period of 10 weeks, with 16 bait replacements during that time (a total of 425 baiting events were monitored). Data has confirmed an almost total lack of non-target bait uptake. Fieldwork should be completed over the next six months.

PhD student Tony Buckmaster is simultaneously investigating feral cat home range, movement patterns and habitat relationships in forested habitats of East Gippsland, the diets of feral cats in relation to prey abundance and the time of year when feral cats are most likely to take up baits, as well as collecting information on the effectiveness of monitoring techniques to quantify changes in abundance of feral cats. Some components of this project have been affected by lack of recapture success, delays in baiting of foxes in monitoring areas, delays in the manufacture of feral cat baits for bait uptake experiments and abiotic factors including record monthly rainfall. Other components of the project are progressing satisfactorily and according to schedule.

### **Project 10.U.5 The benefits of a strategic approach to wild dog management**

The last 12 months has principally focused on local stakeholder planning and feedback meetings throughout northern NSW regarding the development of wild dog management plans at local and regional scales. A range of participants continue to be involved, including IA CRC-partners NSW DPI, NSW Department of Environment and Climate Change, Forests NSW, and the State Council of Rural Land Protection Boards. Many wild dog control associations throughout the area are also involved.

A great deal of effort has also been spent constructing and maintaining abundance assessment transects at Tuggolo State Forest, Petroi, Curracabundi National Park, Styx River State Forest, Oxley Wild Rivers National Park and Mt Boss. Monitoring has been conducted before and after management actions (aerial and ground baiting) associated with wild dog control and indices have been obtained for wild dog and fox activity. Data on the effectiveness of each operation are currently being assessed. The site is also developing a research based management plan in the Tanami Desert, NT, for Newmont Asia Pacific.

With additional funding sourced from Newmont and the Northern Rivers CMA, more than 20 wild dogs have now been fitted with GPS collars for research that will aid future management. Training offered through the site (see Education pages following) continues to be over-subscribed and has consistently received excellent feedback from participants. Negotiations are currently underway to offer additional training courses in monitoring pest animals both in NSW and interstate.

## **Project 2.U.1 Roll-out of feral pig control solutions**

Excellent progress has been made in each of the four key objectives of this project. Objective 1, to register and commercialise a 1080 feral pig bait – PIGOUT® – has been completed (see page 41).

### **Objective 2: develop, register and commercialise an alternative toxin feral pig bait – HOG-GONE®**

Much of 2007/08 has involved trying to secure funding for the HOG-GONE® project and to formulate the new active into the PIGOUT® matrix. In July 2007 funding was forthcoming from the National Feral Animal Control Program and the Federal Department of Environment, Water, Heritage and the Arts to undertake the bait formulation trials and to commission non-target sensitivity testing, an independent humaneness assessment and an environmental fate data package. Bait formulation trials were undertaken on Kangaroo Island in October 07 and April 08, and in Inglewood in July and September 08. The provisional patent for the new active was finalised in February 2008. Unfortunately, an \$800K funding application to develop a concentrate of the active for application to grain and meat baits was unsuccessful in June 2008. HOG-GONE® field efficacy trials will commence in late 2008 once the bait formulation has been finalised and project funding is secured.

### **Objective 3: adapt PIGOUT® baits to carry vaccines and fertility control agents for international collaborators**

The United States Department of Agriculture's National Wildlife Research Centre again conducted extensive trials of non-toxic PIGOUT® baits in southern Texas in the hope of finding a suitable delivery vehicle for a combined anti-fertility + pseudorabies vaccine.

### **Objective 4.: investigate the potential of synthetic lures that aid in feral pig trapping and/or bait location and/or novel bait delivery devices (Boar Buffet®)**

2008 saw the creation of the first prototype Boar Buffet®, a large, low maintenance, target-specific bait hopper for population level feral pig management using PIGOUT®, HOG-GONE® or other pig bait substrates. Also recently trialled at the Inglewood facility were four potential feral pig lures. Further trials of the hopper and lures will be on-going throughout 2008/09.

## **Project 10.U.6 Control of feral pigs in tropical rainforest**

CRC PhD student Andrew Bengsen is investigating effective pig control in the Wet Tropics. During the past year he has submitted a manuscript, which is now nearing publication, outlining a methodological framework for developing target-specific pest control tools. An experiment to evaluate the ability of simple bait composition and presentation methods to reduce consumption of feral pig baits by non-target species in tropical rainforest has been completed. Results showed that nocturnal omnivores such as rodents and bandicoots were the most common consumers of baits, and that burying baits substantially reduced their availability to these species. Feral pigs found baits palatable once they had sampled them, but the rates at which pigs encountered and sampled baits were low. The development of suitable attractants or identification of seasonal variation in bait encounter and sampling should improve bait uptake by pigs.

A second trial, which aims to identify the most suitable seasonal conditions to optimise target-specificity and bait uptake by pigs is now underway. A third trial to test whether small nocturnal omnivores can be deterred from feeding on baits by augmenting bait stations with cues indicating an enhanced risk of predation for small mammals has also commenced.

An investigation into the impact of feral pig rooting on vegetation, soil, leaf litter and macro-invertebrates in rainforests is being undertaken by PhD student Amanda Elledge. Fieldwork commenced in July 2007 with paired fenced and unfenced plots initially built for assessing the recovery of rainforest with the short-term exclusion of feral pigs. Extant plots are also being assessed for the recovery of rainforest with the long-term exclusion of pigs. Data for both these experiments are being collected seasonally and are still in progress. The investigation of spatio-temporal variations in



the occurrence of feral pig rooting is progressing well. There is only one more bimonthly survey to complete with data analysis and model development underway.

Carla Meurk is also continuing her PhD study of the social issues surrounding feral pig management in the Wet Tropics, with a specific analysis of issues associated with feral pig hunters.

## Project 10.U.2 Eradication of deer, goats, pigs and cats from Kangaroo Island

Significant progress has been made at the Kangaroo Island demonstration site during the past year.

### Goat control program

Eradication in the Parndana area has been completed with 44 feral goats removed. No goats have been sighted in this area since September 2007, however, three Judas goats are still active and annual monitoring is continuing. Goat management in Flinders Chase National Park (FCNP) is close to completion with only one known group remaining. Seven Judas goats remain dispersed through out the area and the known group is with one of these goats. Management has started on the north coast where goats are close to eradication from half the distribution. The program benefited from the December bushfires which improved access to goats on the coastline and decreased the population. Two of the five Judas goats were destroyed in the fire suggesting that some feral goats would also have been destroyed. Dietary analysis has identified a large range of native plant species eaten by feral goats in FCNP.

### Deer control program

41 deer have been destroyed this year and a monitoring program has been implemented across the island to identify changes in distribution. Deer farm fence inspections are also being undertaken.

### Pig control program

HOG-GONE<sup>®</sup> bait scoping trials were undertaken in Flinders Chase National Park and other areas during April 2008. Genetic samples were collected and will be analysed at Canberra University. This will enable identification of management units based on genetic isolation. Assistance with pig control has also been given to landholders.

### Cat control program

Continued assistance with cat trapping has been given to residents in problem areas and promotion of domestic cat control requirements is ongoing. KI will shortly participate in national trials of the CURIOSITY<sup>®</sup> feral cat bait.

See figure 3 (p. 28) for demonstration site locations.

Header images previous and next page L to R: Shooter and pigs courtesy Adam Henderson, Lake Alexandrina field site courtesy Roger Pech, denuded forest floor and canopy ((both Daintree) courtesy Steve Lapidge, possum trap site courtesy Jennyffer Cruz, WA jarrah forest field site courtesy Steve Lapidge, Macquarie Marshes, fox release courtesy Alex Diment, map from GoogleEarth.



(L to R): Running pig courtesy S. Lapidge, face-on pig courtesy Paul Crock, pig group courtesy Luke Leung.



## Our demonstration sites cont'd

### Project 10.U.8 Carp control in the Logan-Albert Catchment

The research has been progressing well over the last 12 months. A total of 16 000 carp with a combined weight of just under 30 tonnes have been removed. The range of techniques evaluated included seine netting, gill nets, electrofishing, angling (carp fishing comps), draining of dams and water level manipulation and opportunistic removal. These efforts have been targeted in the middle reaches of the Logan-Albert system which appears to be the main recruitment area. Research has also commenced into the cost efficiencies of a few novel techniques such as portable traps that work in conjunction with a range of attractants. Investigation of the spawning sites and movement pathways of carp has also continued.

Evaluation of carp fishing competitions has continued with events at Thallon (March) and Goondiwindi (April). The Thallon competition attracted 305 participants who caught 170 carp from the 4 km of river in the competition area, for a total weight of 108 kg. The overall reduction to the local carp population by angling was only 1.8 %, which was significantly less than the 16.1% reduction by electrofishing. The highest reduction at any particular site due to angling was 6.9 % compared to electrofishing at 32.1%. The 266 competitors (substantially more than last year) of the Goondiwindi Carp Cull caught 149 carp with a combined weight of 105 kg. The impact of angling varied between river (2.1%) and lagoon (1.1%) sites. Electrofishing had a far greater impact with reductions averaging 8.4 % in the river and 16.2 % in the lagoons. Mean reduction rates across the monitoring in the entire 10 km competition area were 1.6% for anglers and 10.6 % for the electrofishing.

### Project 10.U.9 Targeted carp control options for the Lower Lachlan Catchment

The project team have made excellent progress this year with much of the bench-marking now complete. Benchmarking has included:

1. The fish community bench marking survey, including the carp population for the Lachlan river and control sites in the Macquarie and Murrumbidgee rivers.
2. Quarterly bench marking of water quality for all sites.
3. Bench marking of habitat with mapping of all bench marking sites conducted yearly; and
4. Development of a communication strategy, and
5. The conduct of an on-line social survey to determine public attitudes to carp. A significant finding of this survey was that 100% of respondents want to see management actions implemented for carp control. The Lachlan River Revival display trailer, complete with a tank of various fish species, was a highlight when it was featured at the Native Fish Strategy Forum at Narrandera and Condobolin. The display trailer also proved popular when exhibited at the Australian Science Festival in Canberra.

Other achievements this year included an intensive carp tagging program that has been initiated to monitor carp control actions, the undertaking of commercial fishing operations at Lake Brewster and Lake Cargilligo to investigate capture strategies, and a trial of carp screening devices at Lake Brewster. Field sampling of post-larval carp from the Lachlan catchment was also completed, and trace element analysis of post-larval carp otoliths was examined, which found good discrimination among potential recruitment sites. The use of a multi-collector mass spectrometer for measuring isotope ratios in carp otoliths has now resulted in greatly increased accuracy in discriminating between recruitment sites.



## Project 10.U.1 Introduced predator control and sustained fauna recovery in south-west WA

This project aims to improve understanding of predator interactions, resulting in improved best practice on-ground management. The WA demonstration site is comprised of four subprojects:

### Subproject 1

Led by Dave Algar, is investigating sustained predator control in the WA rangelands. The results for the first two years of the project have indicated:

- indices of introduced predator abundance can be significantly reduced for a number of months after the winter baiting
- these indices, particularly foxes, gradually increase over the late summer and autumn during the main fox dispersal period
- indices of cat abundance one year post-baiting were less than half of the initial level
- successes of the first baiting program were demonstrated again in the second year with complete removal of cats and almost complete removal of foxes following baiting
- indices of cat abundance have remained low in the baited site, while indices of fox abundance started to increase again during the period of juvenile dispersal
- the control strategy implemented would be enhanced with the addition of an autumn fox baiting program which would maintain suppression of fox numbers until the subsequent winter integrated introduced predator baiting.

Recent development of an effective and reliable hair capture technique for DNA extraction will now enable collection of data that can be used to identify specific individuals at plots. This will provide valuable information for the development/refinement of more robust indices of relative abundance. The technique may also be able to provide estimates of population size and therefore allow validation of the utility of indices.



Left: ringtail possums killed by a fox and fox fitted with GPS collar, courtesy Alex Diment. Cat sedated for fitting with collar, courtesy Tony Buckmaster.



## Our demonstration sites cont'd

### Project 10.U.1 Introduced predator control and sustained fauna recovery in south-west WA

#### Subproject 2:

Led by Paul de Tores, this work is testing the hypothesis that effective and sustained fox control leads to an increase in the abundance (mesopredator release) of feral cats and/or native predators at the landscape scale in the northern jarrah forest. Sandplot networks have been established at seven sites (five in baited zones and two in the unbaited control) to monitor fox and cat activity and derive estimates of abundance and density for both species. Cats are present throughout the landscape and, at all but one site, indices of activity and estimates of density revealed cats to be more numerous than foxes.

Scats have been collected and hair collection devices have been effectively trialled and deployed to enable use of molecular techniques to determine the species responsible for leaving hair (in collaboration with Dr Berry). Genotyping to identify individual foxes has been demonstrated. Scats are also used to examine the dietary intake of foxes, cats, chuditch, varanids and pythons and assessed against prey availability as determined by seasonal trapping of native prey species (small mammals, reptiles and amphibians) at 10 trapping webs established within baited treatments and unbaited control. Trapped cats and foxes are fitted with satellite collars. Data have now been used to quantify cat home range within the unbaited control.

The native marsupial predator, the chuditch, and two large native reptile predators (*Varanus gouldii* and *V. rosenbergi*) are trapped seasonally (by IA CRC post-docs Al Glen and Duncan Sutherland respectively) to investigate landscape and fine scale analyses of habitat use. This trapping coincides with the prey web trapping and has shown chuditch and varanid density estimates to be higher in baited areas than in the unbaited controls, but highly patchy. Recently DNA analysis of swabs taken from puncture wounds on a dead chuditch indicated that a feral cat was responsible. This was the first concrete evidence of interspecific killing between these two species.

Two PhD programs are included in the northern jarrah forest subproject – one examining pythons from a mesopredator release perspective (Gillian Bryant), the other examining common brushtail possum survivorship, diet and habitat use in baited and unbaited areas (Jennyfer Cruz; IA CRC). Both projects assess their findings in light of the results from the fox, cat and native predator response to fox density reduction. The northern jarrah forest python data alone is equivocal, but is consistent with the mesopredator release hypothesis, with very low numbers of pythons detected in the unbaited control areas. Similarly, data from radio collared common brushtail possums has so far indicated no selection for greater percentage cover at any site.

#### Subproject 3

To date 173 woylies have been trapped. Twenty-two individuals in Dryandra and 20 in Tutanning are monitored five days per week. Fifty-seven (69%) deaths have been attributed to fox predation. A further six (10%) of mortalities have been attributed to fox/cat predation, one (2%) to cat predation, seven (11%) to raptor predation and three (5%) to python predation. The genotypes of nine individual foxes have been determined from DNA samples obtained from swabbed



woylie collars. These will be used to determine if 'rogue' foxes are responsible for most of the woylie predation. Of ten sub-adult woylies monitored, four were killed by foxes, one by either a fox or feral cat and one by a wedge-tailed eagle. Further analyses of prey remains from the 15 wedge tailed eagle nests located in Tutanning and Dryandra is currently occurring.

Bait uptake is monitored by remote cameras. Most baits were taken by brush-tailed possums (20% and 10% in Dryandra Woodland and Tutanning Nature Reserve respectively). Birds and woylies also removed some baits (7% in each site for birds and 5% and 3% respectively for woylies). Foxes removed 5% of the baits in Dryandra Woodland and 3% in Tutanning Nature Reserve. No cats took any baits.

#### **Subproject 4**

Led by Keith Morris, this subproject is investigating factors affecting native fauna recovery in the wheat belt at Lake Magenta and Dunn Rock. Over the last 12 months the subproject has reported:

- despite 12 years of fox control at Lake Magenta, fox activity remains at approximately 50% of that at an unbaited control site (the aim was for an 80% reduction)
- a significant positive correlation has been found between fox activity and fox density, as estimated by sand pad patterns
- a significant negative correlation has been found between fox and feral cat activity indices
- aerial and ground fox baiting activity has been highly variable over the last five years, and there has been little coordination between ground and aerial baiting activities
- foxes at Lake Magenta show some indication of bait avoidance, and bait uptake off track is low.

More recently a new fox prescription of simultaneous aerial and ground fox baiting has been trialled and lower fox activity is being recorded. The uptake of feral cat baits by non target species will also be trialled in 2009.

#### **Project 6.U.1 Feral cat bait uptake in Eastern Australia**

Dr Elizabeth Denny, a University of Sydney Postdoctoral appointment with the 10.U.4 project (see p. 55) commenced field trials of non-toxic CURIOSITY® (ERADICAT bait containing new PAPP active) feral cat baits in 2008 after delays in getting access to the product. Liz has completed a draft review of feral cat control in Australia as part of the project. Bait-uptake trials are to be conducted in arid/semi-arid and forested habitats in Queensland, New South Wales, Victoria and Kangaroo Island. The sites are located in a brigalow woodland near Moonie in south-east Queensland, a forested area in north-east NSW, Yathong near Cobar in NSW, Scotia Nature Reserve on the border of New South Wales and South Australia, forested areas in East Gippsland and the mallee near Mildura, and Kangaroo Island off the coast of South Australia. Arid/semi-arid field protocols are based on (with variations), bait-uptake trials conducted near Wiluna in WA.

It is hoped that the project will be completed in early 2009, with results published later in the year.

## Milestone achievement



Output/ Milestone Number	Description	Contracted Achievement Date	Achieved (Yes or No)	Reasons why not achieved (if applicable)	Strategies to achieve unmet milestone
<b>1.1 Output</b>	<b>Fox and wild dog management packages that include new and existing toxins, application strategies and end-user training</b>	2012			
1.1.4 Milestone	Ecological studies commenced to identify interactions with other processes threatening wildlife or human health or damaging production, and new wild dog and fox management technologies and strategies tested and refined. Issues not covered at demonstration sites	deferred from 30 June 2007 to 30 June 2008	Yes		
1.1.7 Milestone	National recommendations for improved practices for fox and wild dog control drafted and finalised	30 June 2008	No	Milestone deferred. While projects are underway, most are only halfway through their funding life. More logical to produce national recommendations for improved controls and practices towards the end of the collective projects funding life. This will also allow inclusion of PAPP work	Recommend that this milestone be extended to take into account the full gamut of improved practices and controls enhanced throughout the life of the CRC. Extend date to 30.06.2011
<b>1.2 Output</b>	<b>Fox and wild dog management packages that include new and existing toxins, application strategies and end-user training</b>	<b>2008 (Registration) 2010 (Marketing &amp; Adoption)</b>			
1.2.2 Milestone	New products and new applications of existing toxins registered. One new chemical toxicant registered. One synergist to 1080 tested and assessed for registration and marketing. If the new chemical toxicant is successfully registered, the market for the synergist may be reduced, as the new active will replace the 1080 toxin	30 June 2008	No	1080 synergist attempted but failed. PAPP registration for foxes delayed	CRC fast tracking PAPP registration for fox control, which will be submitted to APVMA by September 2008
1.2.3 Milestone	Education and training package linked to demonstration sites developed for end-users.	30 June 2007 and biennial review	Partly	Demonstration Sites 10.U.1 (WA), 10.U.3 (Tas), 10.U.4 (Vic) and 10.U.5 (NSW) education and training packages are underway and ongoing. Each site is utilising the media well to ensure timely information delivery. The Uptake Update newsletters have also provided a popular means of delivering information about each project to those interested. Information dissemination is also occurring at conferences and training days	Currently working up training packages through the CRCs education program (wild dog trapper training).  Final review due for June 2011

## Terrestrial Products and Strategies Program



Output/ Milestone Number	Description	Contracted Achievement Date	Achieved (Yes or No)	Reasons why not achieved (if applicable)	Strategies to achieve unmet milestone
<b>1.3 Output</b>	<b>Additional registered fox and wild dog management tools, including lures and new toxin delivery methods</b>	<b>2008 (Registration) 2010 (Marketing)</b>			
1.3.3 Milestone	National registration (if necessary) obtained for delivery systems and multiple canid lure devices that will increase canid detection and bait uptake	30 June 2008	No	While one synthetic lure is available (Feralgone), no other work on the horizon.	Workshop M44's with key stakeholders to resolve pathway to registration and adoption.
<b>5.1 Output</b>	<b>Bait and other lethal control technologies developed, tested (and where possible) registered for local control of cane toads</b>	<b>December 2007</b>			
5.1.2 Milestone	Discovery phase completed for bait and pheromone projects and decision taken on viability of deployment phase	30 December 2007	Yes		
5.1.3 Milestone	Assessment of ecological or topical control methods against cane toads completed	30 December 2007	Yes		
<b>7.1 Output</b>	<b>The mechanisms behind the lack of effectiveness of Rabbit Haemorrhagic Disease (RHD) in higher rainfall areas understood</b>	<b>December 2010</b>			
7.1.2 Milestone	Field studies, sample collection and laboratory analysis commenced	Review June 2008	Yes		

## Milestone achievement



Output/ Milestone Number	Description	Contracted Achievement Date	Achieved (Yes or No)	Reasons why not achieved (if applicable)	Strategies to achieve unmet milestone
<b>4.1 Output</b>	<b>Business Plan for the Murray-Darling Basin Commission for the control and possible eradication of carp in the Basin, and the operational tools to make the plan feasible</b>	<b>2012</b>			
4.1.4 Milestone	Key elements for national policy and legislative frameworks for effective management of aquatic pest animals recommended to State, Commonwealth and NZ government lead agencies (eg. Vertebrate Pest Committee, Ministerial Council for Natural Resource Management	30 June 2008	No	Would have been premature to make such recommendations. GM Policy review project held over to commence Jul 08 and Rapid response plan project was delayed in starting	Milestone deferred and deadline proposed for review
4.1.5 Milestone	National biennial workshops held with MDBC, NZ DOC, State and Commonwealth agencies, water users, conservation agencies and other key groups, to evaluate progress on and practicality of the business plan	30 June 2008	No	The CRC has used existing intergovernmental mechanisms for consultations relating to the CRC's freshwater pest projects. This includes the Australian Fisheries Management Forum and the Vertebrate Pests Committee fish working group	Milestone proposed for review
4.1.6 Milestone	Annual meetings of 'Daughterless' Consultative Committee held	June 2008	Partly. ongoing.	The CRC has continued consultations at high levels in govt through presentations and discussions using existing inter-governmental mechanisms, incl presentations to the Aust Fisheries Mgmt Forum and the VPC Pest Fish Working Group, rather than through the establishment of new specific intergovt mechanisms. The CRC is also a member of the Basin Alien Fish Plan Working Group, which is considering the role of daughterless carp technology in the scope of the Plan, in accordance with Native Fish Strategy for the MDB 2003-1013 Action 4.9	Milestone proposed for review
4.1.7 Milestone	Recommendations produced for State, Cwlth and NZ government lead agencies on the key elements for national policy and legislative frameworks for effective management of aquatic pest animals	30 June 2008	No	Would have been premature to make such recommendations. GM Policy review project held over to commence Jul 08 and Rapid response plan project was delayed in starting	Milestone deferred and deadline proposed for review

## Freshwater Products and Strategies Program



Output/ Milestone Number	Description	Contracted Achievement Date	Achieved (Yes or No)	Reasons why not achieved (if applicable)	Strategies to achieve unmet milestone
<b>4.2 Output</b>	<b>Improved technologies for reducing rate of spread of pest fish species</b>	<b>2012</b>			
4.2.2 Milestone	Policy recommendations for rapid response options, including vector management, and recommendations for response plans for specific invasive fish problems completed	30 June 2008	No	Staffing changes delayed project commencement. Project now underway	Milestone deferred and deadline proposed for review
4.2.3 Milestone	Risk and hazard analyses for new pest fish and significant range extensions of existing pests completed	01 June 2007 – carried over	Partially	The first research stage has been completed to refine and validate pest freshwater finfish risk assessment models. A second stage may apply these validated assessment models to assess a number of new and emerging pest fish	Milestone deferred and deadline proposed for review
<b>4.4 Output</b>	<b>New generation genetic and biocidal products for controlling invasive fish</b>	<b>2012</b>			
4.4.2 Milestone	Joint R&D with pest control companies & liaison with overseas agencies initiated to assess market opportunities directly & via international biotechnology conferences	30 June 2007 ongoing	Partially	Project leader for the CRC's premier genetic technology project is in on-going liaison with US Geological Survey personnel about possible collaboration and co-funding opportunities	Milestone proposed for review
<b>4.5 Output</b>	<b>Improved technologies for reducing rate of spread of pest fish species</b>	<b>2012</b>			
4.5.1 Milestone	Hazard analysis workshop held for water managers, community groups & local, national & international biologists on reducing risks of spread of pest fish from water storage & irrigation impoundments	30 June 2007 – carried over	No	This is essentially a govt role rather than a CRC role. CRC could contribute but should not be the driver. It will in part be met by our final report which brings together available options	Milestone proposed for review

## Milestone achievement



Output/ Milestone Number	Description	Contracted Achievement Date	Achieved (Yes or No)	Reasons why not achieved (if applicable)	Strategy to achieve unmet milestone
<b>8.1 Output</b>	<b>Management recommendations for endemic and exotic diseases of invasive animals</b>	<b>2009 (Registration) 2011 (Uptake)</b>			
8.1.1 Milestone	Current information relating to invasive animal diseases (exotic & endemic) collated, published and disseminated, & potential risks to Australasia assessed	30 June 2007 – carried over with milestone modified accordingly. New delivery date 30 June 2008	Yes		
<b>9.4 Output</b>	<b>The development of information systems that will improve coordination and evaluation of effort on a national, regional and local level</b>	<b>2011</b>			
9.4.2 Milestone	Web-based data entry systems for abundance, density damage information developed and evaluated	Carried over from June 2007 and ongoing	Yes		Milestone proposed for review
9.4.3 Milestone	Decision support systems to support targeted pest animal control strategies developed	30 June 2008	No	No specific funding available	Milestone proposed for review
9.4.4 Milestone	Pest density-damage relationships for invasive animals assessed to optimise benefits from control	Carried over from June 2007 and ongoing	Yes – and ongoing		
<b>9.5 Output</b>	<b>Development and implementation of improved, cost-effective risk management strategies and response options to restrict introductions or the range of invasive animals</b>	<b>2011</b>			
9.5.2 Milestone	Assessment and prioritisation of risk of pest potential for invasive animals existing in Australia, and those that could potentially be imported completed	30 June 2008 and ongoing reviews	Yes		
9.5.3 Milestone	Tools for monitoring pests at low population densities developed	30 June 2008	Yes and ongoing		



## Milestone achievement



Output/ Milestone Number	Description	Contracted Achievement Date	Achieved (Yes or No)	Reasons why not achieved (if applicable)	Strategies to achieve unmet milestone
<b>2.1 Output</b>	<b>Management packages for feral pigs, including new &amp; existing toxins, application strategies &amp; end-user training</b>	<b>2012</b>			
2.1.1 Milestone	'Achilles Heel' review of feral pig physiology to find species-specific toxicants completed	31 December 2007	Yes		
2.1.4 Milestone	Ecological studies commenced to identify interactions with other processes threatening wildlife or human health or damaging production, & new feral pig management technologies & strategies tested & refined	Review June 2008	Yes		
2.1.7 Milestone	National recommendations for improved practices for feral pig control drafted and finalised	30 June 2008	No	Milestone deferred. While projects are underway, most are only halfway through their funding life. More logical to produce national recommendations for improved controls and practices towards the end of the collective projects funding life. This will also allow inclusion of HOGGONE® work	Project 2.U.1 has published 12 scientific papers, 1 patent and numerous scientific reports since the project commenced. All this information will be assimilated into updated national recommendations for improved feral pig control before the end of the IA CRC
<b>2.2 Output</b>	<b>Humane and target specific feral pig baits</b>	<b>2006 (bait) 2008 (Marketing &amp; adoption) 2012 (Achilles heel baits) Humane &amp; target specific baits</b>			
2.2.1 Milestone	Registration & market delivery of sodium fluoroacetate feral pig baits	30 December 2006 - Product registration was delayed due to extended APVMA approval process	Yes		

## Uptake of Products and Strategies Program



Output/ Milestone Number	Description	Contracted Achievement Date	Achieved (Yes or No)	Reasons why not achieved (if applicable)	Strategies to achieve unmet milestone
2.2.2 Milestone	Commercial uptake of new feral pig baits	30 December 2007	Yes		
2.2.3 Milestone	Adoption of new baits through demonstration sites and publicity	30 June 2008	Partly		Demonstrations of PIGOUT are currently occurring in the Daintree rainforest (10.U.6, non-toxic baits) and will again occur on Kangaroo Island (10.U.2)
<b>2.4 Output</b>	<b>Feral pig management packages that include new and existing toxins, application strategies and end-user training passed to end users</b>	<b>2010 (Registration) 2012 (Marketing and adoption)</b>			
2.4.3 Milestone	Rapid adoption of new management strategies to reduce agricultural and environmental impacts ensured through demonstration sites and collaborative field-based projects with end-users	30 June 2008	Yes and ongoing		
<b>6.2 Output</b>	<b>Humane and target-specific feral cat baits</b>	<b>2011</b>			
6.2.3 Milestone	Registration of recently-developed feral cat bait with inclusion of new or existing toxins encouraged and assisted	30 June 2008	No	Different formulations still being trialled to reduce non-target impact	ERADICAT (1080 feral cat bait) was registered by the WA Demonstration Site (10.U.1) and is being utilised at that site and possibly at 10.U.4. Registration assistance is currently being provided for the CURIOSITY bait (PAPP feral cat bait), and non-toxic and toxic field trials of the bait will shortly be undertaken by 6.U.1, 10.U.1 (WA), 10.U.2 (SA) and 10.U.4 (Vic).
6.2.4 Milestone	Education and training package linked to demonstration sites launched for end-users	30 June 2008	Partly	Would have been premature to develop the education and training package so early in the life of the CRC. Delay will enable all relevant Centre IP to be included in education and training package.	Milestone deferred.

## Milestone achievement



Output/ Milestone Number	Description	Contracted Achievement Date	Achieved (Yes or No)	Reasons why not achieved (if applicable)	Strategies to achieve unmet milestone
<b>11.1 Output</b>	<b>Increased professional and practical skills base in invasive animal management through education, training and community awareness</b>	<b>2012</b>			
11.1.4 Milestone	Thirty honours degree candidates (1 year full-time, 2 years part-time) enrolled in the life of the IA CRC. Students enrolled each year in 2006 – 2010 (enrolment may be at any CRC partner university)	28 February 2006 and annually	No	Due to budget constraints the Honours program will not achieve this milestone – only 2 honours students have been accepted	This milestone will not be achieved and is proposed for modification
<b>11.2 Output</b>	<b>Stakeholder Training: delivery of workshops, training courses and community awareness to increase practical skills and knowledge, and ensure consistent national management strategies of invasive species</b>	<b>2012</b>			
11.2.2 Milestone	A series of five 'training the trainer' courses, delivering consistent national approaches to knowledge, management and practical skills training, presented to facilitate a rapid uptake of new technologies, and provide the opportunity for two-way information flow	01 June 2007 and ongoing	Partly	Ongoing project	This activity will be covered by the Diploma in CLM course which commenced early 2008
11.2.3 Milestone	Specialist training presented to national and international students, researchers and land managers for each key invasive species targeted by the IA CRC	30 June 2007 and ongoing	Partly	Ongoing project	This activity is covered by the Diploma in CLM course which commenced early 2008
11.2.4 Milestone	Awareness training presented for councillors and staff at a minimum of 14 urban electorates to facilitate informed policy making	30 June 2007 ongoing until 2012	Partly	Ongoing project	Many staff have presented best practice management advice at various venues. As part of the development of the Pestplan Diploma course, wide consultation and discussion with industry partners and stakeholders has been conducted. These include 2 presentations to the Vertebrate Pest Committee, discussions with DSE Victoria, NSW DPI, DEC, NSW NPWS, Dubbo RLPB, Cobar RLPB, Land and Water Australia, a number of NRM regions including Lachlan NRM, Eyre Peninsula NRM, Boarder Rivers NRM and the Commonwealth NRM team. Furthermore, the Pestplan Diploma will run a pilot course has has granted free places to relevant organisations in each state. Currently these include Inglewood Shire Council QLD, Queensland Murray-Darling Committee QLD, HESROC QLD, DPIW TAS, DSE VIC, DPI Leongatha VIC, DPI NSW, RLPB NSW, MDB NRMB SA, KI NRMB, Environment ACT and DEC WA. The aim of the pilot course is to provide training in the developemnt of strategic pest management plans and to obtain feed back on the suitability and accessibility of the course for land managers in each region.

## Education Program



Output/ Milestone Number	Description	Contracted Achievement Date	Achieved (Yes or No)	Reasons why not achieved (if applicable)	Strategies to achieve unmet milestone
11.2.5 Milestone	Invasive animal management training presented for local government land managers and rangers at a minimum of 14 urban electorates	30 June and ongoing until 2012	Partly	Ongoing project	Diploma in CLM course commenced early 2008 and addresses this milestone in full. This should be covered by Pestplan and the DPI CLM level II-IV course, but we are also keeping a log of training events that CRC staff run at specific sites.
11.2.6 Milestone	Four courses delivered to agency staff and land managers focussing on practical detection, monitoring and control skills for dealing with invasive animal incursions	30 June 2008 and ongoing	Partly	Our stakeholder training project may partly cover off on this milestone	This is not specifically covered in Pestplan, but may be covered in the CLM level II-IV course – may need more input, but no funding currently allocated to this milestone.
11.2.9 Milestone	Host workshops held for each key invasive species (including native species) targeted by the CRC to ensure consistency of national management strategies	30 June 2008 and ongoing	Partly	New 2nd phase project to develop management and education packages	A national pig workshop was held in 2003 and a national wild dog workshop was held in 2004 by previous PAC CRC. The IA CRC has held national workshops for cane toads, deer and horses, and is jointly convening the Rabbit Management Advisory Group. The 2008 national Vertebrate Pest Conference (organised by the CRC) included a number of specific invasive animal symposia or workshops (eg. cane toads). Workshops and focus groups are envisaged in the process to develop management and education packages for CRC priority invasive animals though will be structured around end-user groups rather than key invasive species.
11.2.11 Milestone	Extension practitioner workshop held to enhance skills and knowledge to effectively deliver strategic best practice invasive animal management strategies	31 December 2007	No	It is more strategic to deliver this milestone as part of roll-out of CRC education and management packages in 2011/12	This milestone needs to be delayed and delivered near the end of the CRC as part of the roll out of CRC education and management packages. It/they should be integrated with existing for a and processes, eg. held in tandem with State pest control conferences.
11.2.12 Milestone	Training provider workshop held to update and discuss future directions, issues and requirements of training providers	31 December 2007	Yes		Completed as part of course preparation.

# Business performance



## Communications report

### Platform SME marketing – main events

In September 2007, the CRC launched a new book 'Managing Bird Damage to Fruit and Other Horticultural Crops' (Tracey, Bomford, Hart, Saunders & Sinclair). We provided graphic design, event management and media promotion skills and effort and attracted Senator Abetz to open the launch. Invited speakers included the CEO of Horticulture Australia Ltd, the President of the NSW Wine Industry Association, and an economist from ACIL Economics (who were contracted to conduct analysis for the project). The CRC was a co-supporter of the production of this book, which was published by the Bureau of Rural Sciences. Horticulture Australia Ltd and the National Wine and Grape Industry Centre were co-sponsors of the book and the event. Our media release and promotion through our website and regular e-newsletter 'Feral Flyer' (with its readership of over 900) contributed to the profile of these organisations and their aim of increasing the skills base in their industry.

In March 2008, the CRC provided financial and communications resources for the launch of Animal Control Technologies Australia's new feral pig control product – PIGOUT® – thus significantly increasing its profile and boosting sales. Communications activities included graphic design, writing and layout of invitations, flyers, a media information pack (also distributed on cd), fact sheets and media releases. We managed the event, and afterwards widely promoted the product, including in 'Feral Flyer', on our website and in numerous media interviews.

These communications activities were aimed at achieving goal 10 of our Strategic Plan: growth in Australian invasive animal pest control industries. Through industry collaboration on the registration, marketing, export and community uptake of new products the CRC will enhance control of problem species.

### Networking SMEs into research providers

Towards our Goal 11 – 'increased professional and practical skills base in invasive animal management through education, training and community awareness' – we undertook a range of activities.

The CRC organised (on behalf of the VPC) the Vertebrate Pest Conference held in Darwin (June 2008). We additionally provided sponsorship to this event, where several SMEs (and our CRC) took exhibition stands to promote their products. Sponsorship packages and presentation of papers gave SMEs such as EcoGene, Sirtrack and Pestat Ltd exposure to over 300 delegates from a wide variety of organisations. These included international, national and state government bodies, and international and national R&D organisations plus other land management personnel. The conference provided a significant opportunity for SMEs to meet and share information with other research providers, and potential clients or collaborators. ACTA's profile was further enhanced by the opportunity to present a student prize at the conference dinner – this activity was photographed and disseminated widely through 'Feral Flyer'.

The prominence of invited guests and speakers at that event also generated a significant media profile for the CRC and a number of our partner organisations who took the opportunity to showcase their work.

We published the proceedings of a workshop that we co-hosted with SME Parasitech last year on remote monitoring of wild canids and felids. This workshop brought together 33 people representing IA CRC partners undertaking studies to improve the management of wild dogs, foxes and feral cats with other people/organisations identified to be working with remote monitoring technology. The parties identified common themes, appointed applicants for joint funding proposals and shared information to build a database of sites and availability of such equipment. The publication of this data contributed significantly to our goal of increasing the skills base in invasive animal management and fostering collaboration to promote the efficient use of this expensive technology.

We have also published a range of other technical reports, all of which are available for free download via our website. These reports contribute to our other communications target – meeting Strategic Plan goal 12: increased professional and practical skills base in invasive animal management through education, training and community awareness.

## Communication leadership

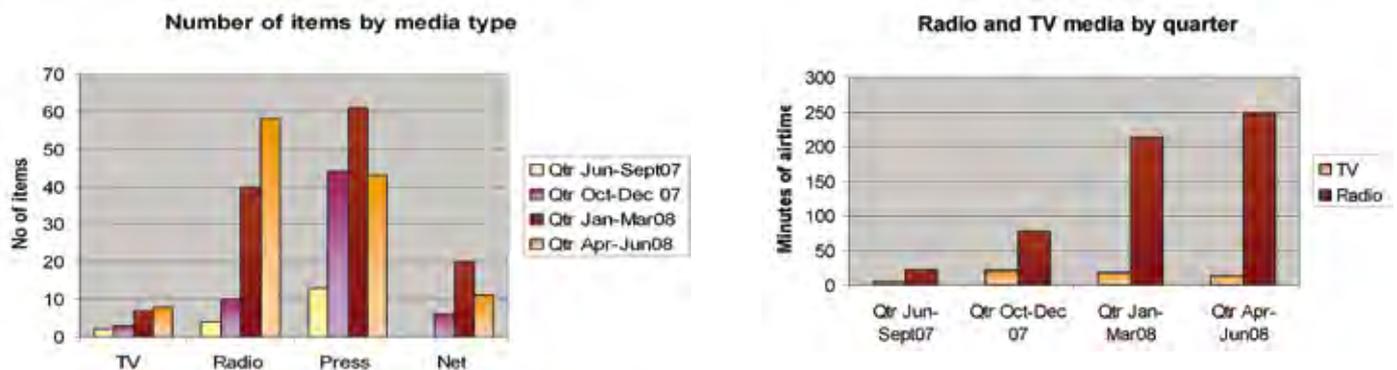
The CRC has an important role to play not only in innovation, but also in presenting potential risks to the community. Two issues that we have tackled in the past year are foxes in Tasmania, and the potential biosecurity risk of importing hybrid animals (Savannah cats) into Australia.

The CRC, upon discovering the potential importation of these hybrids (African serval x domestic cat), possible through a loophole in the Environment Protection and Biodiversity Conservation Act 1999, advised the government, issued media statements, and made a submission to the review process. The public overwhelmingly supported the CRC's stance, with over 2 000 responses being made to online surveys. Of 549 submissions to the DEWHA, 526 supported a ban. This highlighted the Australian public's generally good understanding of the risks to our biodiversity posed by invasive vertebrates, and the importance of our work to find new ways to control them. The Minister subsequently announced that the importation of Savannah cats would not be permitted. See our website for further details.

## CRC in the media

Over the year we achieved a strong media presence, with approximately 250 minutes of radio time and 13.25 minutes of TV time in the last quarter alone. In the first half of 2008, stories featuring the CRC or its researchers accounted for over 70 000 words in print media; and over 6 000 words online.

Figure 5 (left): Number of items in the media by quarter; Figure 6 (right): Number of items on TV and radio per quarter.



The top invasive vertebrates featured by the media were wild dogs, foxes, tilapia and carp, feral pigs, cats and cane toads. A breakdown of the animal receiving the most coverage by month is shown here:

July	August	September	October	November	December	January	February	March	April	May	June
toads	various	rabbits	wild dogs	carp	carp	wild dogs/foxes	tilapia	tilapia	pigs	toads	feral cats

Media interest has generally aligned with promotional activities of the CRC, including Professor Peacock's regular fortnightly radio slot on ABC 666's 'Morning' program, or following media releases about new products, strategies or scientific breakthroughs. For example, the launch of PIGOUT® on 31 March was the trigger for feral pigs to be the 'hot topic' in April (see above), and the CRC's media release on Savannah Cats on 16 June promoted cats to 'enemy number 1' for that month.



## Other key communications activities

Our community engagement work associated with carp fishing competitions has resulted in communications opportunities. We co-supported (with Lachlan CMA and NSW Department of Primary Industries) a mobile display unit for invasive fish. This forms part of the 'River Revival' project and staff travel with the trailer and interpretative/educational materials to community events to raise awareness of pest species and the issues.

Our website has been completely updated and redeveloped, with a contemporary design and more tabs leading the user through to a wider range of information. This includes detail on our staff, Participants, our work and policies, demonstration sites, individual projects, hot topics, publications and information on invasive animals generally. We have recently added distribution and abundance maps developed through our supported National Land and Water Resources Audit mapping project. The website hosts a portal to our project management system, which can be accessed by Participant SME's and through which they can obtain project, staff, IP, publications and other information on the CRC's work. The website also has hotlinks to Participant SME websites.

The CRC's electronic newsletter 'Feral Flyer' is produced weekly to fortnightly. It enables communication to and between CRC participants through, for example, announcing achievements or position vacancies, carrying requests for information or resources, announcing upcoming activities or events, introducing new personnel, etc.

The fox DNA project established its own e-newsletter 'Fox DNA News' and website [www.foxDNA.animals.uwa.edu.au](http://www.foxDNA.animals.uwa.edu.au), that update participants (including members of the community) with progress on scat collection and analysis. The collection sites of all samples have been plotted via Google Earth maps, allowing participants to 'see' their effort in relation to confirmed fox locations across the whole country (see page 35). This project is a collaboration between the CRC, University of Western Australia and BRS's Natural Heritage Trust.

Our Uptake Program produces a further periodical newsletter, 'Uptake Update' which is printed and sent to all participants in our projects involved in demonstration sites. Again, the aim of this communications effort is to keep participants and staff engaged in the projects, by updating findings and progress, providing site/location/team information, and generally highlighting how the collaboration is producing results.

All of these newsletters are available for free download via our website, which has been completely rebuilt over the past year. The new site includes a portal to our project management system and is accessible to all CRC participants and staff.

*Below: our website and the Feral Flyer mastheads.*



### Hot Topics and News

Australia named as one of the world's six hot spots for invasive fish invasions [\[more\]](#)

### Latest media release

Media release-Garrett bans Savannah cats  
4 Aug08 [pdf 39.4 kb]

## Commercialisation report

### Commercialisation strategy

The IA CRC comprises 41 members from community groups, SMEs, industry investment and representative corporations, Government agencies, educational and training institutions, research providers and international agencies.

The IA CRC business model has been designed to overcome current market failure and weaknesses that impede the development and adoption of new invasive animal management technologies.

The IA CRC commercialisation strategy is built on two fundamental principles: each commercial project has at least one commercial participant involved in managing the research and a dedicated commercialisation resource within the CRC whose aim is to add and capture value from centre activities. The advantages of this strategy within this CRC's field are:

1. The most significant imposts (research and registration costs) to SMEs launching innovative products into niche 'public good' markets are shared.
2. The commercialisation critical path, commercialisation arrangements and appropriate business plans are agreed upon early in the development of research projects.
3. Commercial partners that will ultimately launch and support products and services in the market place are active participants in the development of the product – often with the assistance of individuals or organisations that will be key influencers to end-users.
4. The critical mass that partnering with the IA CRC brings to research, registration and commercialisation activities adds significant value and credibility to research development and market acceptability of products and services.

The commitment of the IA CRC to this commercialisation strategy is reflected in the appointment of a dedicated Commercialisation Manager with technology transfer, negotiating commercial arrangement/agreement, project management and regulatory expertise.

### Major pathways to adoption for industry

**Commercial technologies** – patenting, licensing and royalty streams.

#### Other technologies

- Information tailored to specific end-user groups (education and management packages, national recommendations for policy end-user groups)
- Academic publication activities (performance measure: bibliometrics).

### CRC commercialisation arrangements

A standard commercialisation arrangement with the IA CRC will be agreed to by all parties, whereby a royalty within a predetermined range will be paid to the IA CRC when a product is commercialised. A key factor in making this system work will be the capacity of the IA CRC to underwrite the advance cost of research on behalf of those members whose role is to provide research services. This mechanism greatly reduces the complexity of IP arrangements because members providing research services will receive immediate reward for effort, without expecting to build equity in the IA CRC for later distribution.

Our success will be measured in growth of IA CRC associated companies, industries and the effective delivery of outcomes to end users and the realisation of national conservation and agricultural production results, not in building our own IP portfolio. This approach represents a paradigm shift from previous research driven IP creation without associated uptake and delivery.



## **Uptake by industry of outcomes of contracted research**

Key features of the IA CRC business model that will maximise uptake of research outcomes are:

### **National cross jurisdictional scope**

The IA CRC involves government agencies from all State and Territory jurisdictions except the Northern Territory, as well as major agriculture industry groups to assist nation-wide promotion and uptake of IA CRC technologies.

### **Key invasive species research and management SMEs partnered within IA CRC structure to commercialise new products**

This direct partnership approach with established pest management SMEs enables rapid commercialisation, production and effective distribution of new products and technologies. In taking this approach the IA CRC will help to grow a stable pest management industry and potentially achieve a long-term royalty return (that will be re-invested in research) on licensing of technologies, rather than establishing a competitive new spin-off company that could reduce the financial viability of existing major SMEs. The IA CRC's default position is that if a product or service can be efficiently and effectively delivered by a private sector member of the IA CRC, it will be assigned to them as the lead agency.

### **Strategic mix of participants to span research-providers, commercialisation, registration, delivery and end-user organisations**

This structure ensures that IA CRC technologies are needs-driven, end-users are involved in development of new technologies from an early stage, and the IA CRC establishes an institution that takes an innovation from concept stage all the way to usage. It will also enable participants to achieve economies of capability and capacity and significantly cut the cost of innovation and implementation. For example; companies participating in the IA CRC will access field sites and resources beyond their current (or future) means; policy development will be fast-tracked through involvement of policy makers in the innovation chain; and delivery/uptake will be improved through national training programs and stakeholder participation.

### **Providing participant members with access to all Centre IP for research purposes**

This enhances rates of progress of R&D uptake.

### **Building public-private-community partnerships**

Much of the impetus for invasive animal management has historically been derived from government coercion, which will continue to be important, but which on its own provides an inadequate, and these days an unacceptable basis for action and government leadership. However, individual landholders also have responsibility for invasive species control, but rely heavily on group control effort for effectiveness. Average landholdings continue to grow in size and an increasing amount of land is managed by absentee landholders. In addition, the wider community demands increasingly more say in invasive species control, with issues such as animal welfare and conservation going beyond the individual land manager. Given this dynamic and changing social attitudes and interests, development of appropriate partnerships is vital. The IA CRC has established a series of major Demonstration Sites (see page 24) to showcase new ways of looking at cross-tenure and cross-discipline invasive species control issues. This highly visible sub-program is a key element of our own innovation chain starting with strategic research.

### **Specific 'off-shore' initiative**

This aims to focus the IA CRC on adapting CRC generated products to overseas markets, and to build productive relationships with key overseas agencies. In relation to the latter, this fostering of active, project-oriented collaborations to import practical solutions will facilitate knowledge transfer between countries that will in turn increase the rate of technology innovation in Australia.

## Commercialisation report cont'd

The outcomes of the IA CRC business model include:

- development of effective knowledge relationships to create and ensure utilisation of technologies through relationships, joint ventures, partnerships and alliances between research organisations, industry and government providers
- sufficient capacity and investment to overcome the major commercialisation barrier for most invasive species control SMEs, namely large-scale-field-proving of technologies in development and preparing registration packages to enable APVMA approval and the broadest use of new invasive species population control products eg new actives and delivery mechanisms
- delivery of new technologies through member government (eg. State government extension services), industry (eg. AWI member networks) and non-government partner (private land trusts) adoption systems to enhance efficient and sustainable uptake by end-users
- enhanced delivery of new technologies by increasing IA CRC capability to access emerging NRM adoption systems and national policy institutions, such as Vertebrate Pests Committee.

## Products, services and processes developed

### Products

- PIGOUT® – a world first purpose-made feral pig bait – has now been delivered – see page 37.
- National, state and natural resource region digital maps of invasive vertebrate distribution and abundance – see page 52.
- Improved risk assessment models – see page 42.

### Management tools

We have launched a number of products to assist land managers, agriculturists and horticulturists. These include two books: 'Managing Bird Damage to Fruit and Other Horticultural Crops' and 'Improving Fox Management Strategies in Australia' and a booklet 'Rabbits: a threat to conservation & natural resource management (quick reference guide).



Shane Adams, NRM Liaison Officer



Greg Mifsud, Wild Dog Management Facilitator



Niccy Aitken in the University of Canberra's genotyping lab



## Services

### National Wild Dog Management Facilitator

The Facilitator's role is to provide a service – identifying and bringing stakeholders together, fostering collaboration and updating their skills and knowledge about strategic management. This assists industry (agricultural and pastoral producers) by helping them work with other land management personnel (local councils, wild dog control associations, rural lands protection boards, National Parks and Wildlife Service etc.) to design and implement coordinated regionally-focused management plans (see page 34).

### NRM Liaison Officer

Assists Natural Resource Management Boards and Catchment Management Authorities to prioritise issues and develop pest management plans with the aim of developing greater integration of CRC research outcomes (IP) into best current practice pest animal management.

### Improved genotyping facility

This service, operating out of the University of Canberra (our partner), has developed (with CRC assistance) successful tests that can now identify five large carnivore (devil, quoll, cat, dog, fox) DNA from scats. This service has been instrumental in confirming the presence of foxes in Tasmania, and the knowledge gained has been applied to modify management activities. It also provides support for our other projects on Kangaroo Island, in the Gippsland region and in northern NSW and southern Qld. Future work will develop markers for other species.

## Patents

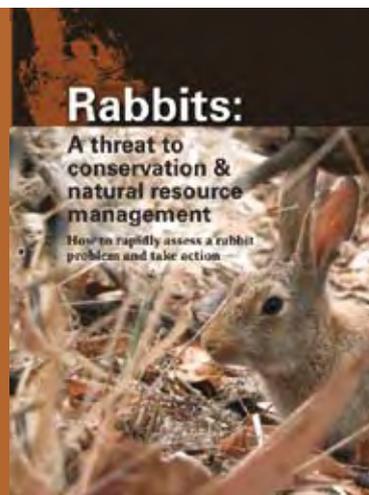
No new patents were filed in the reporting period. The CRC maintained one patent and abandoned one patent.

### Maintained patent

Feral omnivore bait and uses thereof'. International patent application no. PCT/AU2008/000260.

### Abandoned patent:

Genetic control of sex ratios in animal populations'. US patent no. 10/398482; Japanese patent application no. 2002-533636.



*Improving Fox Management Strategies in Australia, available from DAFF.  
Rabbits: A threat to conservation & natural resource management, available from BRS.*

## Intellectual property management

The CRC's management of IP encompasses a balanced strategy based on the following parameters:

- resources
- maximising value of the CRC to participants
- benchmarking background IP and maximising the added value to centre IP
- priority for CRC IP management
- enhancing commercial awareness of centre staff and students
- minimising the risk of inappropriate IP disclosure.

The IP Management Plan was tailored to take into account the unique qualities of the CRC and the focus of its activities. This strategy balanced a requirement for IP identification, while recognising that university researchers commonly saw little prospect of their outputs having value which required IP protection.

Managing the intellectual property of the CRC is critical to achieving an organisation that maximises the value created through applied research and innovation. For this to occur, a capacity to foster invasive animal research and development must be created, whereby innovative methods of controlling invasive animals within Australasian communities and ecosystems are brought to market for the benefit of all stakeholders. The Board and executive of the CRC recognise this key dynamic and have pre-empted the importance of value-adding to participant background intellectual property (BIP) in creating centre intellectual property (CIP), by resourcing the Uptake Program to effectively plan for and manage the IP encompassed within all projects.

Broadly speaking, managing IP can be divided into internal and external IP management. In the context of the CRC operations, internal IP management encompasses all activities required to audit, assess, develop, protect and exploit BIP and CIP, while external IP management encompasses all activities required to identify, evaluate and interpret the relevance of global non-participant IP to the BIP and CIP. Depending on the field and jurisdiction of the relevant global non-participant IP, it will be interpreted as an opportunity or a threat to centre activities and potential CIP. In this way, the CRC can readily pinpoint its IP strongholds and weaknesses within the relevant global IP environment and plan strategically how best to establish a world-leading footprint within the field of invasive animal control techniques. This has the advantage that the CRC can be confident that the value it adds to participant BIP in progressing projects is not placed at unacceptable risk. Also that it builds the profile and brand of the CRC in attracting new research partners and with them opportunities.

For the purposes of this IP Management Plan, IP is defined by the following seven asset classes:

1. technologies
2. manuals, protocols and processes
3. training programs and associated training manuals
4. employees' expertise and experience or know-how
5. databases of information; marketing and promotional materials
6. software
7. photographs and other creative designs.

Rights to exploit the IP are encompassed within the following seven legal devices:

1. Patent for new or improved products or processes.
2. Copyright for original material in literary, artistic, dramatic, or musical works, and in other works that include films, broadcasts, multimedia and other computer programs.
3. Trademarks for words, symbols, pictures, sounds, smells or a combination of these, to distinguish the goods and services of one trader from those of another.
4. Design for the shape or appearance of manufactured goods.
5. Circuit layout right for the 3-dimensional configuration of electronic circuits in integrated circuit products or layout designs.



## Intellectual property management cont'd

6. Plant breeder's rights for new plant varieties.
7. Confidentiality agreements for trade secrets including know-how, other confidential or proprietary information and background knowledge.

Management of these types of IP by the CRC encompasses risks that must be managed in order to maximise the value of BIP and CIP to the company and CRC participants.

This IP management plan aims to describe the processes that the CRC will use to effectively manage these risks.

Key IP risks to the CRC and its participants are:

1. Failing to identify and capture the value in project BIP, assignment of IP and the potential CIP arising from projects.
2. Failing to identify new opportunities within non-participant IP that can be enhanced through the value adding activities of the centre.
3. Failing to identify non-participant IP that is most relevant to centre activities and the potential for infringement.
4. Failing to commercialise centre IP.

More specifically, the CRC IP Management Plan has been designed to accomplish the following key operational outcomes:

1. Conduct an IP audit of all project BIP that defines the IP asset class of BIP in each project, pre-emptively identifies the potential CIP, and highlights project CIP of probably commercial value (internal IP management).
2. Identify BIP that is likely to be commercially valuable and should be (if not already) protected (internal IP management).
3. Predict from BIP and project milestones potential centre IP that will be commercially valuable, so as to pro-actively manage value-adding activities and the researcher's motivation and goals (internal IP management).
4. Identify relevant non-participant IP such that CIP is positioned within the broader global context, in order to highlight infringement risks and future opportunities for collaboration and value adding.
5. Increase the awareness of centre staff and students of the critical processes that underpin commercialisation of research (appropriate record keeping, protecting confidentiality, disclosure, IP asset classes, IP protection methods and the value their research adds to the IP they are working with or developing).
6. Plan and implement procedures that capture the value of centre IP without adversely affecting research collaboration, a researcher's personal motivations, or the unique selling points of the CRC.

The IP Management Plan and how it will operate is conceptualised in the schematic following (Figure 1), which broadly outlines those activities critical to achieving the six operational outcomes. Each of the four segments of this plan are detailed separately, allocating tasks and staff responsibility.

Effectively managing information relevant to IP within an organization that has 41 participants relies on excellent communication and compliance to procedures designed to minimize identified risks. IA CRC has a tailored project/information management system – CRC-Centric. This information management system is an excellent platform from which to effectively manage the information regarding BIP and all emerging CIP as project milestones are accomplished. The IP Management Plan and how it operates is conceptualised in the following schematic (figure 7), which broadly outlines those activities critical to achieving the six operational outcomes.

## Intellectual property management cont'd

Figure 7: schematic overview of CRC's IP management plan





## **First segment – project agreements**

### **Operation Outcomes:**

1. IP Audit
2. Benchmark BIP (asset class, assignment, ownership)
3. Predicting CIP

The Commercialisation Manager is responsible for conducting the IP audit, during which BIP are benchmarked. Benchmarking BIP defines the asset class of the IP, all assignments and ownership of the IP and relevant IP. The Commercialisation Manager is responsible for coordinating with program leaders, project managers and the Business Manager to pre-empt and classify all potential CIP. This information is critical in forward planning for appropriate protective measures and the resources that any protection will require. Specifically, this information is used to flag projects within CENTRIC (our data management system) that are likely to generate commercially valuable IP, such that milestones comprising the critical path in these projects are used as trigger or decision points for the executive in considering an IP plan for the specific project.

## **Second segment – national and international IP research**

### **Operation Outcome:**

4. Providing a context of relevant IP from around the world to highlight threats and opportunities specific to centre activities.

Using information from the IP audit, the Commercialisation Manager in concert with the Business Manager is responsible for developing an optimal search string that is used to search global IP databases for IP relevant to the CRC activities. The Commercialisation Manager is responsible for coordinating and out sourcing to Pestat Ltd patent searches. Pestat was chosen for its expertise in IP law (Dr David Dall) and IP management and access to IP data-bases (Prof Joan Dawes). This expertise and access to information systems is critical to successfully achieving this segment of the IP Management Plan and a project agreement has been negotiated with Pestat Ltd to secure its services in this regard under commercial terms.

## **Third segment – publications, presentations and conference attendance**

### **Operation Outcome:**

5. Plan and implement procedures that minimise the risk of centre IP being inappropriately disclosed

The Commercialisation Manager is responsible for coordinating with project leaders, project coordinators and the CRC executive to plan and implement procedures that are designed to minimise the risk of IP disclosures that would adversely impact the CRC, the public's perception of the CRC or its operational outcomes. These procedures result in an outline of the project's IP asset class, the disclosure content, the disclosure forum and dates. The standard operating procedures also encompass staff/student submissions for publication and media releases. All requests for disclosure need to be reviewed and signed off by the executive prior to the disclosure, wherever possible.

The Commercialisation Manager is also responsible for planning and conducting (with commercial participants) workshops for staff and students that increase the awareness of the importance of IP disclosure (see fourth segment) and the ramifications of inappropriate disclosure to themselves, the centre and its participants.

## Intellectual property management cont'd

### Fourth segment – commercialisation workshops

#### Operation Outcomes

6. Increasing the awareness of commercialisation processes and the critical steps within research that support these processes.

The Commercialisation Manager is responsible for coordinating with Pestat (David Dall – IP law, Joan Dawes – commercialisation of research) to plan and conduct commercialisation workshops for staff and students. The workshops are designed to increase the awareness of staff and students to the importance of IP, IP protection, IP disclosure and the commercialisation process more broadly.

These workshops focus strongly on the methods that should be used to collaborate and communicate effectively within the research community, without undermining the value being created by the research. The methods are demonstrated practically. The aim is to develop a culture within the CRC that values the strategic importance of IP and recognises how it compliments our research. Post-graduates receive the training (and personal advice) at an annual training camp.

The 6 hour workshop is conducted twice a year in the first two years and then reviewed prior to presentations being given in other years. Staff and students are required to attend and at least one of the two workshops are presented in Canberra each year, with the second progressively held in locations across the country in order that it is cost-effective and conveniently held for the majority of attendees.

### Adherence to the national principles of IP Management

The Board has approved an IP management strategy that involves the following:

1. An IP audit of all projects to identify Background IP (BIP) to:
  - a. Define the IP asset class of BIP
  - b. Pre-emptively identify the Potential Centre IP (CIP); and
  - c. Highlight IP of probably commercial value.
2. Predicting from BIP and project milestones CIP that will be commercially valuable so as to proactively manage value adding activities and the researcher's motivations and goals
3. Identifying relevant non-participant IP such that CIP is positioned within the broader global context in order to highlight infringement risks and future opportunities for collaboration and value adding
4. Increasing awareness in centre staff and students of the critical processes that underpin commercialisation of research (appropriate record keeping) protecting confidentiality, disclosure, IP asset classes, IP protection methods and the value their research adds to the IP they are working with or developing.
5. Planning and implementing procedures that capture the value of centre IP without adversely affecting research collaboration, a researcher's personal motivations or the unique selling points of the CRC.

### Operational mechanisms to manage Intellectual Property

Commercialisation of IA CRC outputs occurs through an agreed and effective system for management of intellectual property (IP). This system is based on recognition of three types of IP, namely:

1. 'Centre IP' (CIP) which is IP generated as a consequence of IA CRC supported activities of its members.
2. 'Background IP' which is IP owned by participant members of the IA CRC and made available for use in Centre projects, and
3. 'External IP' which is owned by (non-member) third parties, and to which access is necessary or desirable in order to deliver commercialised IA CRC outputs aligned to our operational targets.



Centre IP (CIP) is legally owned by IA CRC (or held on trust, dependent on ATO advice). The specific origin of all CIP will be recognised and recorded, so that beneficial ownership, in equal shares, can be ascribed to IA CRC members that participate in its development. All members will be able to access CIP free of charge for purposes of R&D within approved IA CRC projects.

Commercialisation rights for specified CIP is set out in relevant Project Agreements. Each Agreement recognises one or more project participants as the intended 'commercialiser(s)' of CIP. Nominated commercialiser(s) will be granted an option (generally exclusive) to take up a licence to commercialise or the right to commercialise CIP in a defined area of application (field and territory) based on their commercialisation plan for the product.

Project Agreements will specify the timeframe within which any claim to commercialisation rights must be exercised, and how such rights may be apportioned where more than one commercialiser is involved in a project. Where a commercialiser does not take up the first right of refusal or the potential application of the CIP lies beyond the interest of project participants, or where CIP is generic in nature, first rights of refusal for commercialisation will be offered to other IA CRC members. If CIP remains unexploited after that, external parties will be invited to bid for commercialisation rights.

The licences granted for commercialisation will be on commercial arms-length terms, as agreed between involved participant(s) and the Board. Licence conditions will include payment of fees and/or royalties for commercial use of CIP, and, as noted above, the Board will require a commercialisation plan that includes set minimum performance indicators.

Background IP made available to a project by a participant member will be secured both for the immediate conduct of the project, and also for its subsequent use in commercialisation of CIP arising from the project. The terms of commercial use of the BIP will be negotiated before commencement of the project, on an arms-length basis. Project agreements will stipulate that access to BIP for the purposes of the project at hand will not incur cost to the IA CRC.

Requirements for access to external IP will be assessed in advance of major investment in IA CRC projects and, as far as possible; terms of access will be settled before major commitments are made. This proactive approach to such IP issues will prevent situations arising where the cost of major investment cannot be recovered due to licensing impediments beyond the control of the Centre. Responsibility for oversight of Centre IP will be an IA CRC function.

## **New IP developed and sold, transferred or licensed for commercialisation during the reporting period**

1. CarpSim2
2. SenesTech anti-fertility technology.

## **Benefits to Australia of IP arrangements**

CRC IP arrangements require a return on investment from the assignee that to date have taken the form of increasing royalties on future product sales. This approach maximises the value of centre IP and the benefits that flow back to Australia, because it recognises that the potential markets and product margins for pest animal management products are comparatively small, minimises the upfront capital outlay for entering a market for assignees, and maintains an upside should product sales exceed forecasts.

*AWC's Tony Cathcart holding a can of FeralMone® wild dog and fox attractant spray. Feral proof fence, Scotia. Courtesy of Tony Peacock.*



## Financial information

### Consultancies

The CRC was commissioned to undertake two consultancies over the reporting period. The first was by the Western Australian Government (Department of the Environment and Conservation), who contracted Professor Peacock to produce a report on the effects of community on-ground cane toad control in the Kimberley. The report contributed to the WA government's decision to invest in a \$7 million, four-year survey of Kimberley biodiversity, and adjustments to its cane toad activities. The report was released by WA Premier Alan Carpenter.

Dr Stephen Lapidge was contracted by the Desert Knowledge CRC to identify and compare all potential methods of chemical, fertility and biological control for the camel in Australia.

Undertaking this work has fostered collaborative linkages and contributed to our and others' understanding of invasive pest issues. The CRC has benefitted from additional income, and our profile has been raised as a service provider and source of expertise in our field. The CRC only undertakes consultancies that clearly contribute to our own strategic plan.

### Grants

Table 3: Externally funded projects signed up in the reporting period.

Project	Grant from	Total value \$	Program/Researcher
2.U.2e Pig toxicant	DEHWR	70,000	Uptake
2.U.3e Hoggone	BRS, DAFF	75,000	Uptake
5.T.4e WA cane toad consult	WA DEC	16,818	Tony Peacock
7.T.1e Rabbit caliciviruses	WEDPP	23,900	Terrestrial
8.D.2e Disease review	WEDPP	17,000	Detection & Prevention
9.D.6e COPS regulatory	DAFF	15,000	Christopher Buller
9.D.7e COPS and SOPS workshop	DAFF	14,000	Detection & Prevention
9.T.5 Camel study grant	DAFF	119,000	Terrestrial
9.U.1 Camel consultancy	Desert Knowledge CRC	35,000	Stephen Lapidge
10.U.17e CO fumigator	NHT and Vic DSE	62,350	Uptake
10.U.18e Shelf stable RHDV	NHT	98,600	Uptake
12.D.1 Mapping project	NLWRA	13,000	Detection & Prevention



External grants are essential for the CRC to fulfill its Strategic Plan. Many organisations are unable to commit to the seven-year CRC contract because of their own constraints. Therefore, it was always anticipated that funding would be won in competitive rounds in order to provide sufficient investment. For example, the Commonwealth Department of Agriculture, Fisheries and Forestry, principally through its Bureau of Rural Sciences (BRS), was a major contributor in 2007/08. BRS was unable to commit funds in the original CRC bid, although it was in both parties' strategic interest for them to be a Participant.

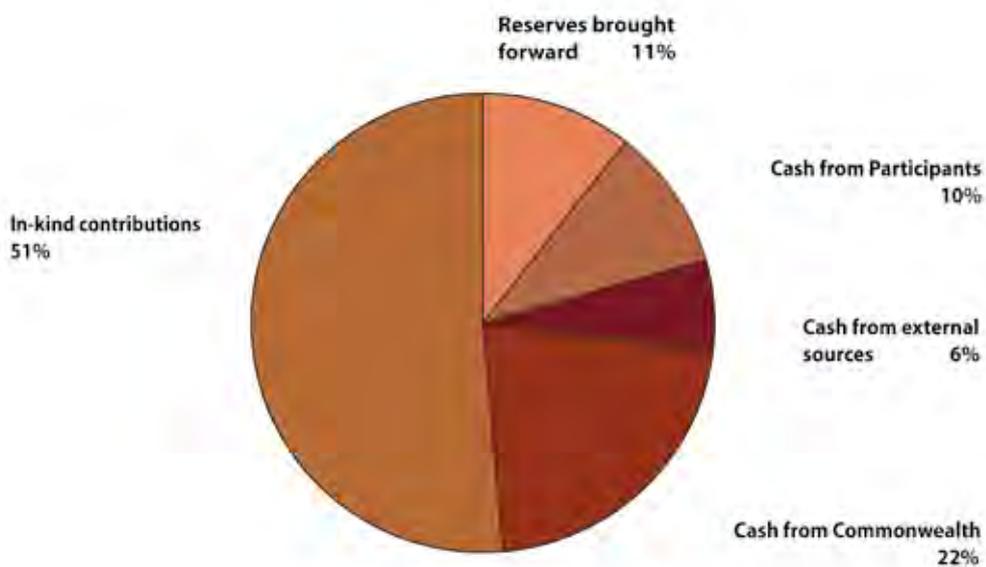


Figure 8: Resources received (total \$20 333 463M)

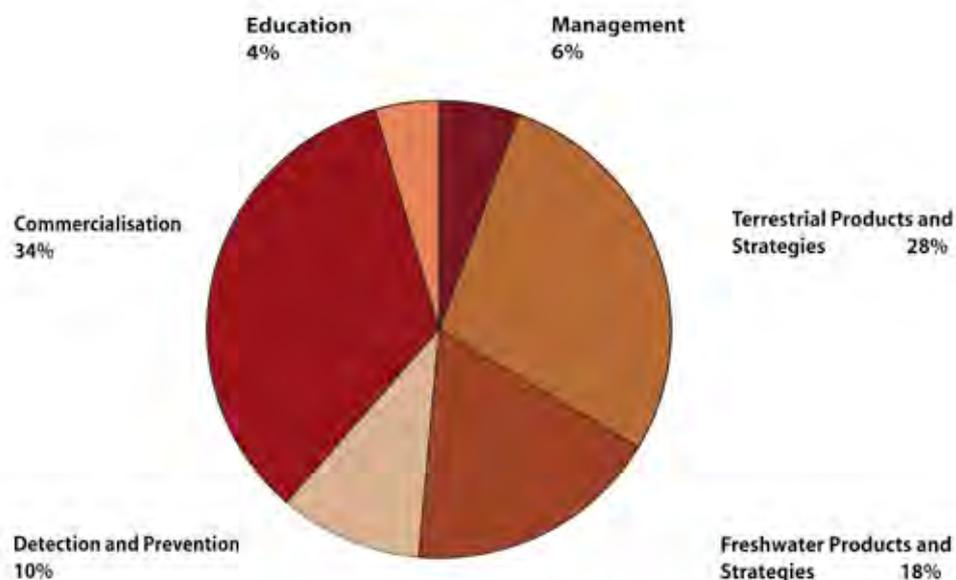
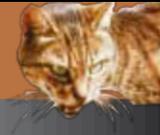


Figure 9: Resources applied (total \$19 079 815M)

## Appendix 1: Glossary

annulus	Latin for 'ring – in fish research, refers to annual rings that form in fish scales or bone sections (otoliths)
antibodies	an immunoglobulin, a specialised immune protein, produced because of the introduction of an antigen into the body, and which combines with the very antigen that triggered its production, either destroying the antigen directly or facilitating the white blood cells to destroy it
avirulent	not virulent – refers to an infectious agent that does not produce pathological (disease manifestation) effects
biodiversity	variety of taxonomic life forms
biosecurity	protective measures to prevent a country from the entry and spread of unwanted animals, pests, diseases and weeds
canid	members of the family <i>Canidae</i> (carnivorous mammals) which includes the foxes, wolves, dogs, jackals and coyotes.
calicivirus	a genus in the family <i>Caliciviridae</i> , a family of RNA viruses. They possess a characteristic six-pointed starlike shape whose surfaces have cup-shaped (chalice) indentions. Caliciviruses include the hepatitis e virus, a form of swine virus, feline calicivirus and rabbit haemorrhagic disease virus. We refer to the latter.
CIP	Centre Intellectual Property
cohort	(student) an organisational group defined to facilitate the analysis of student progression, comprising programmes commencing in a particular academic year
CRC	Cooperative Research Centre
daughterless	genetic engineering technique using species-native genes that are inheritable and bias offspring sex ratios towards males
DNA	Deoxyribonucleic acid
efficacy	the ability to produce a desired amount of a desired effect
endemic	unique to its own place or region – found only there and not naturally anywhere else
eutherian	mammals having a placenta
exotic	introduced – not native to Australia
felid	members of the family <i>Felidae</i> (carnivorous mammals) which includes the big cats and domesticated cat
invasive	usually non-indigenous species that adversely effect the habitats they invade economically, environmentally or socially. We include some native animals where altered environments have caused their numbers or range to increase artificially
hybrid	something of mixed origin or composition. (Genetics) the offspring of genetically dissimilar parents or stock, especially the offspring produced by breeding plants or animals of different species or races
Judas animal	captive animal used to attract others, or which is fitted with a transmitter and released, leading researchers or hunters to a herd
KHV	Koi Herpes Virus



macropodid	member of the <i>Macropodidae</i> family, which includes kangaroos, wallabies, tree-kangaroos, pademelons and several others
macro-invertebrate	refers to aquatic invertebrates, including insects, crustaceans, molluscs and worms
mesopredator	a medium-sized predator which often increases in abundance when larger predators are eliminated; eg. raccoons, skunks, snakes, cats, foxes.
monoclonal	of, forming, or derived from a single clone
myxomatosis	a virus specific to rabbits caused by the myxoma virus
otolith	structure in the inner ear (see annulus above)
PAPP	Para-aminopropiophenone
pathogenic	capable of causing, originating or producing disease
pathological	of or relating to causing disease
PCR	polymerase chain reaction
pheromone	chemical that triggers an innate behavioural response in another member of the same species
primordial follicles	follicles within the ovaries from which eggs arise
RHD	Rabbit Haemorrhagic Disease (see caliciviruses)
RHDV	Rabbit Haemorrhagic Disease Virus
RSPCA	Royal Society for the Prevention of Cruelty to Animals
Savannah cat	an African serval crossed with a domestic cat
scat	faeces, droppings
shelf-stable	(non formal) a product that has been altered so it can be safely stored and sold in sealed containers at room temperature while still having a useful shelf life (quality for a suitable time)
SMEs	small to medium enterprises
spawning	production or depositing of large quantities of eggs in water
specificity	intended for, applying to, or acting on a particular thing (species)
sylvatic	referring to diseases or pathogens affecting only wild animals
terrestrial	land based
threatened	at risk of becoming endangered (plant or animal)
toxin	poisonous substance produced by living cells or organisms
virulence	a. extremely infectious, malignant, or poisonous. Used of a disease or toxin. b. capable of causing disease by breaking down protective mechanisms of the host. Used of a pathogen.

## Appendix 2: Publications

### Books

Tracey J.P, Bomford M, Hart Q, Saunders G and Sinclair R. 2007. 'Managing Bird Damage to Fruit and Other Horticultural Crops'. Bureau of Rural Sciences, Canberra.

### Book Chapters

Cooke, B. 2007. 'Managing the European Rabbit: Converging interests between Australian research for rabbit control and European research for their conservation'. *Lagomorph Biology, Evolution, Ecology and Conservation*.

Saunders G, Lapidge S.J, Fulton W, Murphy E, Sarre S, Buller C and Peacock T. 2007. 'The Invasive Animals CRC: a new research initiative for managing some old problems'. in '*Pest or Guest: the zoology of overabundance*.' (Ed. D. Lunney, P. Eby, P. Hutchings and S. Burgin). Royal Zoological Society of New South Wales, Mosman, NSW, Australia. Pp 88 – 93.

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Barney, M. L., Patil, J. G., Gunasekera, R.M. and Carter, C.G. 2008. 'Distinct cytochrome P450 aromatase isoforms in the common carp (*Cyprinus carpio*): Sexual dimorphism and onset of ontogenic expression'. *General and Comparative Endocrinology* **156**(3): 499-508.

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Cowled B, Lapidge S.J, Smith M.J and Staples L.D. 2008. 'Vaccination of feral pigs (*Sus scrofa*) using iophenoxic acid as a simulated vaccine'. *Wildlife and Zoos* **86**, 50-55.

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Glen A.S and Dickman C.R. 2008. 'Niche overlap between marsupial and eutherian carnivores: does competition threaten the endangered spotted-tailed quoll?' *Journal of Applied Ecology* **45**, 700-707.

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Henderson W and Murphy E.C. 2007. 'Pest or prized possession? Genetically modified biocontrol from an international perspective'. *Wildlife Research* **34**, 578-585.

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Jacob J, Hinds L.A, Singleton G. R, Sutherland D. R and Ylönen, H. 2007. 'Is the reproductive potential of wild house mice regulated by extrinsic or intrinsic factors?' *Austral Ecology* **32**, 202-209.

McLeod S.R, Saunders G, Twigg L.E, Arthur A.D, Ramsey D and Hinds L.A. 2007. 'Prospects for the future: is there a role for virally vectored immunocontraception in vertebrate pest management?' *Wildlife Research* **34**, 507-510

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## Appendix 2: Publications cont'd

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## Appendix 2: Publications cont'd

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## Appendix 3: Other acronyms

Acronym	Meaning	First use (page)
AAWS	Australian Animal Welfare Strategy	2
APVMA	Australian Pesticides & Veterinary Medicines Authority	35
APCG	Animal and Plant Control Group (SA)	44
AWC	Australian Wildlife Conservancy	24
AWHN	Australian Wildlife Health Network	46
AWMS	Australian Wildlife Management Society	8
BRS	Bureau of Rural Sciences	4
CMA	Catchment Management Authority	9
CSC	Carp Separation Cage	42
CSL	Central Science Laboratories (UK)	28
DEWHA	Department of Environment, Water, Heritage & the Arts	4
DOC	Department of Conservation (NZ)	31
DPI	Department of Primary Industries	4
EPBC Act	Environment Protection and Biodiversity Conservation Act	49
FAS	Fitzgerald Applied Sociology	30
GPS	Global Positioning System	36
KHV	Koi Herpes Virus	22
KINRMB	Kangaroo Island Natural Resources Management Board	25
MDBC	Murray-Darling Basin Commission	9
NLWRA	National Land and Water Resources Audit	5
NRM	Natural Resource Management	50
NRMB	Natural Resources Management Board	9
RMAG	Rabbit Management Advisory Group	7
RIS	Regulatory Impact Statement	4
VPC	Vertebrate Pests Committee	4
WEDPP	Wildlife and Exotic Diseases Preparedness Program	25
WTMA	Wet Tropics Management Authority	27

