17th Australasian Vertebrate Pest Conference

Canberra, 1-4 May 2017

Innovative Solutions and Future Directions

Proceedings

Australian Government
Department of Agriculture and Water Resources

Invasive Animals Cooperative Research Centre

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Excellence in Pest Animal Management

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RESTORING THE BALANCE

HELPING
YOU MANAGE VERTEBRATE PESTS

- Want help designing a pest management programme?
- Need advice on solutions to pest animal problems?
- Want to know if you can keep a particular animal?
- Need baits for rabbit, fox or wild dog control?

ACT Government

CONTACT US

Access Canberra 132281

environment@act.gov.au

www.environment.act.gov.au

17th Australasian Vertebrate Pest Conference

Canberra, 1-4 May 2017

Citation:

17th Australasian Vertebrate Pest Conference, Canberra, May 2017

Buckmaster, T (ed) (2017) Proceedings of the 17th Australasian Vertebrate Pest Conference, Canberra. Invasive Animals Cooperative Research Centre, Canberra

Hotel Realm
18 National Circuit
Barton, ACT 2600

Front cover image attributions:

Feature image:	Dr Tarnya Cox, Researcher with NSW DPI and National Coordinator of the RHDV1 K5 release (Australia's first new rabbit biocontrol agent in 20 years), is one of the first to release virus-laced carrots near Orange, NSW (image supplied)
Boxed image 1:	Feral pigs in full fight, by Thomas Garrett
Boxed image 2:	A European fox seen taking down a native egret in wetlands, by Mary Anne Addington
Boxed Image 3:	A large European carp taken out of the waterways, by Marc Ainsworth

Copies available from

Invasive Animals CRC
Building 22, University Drive South
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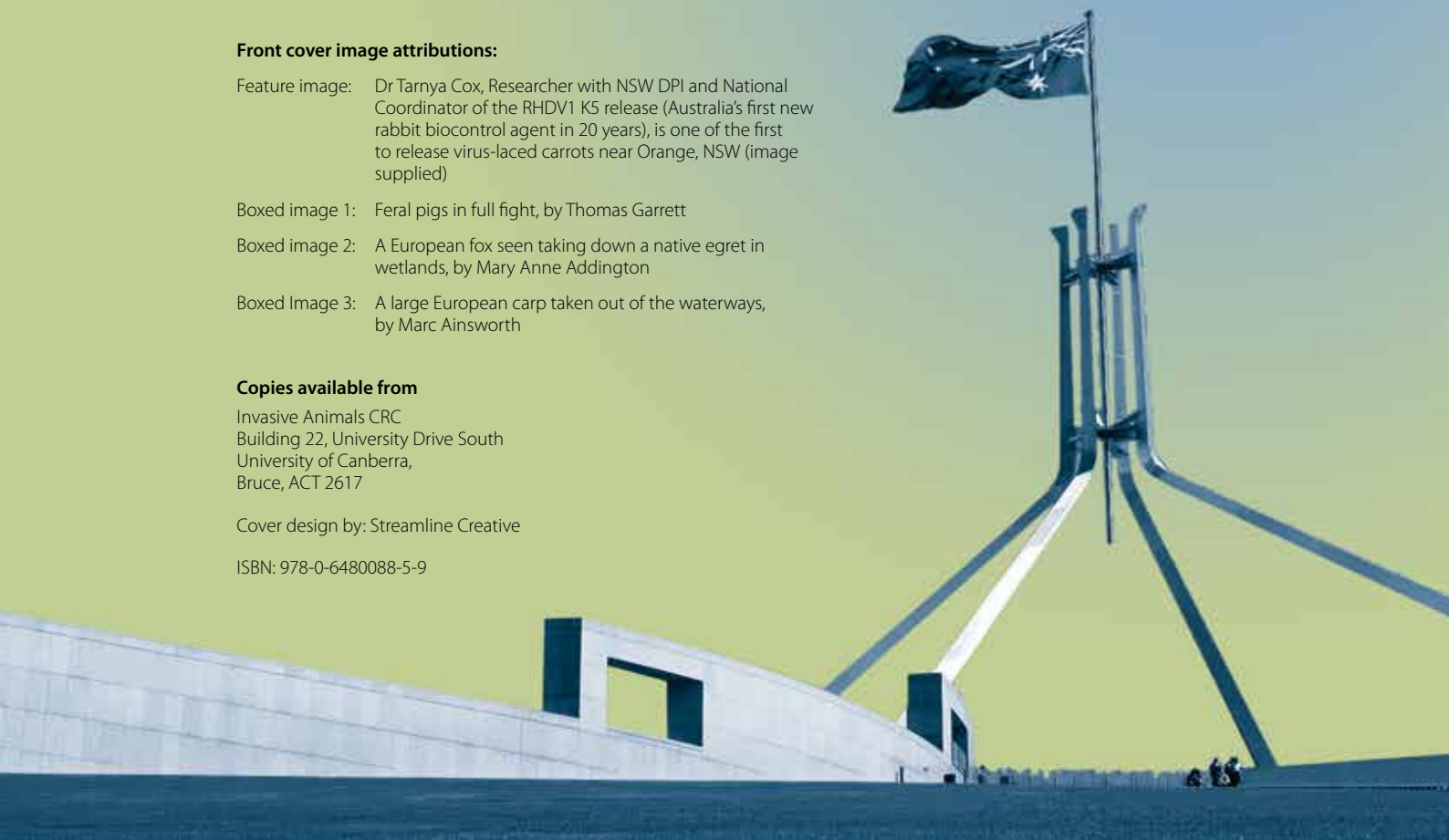
Bruce, ACT 2617

Cover design by: Streamline Creative

ISBN: 978-0-6480088-5-9



CONTENTS

WELCOME

The 17th Australasian Vertebrate Pest Conference (AVPC) held in Canberra is proudly organised by the Invasive Animals Cooperative Research Centre on behalf of the Australian and ACT governments. The AVPC is the triennial conference of the Invasive Plants and Animals Committee (IPAC) with the previous conference being held in Brisbane, Queensland. As it is only held every three years it provides an important venue for highlighting opportunities and challenges in relation to vertebrate pest policy, planning, management and community engagement, innovation and knowledge.

The theme of this year's conference is '*Innovative solutions and future directions for vertebrate pest animal management*'. The conference scientific program encompasses presentations from a range of themes integral to effective pest management such as prevention and incursion response, pest control and management and community led action. The last session of the conference will be a moderated panel discussion examining some new and future technologies for managing pest animals. The conference provides a significant opportunity for networking and the sharing of knowledge, ideas and innovations in the field of vertebrate pest management between those involved in vertebrate pest management in Australia and New Zealand as well as internationally.

Andreas Glanznig

Conference Scientific Committee

Dr Bertie Hennecke (Chair)	Australian Government Department of Agriculture and Water Resources
Dr Andrew Bengsen	New South Wales Government Department of Primary Industries
Dr Tony Buckmaster (Secretary)	Invasive Animals Cooperative Research Centre
Dr Matt Gentle	Queensland Government Department of Agriculture and Fisheries
Mr Andreas Glanznig	Invasive Animals Cooperative Research Centre
Dr Lyn Hinds	CSIRO
Dr Malcolm Kennedy	West Australian Government Department of Agriculture and Food
Prof Paul Martin	University of New England
Dr David Ramsey	Victorian Government Department of Environment, Land, Water and Planning
Dr Tanja Strive	CSIRO
Dr Dan Tompkins	Landcare Research - Manaaki Whenua, New Zealand

Conference Organising Committee

Mr Andreas Glanznig (Chair)	Invasive Animals Cooperative Research Centre
Mrs Carolyn Campbell-Wood	Invasive Animals Cooperative Research Centre
Mrs Monica Finlayson	Australian Government Department of Agriculture and Water Resources
Ms Margaret Heath	Australian Government Department of Agriculture and Water Resources
Dr Ian McDonald	Invasive Animals Cooperative Research Centre
Ms Julie McGuiness (Secretary)	Invasive Animals Cooperative Research Centre
Dr Alison McInnes	ACT Government Environment, Planning and Sustainable Development Directorate

PROGRAM AT A GLANCE

Monday 1 May

5:30pm – 7:30pm	Registration
6:00pm – 7:30pm	Welcome Reception Ostani Bar, Hotel Realm

Tuesday 2 May

7:30am – 6:30pm	Registration Conference floor, Hotel Realm
8:30am – 5:00pm	Plenary and concurrent sessions
5:10pm – 6:10pm	Speed talk session 1 Poster session 1
6:45pm – 7:30pm	IA CRC Celebration & Thank you event, Conference floor, Hotel Realm
7:30pm – 11:00pm	Conference Dinner National Ballroom, Hotel Realm

Wednesday 3 May

7:30am – 6:30pm	Registration Conference floor, Hotel Realm
8:30am – 5:00pm	Plenary and concurrent sessions
5:10pm – 6:10pm	Speed talk session 2 Poster session 2
5:20pm – 9:40pm	Mulligans Flat field trips Buses depart from Hotel Realm

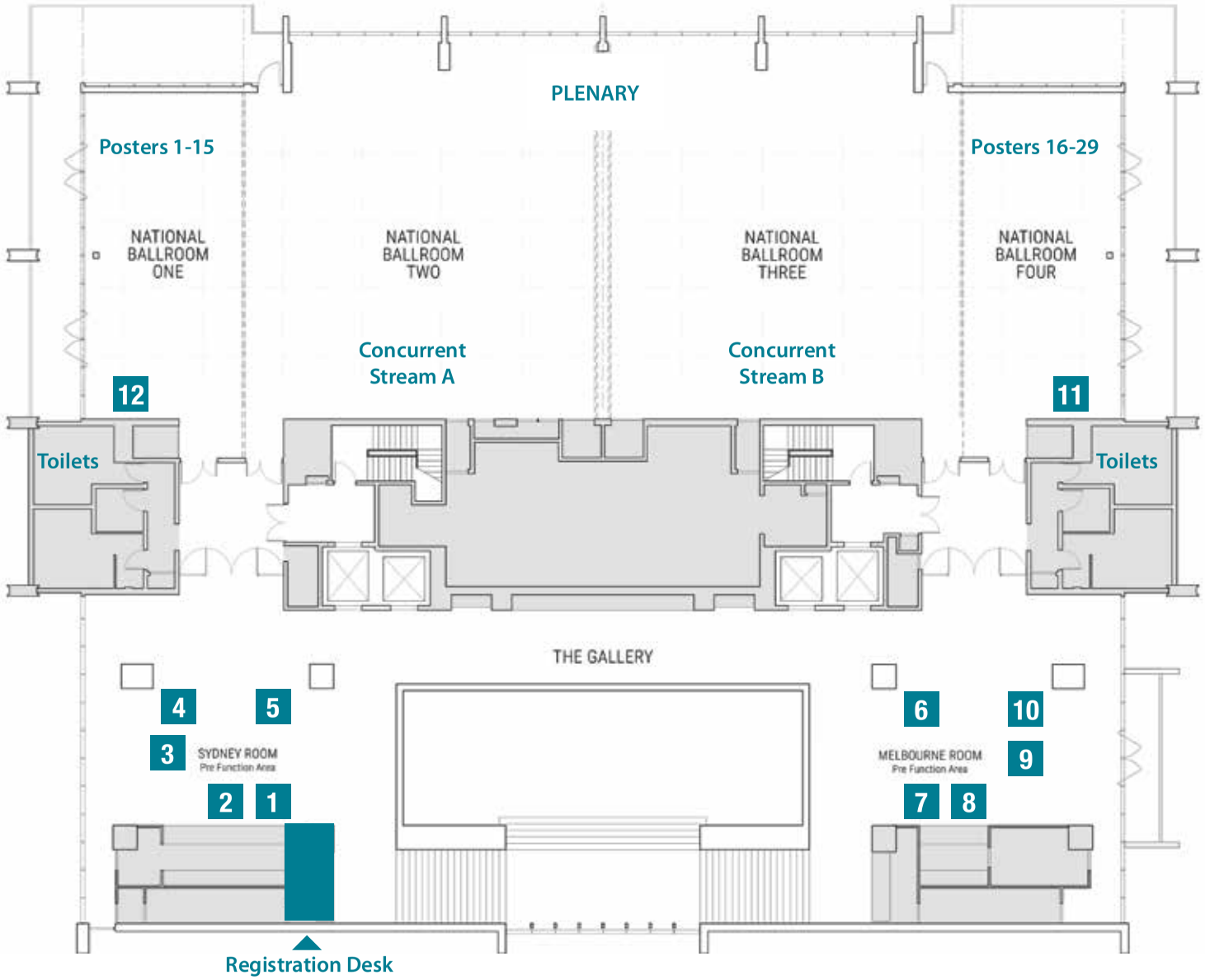
Thursday 4 May

7:30am – 5:00pm	Registration Conference floor, Hotel Realm
8:30am – 5:00pm	Plenary and concurrent sessions

Thank you to our valued exhibitors of AVPC 2017

FLOORPLAN

Booth	Exhibitor
1 & 2	Animal Control Technologies (Australia)
3	National Wild Dog Action Plan
4	Advanced Telemetry Systems
5	Waratah Fencing
6	Professional Trapping Supplies
7	Heli Surveys & Airborne Technologies
8	Sirtrack
9	Hunter Land Management
10	Protect-us Australia
11	ProCon Pest & Wildlife Management
12	Outdoor Cameras Australia



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ACT Government

The ACT Government is the main land manager in the Territory, with conservation being the major land use. The Minister for the Environment and Heritage and the Environment, Planning and Sustainable Development Directorate (EPSDD) have primary responsibility for biosecurity, including vertebrate pest animal management and policy. The ACT Parks and Conservation Service (PCS) vertebrate pest operations reduce the impacts of pest animals on biodiversity and natural ecosystems. PCS works closely with the Transport Canberra and City Services Directorate, Nature Conservation Policy, EPSDD and Commonwealth, NSW and rural land managers to coordinate vertebrate pest management across land tenures and jurisdictional boundaries.

Welcome Reception Sponsor

UNIVERSITY OF CANBERRA

The Institute for Applied Ecology (IAE) at the University of Canberra undertakes world-class research to improve our understanding of the environment, and enhance decision-making for natural resource management and sustainable development. We engage with on-ground managers and policy makers to solve environmental problems.

We have specialist expertise in conservation biology and genetics, freshwater ecology, landscape modelling and environmental chemistry. The inter-disciplinary nature of the IAE, combined with a culture of external engagement, provides the ideal basis for carrying out innovative solutions-focussed environmental science.

Satchel Sponsor

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PEST MANAGEMENT

Session Sponsor

CSIRO

GENERAL INFORMATION

Conference secretariat

CONFERENCE LOGISTICS

Conference Logistics
PO Box 6150
Kingston ACT 2604
P: +61 2 6281 6624
E: avpc@conlog.com.au
W: www.conferencelogistics.com.au

Conference venue

Hotel Realm, 18 National Circuit, Barton, ACT

P: +61 2 6163 1800

W: www.hotelrealm.com.au

Registration desk

The registration desk will be open and contactable on **0498 435 169** during the hours below:

Monday 1 May	5:30pm – 7:30pm
Tuesday 2 May	7:30am – 6:30pm
Wednesday 3 May	7:30am – 6:30pm
Thursday 4 May	7:30am – 5:00pm

Conference evaluation

Delegates are encouraged to complete the online evaluation as it assists in planning future AVP Conferences. A link to the evaluation will be sent out immediately following conclusion of the conference.

Catering

Morning, afternoon teas and lunches will be held in the conference floor foyer, Hotel Realm. Lunches will be served as an informal stand-up buffet. Special meals have been prepared for those delegates who pre-registered their special requirements and will be available from the designated buffet stations during meal breaks. Please see the catering staff for assistance.

Dietary requests will be catered for to the best of the venue's ability. Individuals with severe allergies are requested to advise Conference Logistics prior to the conference of their requirements, and bring any allergy medication (EpiPen, Phenergan, etc) as prescribed by your doctor to the conference and any associated function. Whilst due care is taken by the organisers and venue, individuals must take primary responsibility for their own health.

Delegate list

The delegate list was emailed before and will be emailed again after the conference to all participants. Those delegates who did not give permission on their registration form have not been included.

Internet access

Throughout AVPC 2017 internet access is available via the Hotel Realm connection.

Network Name: DomaConference

Password: @DomaHotels

Lost or found property

Please report any lost or found property to the registration desk.

GENERAL INFORMATION

Luggage cloak room

Complimentary cloak room facilities will be available for your luggage. Please see the Concierge at Hotel Realm for assistance.

Mobile phones

As a courtesy to other delegates, please ensure all mobile telephones are turned off or are in silent mode during all sessions and social functions.

Non-smoking policy

All the function rooms at the Hotel Realm are non-smoking.

Personal insurance

Delegates shall be regarded in every aspect as carrying their own risk for loss or injury to person or property, including baggage during the Conference. We strongly recommend that at the time of booking your travel you take out a travel insurance policy of your choice. The policy should include the loss of deposit through cancellation, medical insurance, loss or damage to personal property, financial loss incurred through disruptions to accommodation or travel arrangements due to strikes or other industrial action. The organisers are in no way responsible for any claims concerning insurance.

Special needs

We endeavour to ensure delegates with special needs are catered for. Should you require particular assistance, please notify the registration desk.

Useful telephone numbers

Hotel Realm	+61 2 6163 1800
Burbury Hotel	+61 2 6173 2700
Brassey Hotel	+61 2 6273 3766
Little National	+61 2 6188 3200
Hotel Kurrajong	+61 2 6234 4444

Taxis

Canberra Elite Cabs	SMS: 0481 072 700 (SMS name, pickup address and time required)
Canberra Cabs	13 22 27
Cabxpress	+61 2 6181 2700

Airlines

Qantas	13 13 13
Virgin Australia	13 67 89
Jetstar	13 15 38

Weather

In May, the temperature is dropping in Canberra. The days are mild (average maximum temp is 15 degrees Celsius) and the nights are cool (average minimum temp is 3 degrees Celsius). The mornings can be foggy but that often burns off to a sunny day. Canberra has a lot of deciduous plants that provide wonderful colours during Autumn – make sure you make time for a walk.

SOCIAL PROGRAM

WELCOME RECEPTION

Time: 6:00pm – 7:30pm

Date: Monday 1 May 2017

Venue: Ostani Bar, Hotel Realm

Tickets: Included in full registration, $35 for day registrations and additional tickets

Join us at the Ostani Bar to begin the conference with drinks and finger food. Network with fellow attendees and build the excitement towards the program.

IA CRC CELEBRATION & THANK YOU EVENT

Time: 6:45pm – 7:30pm

Date: Tuesday 2 May 2017

Venue: Conference floor, Hotel Realm

Tickets: Included in full registration

Prior to the conference dinner, join us for a celebration event to farewell and say thank you to all those who have been involved in the Invasive Animals CRC since its inception.

CONFERENCE DINNER

Time: 7:30pm – 11:30pm

Date: Tuesday 2 May 2017

Venue: National Ballrooms, Hotel Realm

Tickets: Included in full registration, $120 for day registrations and additional tickets

Join us for the conference dinner following the close of sessions on Tuesday. The conference rooms will be transformed into a comfortable space to eat and spend time with your colleagues.

FIELD TRIP

Time: First bus leaves at 5:20pm, second bus leaves at 6:50pm

Date: Wednesday 3 May 2017

Tickets: $65 (registration essential)

An evening field trip to the Mulligans Flat Woodland sanctuary, hosted by the Woodlands & Wetlands Trust and the ACT Government. The field trip will be a 90 minute guided walking tour of the predator-free Sanctuary, spotlighting for Eastern Bettongs, Eastern Quolls and Bush Stone-curlews, with a discussion on pest animal management within the sanctuary.

SOCIAL MEDIA

Join the online conversation through Twitter:

#AVPC2017 @AVPC17

Cultivate your networks through social media. Whether you are a presenter, delegate, sponsor or exhibitor, social media is a great way for you to share what is happening at the conference, comment and ask questions.

Presenters and delegates:

+ As a presenter, promote your session or poster through social media
+ Share your opinions and ideas with your network. This might include a quote from a plenary session, a message from a presenter or a comment about a poster
+ Broaden your network! Chat to others on social media about sessions you have attended
+ Ask presenters questions and find out what other people think

Sponsors and exhibitors:

+ Raise awareness of your sponsorship or exhibition booth
+ Run your own promotion by linking photos, videos and website to your Twitter feed or Facebook page
+ Encourage visitors to your booth by highlighting something special you have to offer

PLENARY SPEAKERS

Andreas Glanznig

Mr Andreas Glanznig is the CEO of the Invasive Animals Cooperative Research Centre – Australia's largest collaboration of governments, industry groups and research institutions, working together on national scale pest animal management innovation. He led the CRC's executive team in assembling the successful IA CRC 5 year extension program, 2012-2017, and its transition into the Centre for Invasive Species Solutions. The Invasive Animals CRC is on track to deliver: new Rabbit Biocontrol (the rabbit calicivirus RHDV K5 strain national release program); a new Carp Biocontrol agent (the Cyprinid Herpesvirus-3); and new Wild Dog and Fox control products.

Mr Glanznig's career has, for nearly 30 years, transversed science management, policy advocacy and development, and strategic communications. Former roles include leading the World Wildlife Fund's advocacy team on invasive species policy reform where he played a driving role in efforts to close Commonwealth quarantine law loopholes that allowed the import of new high risk weeds, as well as elevating island pest eradications to become a national issue.

Mr Glanznig has also served as a Director of the Weeds Cooperative Research Centre and the Global Invasive Species Program. He has degrees in Science and Letters, and a Masters of Business Administration.

Dr Dan Tompkins

Dan leads the Managing Invasives portfolio at Landcare Research, New Zealand, overseeing a broad research programme on the management of invasive weeds, pests and diseases both across New Zealand and internationally.

Dr Kurt VerCauteren

Kurt leads research on feral swine, deer and elk for the National Wildlife Research Center of the United States Department of Agriculture/Animal Plant and Health Inspection Service/Wildlife Services (NWRC). He has been with NWRC for nearly 20 years and has conducted research that has led to improved understanding and management of human-wildlife conflict. His research focusses on wildlife damage management and diseases of wildlife that impact humans, livestock, and natural resources. His current efforts focus on addressing damage and disease issues associated with invasive and native ungulates.

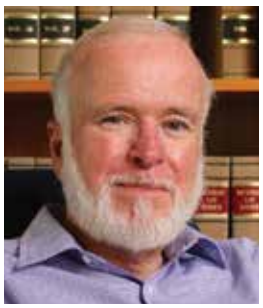
Dr Craig Cormick

Dr Craig Cormick has been a science communicator for over 25 years, working with agencies such as CSIRO, Questacon and the Department of Innovation, Industry and Science. He is widely published in academic journals, and more popular mediums such as the *Conversation* and the ABC, on the drivers of public attitudes towards new technologies. He has written or edited several books including the award-winning *Ned Kelly Under the Microscope*.

He has given keynote addresses, workshops and conference talks on science communication issues and better understanding the public, on all seven continents.

In 2014 he was awarded the Unsung Hero of Science Communications by the Australia Science Communicators (ASC), and is currently the organisation's president.

Professor Paul Martin



Professor Paul Martin is the Director of the Australian Centre for Agriculture and Law and the Program Leader for the Invasive Animals CRC program on facilitating community action in controlling invasive species. Paul is an internationally acknowledged expert in researching ways to improve the effectiveness of environmental governance, being the leader of projects on institutional issues for the IUCN World Commission on Environmental Law and the IUCN Environmental Law Centre. He is also on the governing Board of the IUCN Academy of Environmental Law and has lectured and conducted research in countries including the USA, the UK, France, Canada, China, Iceland, and Brazil.

In the last 10 years Paul has conducted or led many research projects concerned with the better management of invasive species issues. In particular he has investigated ways to improve institutional issues such as funding, administration, regulatory enforcement, coordination and many other matters essential to effective control of established invasive species.

Dr Michelle Christy

Michelle Christy is the Invasive Animals CRC National Incursions Prevention and Response Facilitator who assists government, industry, research, and community with the development and implementation of their animal incursion management programs. For over 25 years, she has worked closely with USA, CNMI, Madagascan and Australian governments, industry and community as a conservation ecologist, and incursion prevention specialist. Her recent research includes determining pathways of incursion, probability of detection, and establishing what motivates animals to move. Michelle's passion centers on developing a global program of incursion prevention and control, the foundation of which is effectiveness, simplicity and shared responsibility. She hopes this vision will significantly contribute to the protection of agriculture and biodiversity through prevention and management of pest animal incursions.

PROGRAM

Monday 1st May 2017

17:30 – 19:00	Registration	Ground floor
18:00 – 19:30	**Welcome reception**	Ostani Bar

Tuesday 2nd May 2017

7:30	Registration		Conference floor
8:30	Welcome *Bruce Christie – Chair of the Invasive Plants and Animals Committee*		Ballroom 2 & 3
8:35	Welcome to country		
8:40	Official opening		
9:00	Plenary 1: Australian developments and outlook in pest animal research *Andreas Glanznig, Invasive Animals CRC*		
9:30	Plenary 2: Research to enable a 'predator free' New Zealand by 2050 *Dan Tompkins, Landcare Research - Manaaki Whenua, New Zealand*		
10:00	Plenary 3: The US Perspective: challenges and directions in invasive and overabundant animal research *Kurt VerCauteren, National Wildlife Research Center, US Department of Agriculture*		
10:30 – 11:00	Morning tea		Conference floor
11:00 – 12:30	**Concurrent sessions**		
	Concurrent session 1A Prevention / incursions Ballroom 2 Chair: Andrew Bengsen	**Concurrent session 1B** Control: biocontrol Ballroom 3 Chair: Tanja Strive	
11:00	Community-based invasive species surveillance: bringing innovation to information sharing and improved management *Peter West*	Cyprinid herpesvirus 3: a potential biological control for carp in Australia *Ken McColl*	
11:15	Frontiers and lessons in island eradications: the case of foxes on Phillip Island *Duncan Sutherland*		
11:30	Making inference from wildlife collision data: inferring predator absence from prey strikes *Peter Caley*	Gene drive and the potential to control vertebrate pests *Mark Tizard*	
11:45	Advanced remote acoustic surveillance technology at a "real-time" invasion front *Susan Campbell*		
12:00	Using wildlife camera for invasive turtle surveillance *Ryan Melville*	Immune response of common carp, *Cyprinus carpio*, to cyprinid herpesvirus 3 infection: implications for viral control *Matthew Neave*	
12:15	Development of a NSW tilapia incursion response plan: failure to plan is a plan to fail *Victoria Greentree*	Trojan Y genetic control of *Gambusia holbrooki*: rationale, progress and challenges *Jawahar Patil*	
12:30 – 13:30	Lunch		Conference floor

13:30 – 15:00	**Concurrent sessions**	
	Concurrent session 2A Prevention / incursions Ballroom 2 Chair: Michelle Christy	**Concurrent session 2B** Control: biocontrol Ballroom 3 Chair Tanja Strive
13:30	The application of DNA to wildlife surveillance *Stephen Sarre*	The release and tracking of RHDVs in Australia's rabbit population *Tarnya Cox*
13:45	From faeces to foxes: using genetics to manage an invasive predator for wildlife conservation *Anna MacDonald*	Maximising the impact of RHDV K5 in Victoria *John Matthews*
14:00	Sensitive invasive species surveys using environmental DNA *Elise Furlan*	Fly traps as a tool for monitoring RHDV *Amy Iannella*
14:15	Impact of environmental variables on eDNA detection *Rheyda Hinlo*	RHDV2 in the Australian landscape: 2015-2016 *Robyn Hall*
14:30	Optimising sampling protocols for fish community assessments through environmental DNA metabarcoding *Jonas Bylemans*	Recovering the epidemiology of wildlife disease from viral sequence data: the phylodynamics of the rabbit haemorrhagic disease virus *Carlo Pacioni*
14:45	Targeting 'gen one': a scalable strategy for detecting and responding to rat incursions in predator-free landscapes *Helen Nathan*	The different roles of myxomatosis and RHD in the suppression of the Turretfield rabbit population *David Peacock*
15:00 – 15:30	Afternoon tea	Conference floor
15:30 – 17:00	**Concurrent sessions**	
	Concurrent session 3A Control: tactical tools Ballroom 2 Chair: Bruce Warburton	**Concurrent session 3B** Institutions / program management Ballroom 3 Chair: Julie Quinn
15:30	Development of the rat specific toxin Norbormide *Charles Eason*	National Wild Dog Action Plan 2014-2019 *Jane Littlejohn*
15:45	Feral pig control and secondary poisoning risks from using PIGOUT® *Peter Adams*	Integrating ecological research and human dimensions: improving feral pig management by fostering innovative community engagement *Darren Marshall*
16:00	Anticoagulant rodenticides in the environment: excretion as a residue transfer pathway *Penny Fisher*	Facilitating the strategic management of wild dogs throughout Australia: how are we tracking after ten years *Greg Mifsud*
16:15	Target specificity of Felixer grooming traps *John Read*	Shared problem shared solution: a review of pest animal management in New South Wales *Bryce Wilde*
16:30	Catastrophic cat predation and the 1080 implant that should stop it dead *David Peacock*	What is the value of national pest management datasets *Nyree Stenekes*
16:45	Developing an aerial PAPP bait for landscape stoat control in New Zealand *Elaine Murphy*	Assessing the extent and abundance of pest animal populations across NSW through expert knowledge *Alyssa Trotter*
17:00 – 17:10	Break	
17:10 – 17:40	Poster speed talk session 1	Ballroom 2 & 3
17:40 – 18:10	Poster session 1	Ballroom 1 & 4
18:45 – 19:30	IA CRC Celebration and Thank You event	Conference floor
19:30 – 23:00	**Conference Dinner**	Ballroom 2 & 3

Wednesday 3rd May 2017

7:30	Registration	Conference floor
8:30	Welcome and housekeeping *Chair: Jo Laduzko*	Ballroom 2 & 3
8:45	Plenary 4: Why won't they listen to us? *Craig Cormick, ThinkOutsideThe and Australian Science Communicators*	
9:15	Plenary 5: What will it take to future-proof shared responsibility as the governance approach to the control of established invasive species? *Paul Martin, University of New England*	
9:45	Plenary 6: Beyond the borders: taking incursion management to the next level *Michelle Christy, Department of Agriculture and Food*	
10:15	ACTA award recipient	
10:30 – 11:00	Morning tea	Conference floor
11:00 – 12:30	**Concurrent sessions**	

	Concurrent session 4A Control: tactical tools Ballroom 2 Chair: Elaine Murphy	**Concurrent session 4B** Institutions / program management Ballroom 3 Chair: Bertie Hennecke
11:00	Remotely sensed feral buffalo damage in Kakadu National Park: comparing drone and satellite based imagery for future management *Stewart Pittard*	What impediments are you facing in peri-urban invasive species control? Institutional expectations for invasive animal management in peri-urban Australia *Vivek Nemane*
11:15	An investigation into the use of thermal cameras for detecting feral pigs during aerial surveys of the Lowbidgee floodplain *Michael Leane*	Test our organisational learning: an empirically based T.O.O.L. for assessing continuous improvement in the management of invasive species *Katrina Dickson*
11:30	Assessing the field efficacy of HOGGONE® feral pig bait, containing sodium nitrite, for controlling feral pigs in Australia *Jason Wishart*	Established invasive species animal training program: building organisational capacity and the next generation of EIA managers *Nigel Roberts*
11:45	The economics of monitoring traps with wireless networks *Bruce Warburton*	Managing threats to threatened species *Sam Dutton (No abstract available)*
12:00	Uptake of feral cat baits in eastern Australia *James Speed*	Minjerribah's most wanted: multi-stakeholder approaches to conservation, prioritising actions to preserve out nature *Hernan Caceres*
12:15	Separating the twitter from the chatter: monitoring and forecasting mouse plagues in Australian grain-growing regions *Stephen Henry*	What is missing from feral pig management: comparisons between the USA and Australia *Linton Staples and Kurt VerCauteren*
12:30 – 13:30	Lunch	Conference floor
13:30 – 15:00	**Concurrent sessions**	

	Concurrent session 5A Control: tactical tools Ballroom 2 Chair: Lyn Hinds	**Concurrent session 5B** Community led action Ballroom 3 Chair: Paul Martin
13:30	Fertility control for wildlife management: good, better, best *Douglas Eckery*	"The community won't be ignored": lessons for community engagement from case studies of wild dog management groups *Tanya Howard*

13:45	Laboratory evaluation of the effectiveness of the contraceptive bait, Contrapest®, on wild-captured black rats (*Rattus rattus*) *Brandy Pyzyna*	Has fifteen years of perseverance lead to the evolution of successful community involvement in vertebrate pest management? *Rhett Robinson*
14:00	Managing macropod populations in peri-urban situations: remote delivery of a fertility control vaccine *Claire Wimpenny*	Community pest control: the successful Canberra experience with the common myna *Bill Handke*
14:15	Implementing implants: efficacy and efficiency of Levonorgestrel for fertility control of peri-urban eastern grey kangaroos *Graeme Coulson*	Understanding inaction: why do landholders fail to participate in pest animal management? *Donald Hine*
14:30	Can long-term fertility control of overabundant koala populations mitigate their impacts on eucalyptus forests? *David Ramsey*	Improving participation through the application of human behavioural approaches: a cat management case study *Lynette McLeod*
14:45	Evaluation of a potential fertility control bait for wild pigs *Brandy Pyzyna*	Use of public bird counts to assist in surveillance for exotic birds *Ryan Melville*
15:00 – 15:30	Afternoon tea	Conference floor
15:30 – 17:00	**Concurrent sessions**	
	Concurrent session 6A Open session 1 Ballroom 2 Chair: Dave Ramsey	**Concurrent session 6B** Community led action Ballroom 3 Chair: Don Hine
15:30	Rabbit eradication at Mulligans Flat Woodland Sanctuary *Mark Sweaney*	Wild dog management groups in Australia: how well are they functioning? *Robert Kancans*
15:45	Outcomes of the 2016 national workshop in management of wild deer impacts *Dave Forsyth*	Wild dogs in North Eastern NSW: how did we get here and where are we going? *Peter Fleming*
16:00	Management of an expanding chital deer population in North Queensland *Tony Pople*	Promoting community reporting of peri-urban wild dogs: a partnership approach to behaviour change *Patricia Please*
16:15	What do South Australians think about feral deer and how their views influence management? *Annelise Wiebkin*	Insights into facilitating cooperative approaches for rabbit management *Lauren Hull*
16:30	Fiddling while Rome burns: "compassionate conservation" is neither *Peter Fleming*	How late is too late? Managing the impacts of wild deer on private land in the upper Murray *Lyn Coulston*
16:45	Implementing effective pest management *Mike Braysher*	Discussion period
17:00 – 17:10	Break	Mulligans Flat field trips (pre booking essential) 17:20 – 20:10 First tour 18:50 – 21:40 Second tour
17:10 – 17:40	Poster speed talk session 2	Ballroom 2 & 3
17:40 – 18:30	Poster session 2	Ballroom 1 & 4

Thursday 4th May 2017

7:30	Registration	Conference floor
8:25 – 10:30	**Concurrent sessions**	
	Concurrent session 7A Open session 2 Ballroom 2 Chair: Malcolm Kennedy	**Concurrent session 7B** Community led action Ballroom 3 Chair: Lynette McLeod
8:25	Welcome and housekeeping	Welcome and housekeeping
8:30	Home range and habitat utilisation of feral cats (*Felis catus*) in Central Queensland *Bronwyn Fancourt*	Wild for Taranaki: a community led response to protecting Taranaki's natural treasure *Steve Ellis*
8:45	Red fox movements at a flatback turtle rookery in the Pilbara, Western Australia *John-Michael Stuart*	Community involvement in pest control: a case study of accredited volunteer shooting programs *Matthew Godson*
9:00	Developing a monitoring program for aerial and ground surveys of waterfowl in NSW *Shannon Dundas*	Who is controlling wild canids? *Trish Fleming*
9:15	Feeding ecology of an invasive predator across an urban land-use gradient *Ben Stepkovitch*	Are we ready to go online? Communicating the national release of RHDV1 K5 *Ian McDonald*
9:30	Undermining possum-centric eradication of bovine tuberculosis from wildlife: are ferrets sometimes independent hosts? *Graham Nugent*	RHDV Boost: community participation on a national scale *Emma Sawyers*
9:45	Understanding red fox (*Vulpes vulpes*) habitat in urban environments *John Martin*	Only an engaged and informed community can lead the way to sustained long term rabbit control *Alex Thorp*
10:00	A protocol for estimating dingo/wild dog abundance and density *David Forsyth*	Self empowered peri-urban community led planning for invasive animal management *Darryl Low Choy*
10:15	The influence of wild dogs, herbivores and climate on vegetation in Australian ecosystems *Helen Morgan*	Community engagement for invasive species management: take home messages from a four year collaboration *Tanya Howard*
10:30 – 11:00	Morning tea	Conference floor
11:00 – 12:30	**Concurrent sessions**	
	Concurrent session 8A Control: strategies Ballroom 2 Chair: Peter Fleming	**Concurrent session 8B** Community & transformative ideas Ballroom 3 Chair: Peter Brown
11:00	A story of challenges & teamwork: development of a new toxin and bait for feral pig management *Linton Staples (no abstract available)*	A new paradigm for invasive species management: application of a systems strengthening approach *Sharyn Williams*
11:15	Managing pests with exclusion fences: progress and potential biodiversity benefits *Lee Allen*	Feral tales that make engagement happen: how stories can shape our views, our actions, our learning *Jessica Marsh*

11:30	The application of genetics to improving peri-urban wild dog management *Matt Gentle*	Evaluation of the IA CRC principles-based multi-disciplinary research program to improve human issues of invasive species management *Paul Martin*
11:45	Population reduction is more important than limiting immigration in a proposed large wild dog cell *Malcolm Kennedy*	A bio-economic decision process for broadscale eradication or containment of invasive pests *Dean Anderson*
12:00	Do dingoes suppress feral cats? Spatial and temporal activity of sympatric feral cats and dingoes in Central Queensland *Bronwyn Fancourt*	Principles of applied ecology: a transformative idea for vertebrate pest management? *Jim Hone*
12:15	Does wild dog control alter feral cat activity? *Tracey Kreplins*	Transforming conflict into collaboration: new tools for old problems of stakeholder engagement *Greg Mifsud*
12:30 – 13:30	Lunch	Conference floor
13:30 – 15:00	**Concurrent sessions**	
	Concurrent session 9A Control: strategies Ballroom 2 Chair: Matt Gentle	**Concurrent session 9B** Open session 3 Ballroom 3 Chair: Stephen Sarre
13:30	Kangaroos and conservation in the bush capital: it's not rocket science *Melissa Snape*	Rabbits do love their veg! Rabbit impacts on horticulture in Queensland *Peter Elsworth*
13:45	Movement of eastern grey kangaroos in Canberra: implications for management and control. *Renee Brawata*	Habitat modelling of predators in Tasmania inferred by DNA-based detection of carnivore scats *Stephen Sarre / Elodie Modave*
14:00	Native pest management: kangaroo over population *Calista Cameron*	Does the hybridisation of Tasmanian and mainland Australian brushtail possums inhibit dispersal in New Zealand? Implications for management *Catriona Campbell*
14:15	Towards a feral cat management strategy for Hattah-Kulkyne National Park: estimation of cat density, bait uptake and comparisons of management strategies *Alan Robley*	Maintaining the capability pipeline: IA CRC Balanced Researcher Program *Stephen Sarre / Tony Buckmaster*
14:30	Destruction of drought refuge rabbit warrens to control rabbits on Bulloo Downs: finishing a 20 year long project *David Berman*	Dung distribution: the first step for Pilliga feral horse management *David Wurst*
14:45	Opportunities to improve pest species mapping through the use of ultra-high-definition aerial survey techniques *Suzie Holbery*	Density-dependent effects of rabbit browsing on Australian native vegetation *Greg Mutze*
15:00 – 15:30	Afternoon tea	Conference floor
15:30 – 17:00	Plenary session *Chair: Alison McInnes*	Ballroom 2 & 3
15:30 – 16:45	Discussion panel – Future technologies in pest animal management Moderator: *Paul Barclay* – Big Ideas, ABC Radio National Panellists: *Dr Edy MacDonald* – Social Science Unit for the Department of Conservation, NZ *Dr Mark Tizard* – CSIRO *Dr Bidda Jones* – RSPCA Australia *Dr Karl Campbell* – Island Conservation, Galapagos	
16:45	Prizes and awards	
17:00	**Conference close**	

POSTER PROGRAM

Poster speed talk session 1 – Tuesday 2nd May 2017

17:10	**Poster 14:** What can camera traps and hunter bags tell us about the growth and spread of deer populations? *Andrew Bengsen*
17:13	**Poster 1:** Applying a standard biosecurity response tool to high risk vertebrate incursions *Jesse Miller*
17:16	**Poster 16:** A strategy for effectively managing feral pig impacts in agricultural enterprises in northern Queensland *Peter Cremasco*
17:19	**Poster 15:** Creeping cats caught out! Using ultrasonic deterrents to keep cats out of urban backyards *Heather Crawford*
17:22	**Poster 7:** Directed experimental evolution of rabbit haemorrhagic disease virus *Robyn Hall*
17:25	**Poster 2:** The IAP2 spectrum of public participation: a useful tool for communication and engagement activities in the pest animal world *Dana Price*
17:28	**Poster 22:** Opportunity from a menace: feral pigs to fertiliser *Stephanie von Gavel*
17:31	**Poster 21:** 1000 pictures is worth how many words? *Jessica Marsh*
17:34	**Poster 17:** An integrated and coordinated landscape-scale approach to vertebrate pest control and monitoring *Sally Jacka*

Poster speed talk session 2 – Wednesday 3rd May 2017

17:10	**Poster 11:** Exploring natural and engineered gene drives for eradications of invasive rodent populations *Royden Saah*
17:13	**Poster 20:** Who has the data? *Roxane Blackley*
17:16	**Poster 28:** Interpreting environmental DNA metabarcoding results to infer biodiversity *Elise Furlan*
17:19	**Poster 4:** Assessing the effects of feral deer management on endangered alpine peatlands: the Alpine National Park Deer Control Trial *Daniel Brown*
17:22	**Poster 26:** Engaging the community to help protect our native fish from aquatic pests such as Redfin Perch *Karina Worrell*
17:25	**Poster 23:** Kangaroo Island feral cat control trials 2016-2018: guiding an island eradication *Pat Hodgens*
17:28	**Poster 13:** The detox-toad: combining CRISPR gene editing and conditioned taste aversion, new horizons for gene technology in cane toad control *Mark Tizard*
17:31	**Poster 27:** Wild dog aware *Bernadette York*
17:34	**Poster 29**: Dietary analysis of feral pigs from the southwest of Western Australia *Joe Porter*

Poster session (both days)

Poster 3: Red fox movement at a flatback turtle rookery in the Pilbara, Western Australia
John-Michael Stuart

Poster 5: The impact of RHDV2 on rabbit populations across Australia
Tarnya Cox

Poster 6: Detection of RHDV2 in European brown hares (*Lepus europaeus*) in Australia
Robyn Hall

Poster 8: Origins of the benign rabbit calicivirus in Australia
Jackie Mahar

Poster 9: Detection of a recombinant RHDVa isolate in Australia
Jackie Mahar

Poster 10: Biological control of tilapia: a potential virus
Ken McColl

Poster 12: Differential diagnostic of rabbit caliciviruses circulating in Australia
Tanja Strive

Poster 18: Threat abatement policy for the environmental impacts of rabbits
Julie Quinn

Poster 19: Threat abatement policy for the environmental impacts of feral pigs
Julie Quinn

Poster 24: Lessons from experience: a multidisciplinary research team pursuing maximum value to end-users in the shortest possible time
Paul Martin

ABSTRACT INDEX

AUSTRALIAN DEVELOPMENTS AND OUTLOOK IN PEST ANIMAL RESEARCH

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Australia has had a number of notable wins since the last conference. Macquarie Island has been officially declared rabbit and rodent free, while no credible physical evidence of foxes has been found in Tasmania since July 2011 and the decade fox eradication program completed in 2014. On the mainland, major investments have been made in cluster fencing to control wild dogs and feral cat free enclosures. The cluster fenced area in Queensland alone covers more than 50,000 km^2 or ¾ the size of Tasmania and continues to grow. Broadscale management outside these 'islands' has also improved through the availability of the first new predator toxin – PAPP – in 50 years that provides an additional tool to work with 1080 in delivering comprehensive regional baiting programs, and the first national release of a new rabbit biocontrol agent in 20 years – RHDV1 K5.

These achievements come at an important time for Australia. A recent review of the Intergovernmental Agreement on Biosecurity (IGAB) highlighted significant vulnerabilities in the National Biosecurity System. This includes *ad hoc* national institutions for collaborative research and innovation (such as time-bound Cooperative Research Centres), which need to be replaced with enduring ones, such as the proposed Centre for Invasive Species Solutions.

The national innovation outlook holds promise. Biocontrol pipeline strategies are being progressed for rabbit and carp biocontrol, and a new potential biocontrol agent for tilapia has emerged. Digital and genetic technology opportunities have great potential to improve detection efforts both at the border and at the farm level, which will enable more rapid and targeted action. In the long-term, next generation genetic technologies, such as gene drives, also have potential that warrants examination. For these technologies to have impact will require on-going and deeper partnerships between communities, industry and governments.

RESEARCH TO ENABLE A 'PREDATOR FREE' NEW ZEALAND BY 2050

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In 2016, the NZ government announced an audacious national goal: to eradicate invasive rats, possums and stoats from the country by 2050 ('Predator Free New Zealand 2050'). This goal was subsequently adopted as the lead commitment of the 'Honolulu Challenge on Invasive Species' launched by the International Union for Conservation of Nature (IUCN).

The cost of invasive species to NZ is high. For example, due to invasive predators NZ has the most 'extinction prone' avifauna in the world. Invasive species are also reservoirs for diseases such as bovine tuberculosis, with the government estimating the cost of introduced species to the NZ economy and primary sector to be $3.3bn a year. The benefits to be obtained from a 'predator free' NZ are thus high.

Researcher and stakeholder co-innovation workshops have identified fourteen activity areas in which research crossing the span of technical, ecological, sociological and policy disciplines can enable achievement of the 2050 goal. The integration of advances across these areas will provide multiple pathways to (1) efficient and acceptable large-scale predator suppression, (2) better detection and surveillance of survivors and immigrants, (3) effective tools being in widespread use, (4) strategy and planning for biodiversity benefit, and (5) increased community engagement.

Several new initiatives to deliver the needed advances are already up and running. These include the development of (1) toxins with increased host-specificity and thus decreased non-target effects, (2) more cost-effective control of multiple predators over large areas, (3) the ability to reliably eradicate possums and rats from large areas using conventional toxins, and (4) predator lures to make conventional traps and detection devices more effective. In addition, the potential of new genetic-based approaches such as 'suppression' gene-drives is being explored, along with the 'bioethical' and 'social licence to operate' aspects of both existing and new potential tools and technologies.

THE US PERSPECTIVE: CHALLENGES AND DIRECTIONS IN INVASIVE AND OVERABUNDANT ANIMAL RESEARCH

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Wildlife managers in many countries around the world are facing similar challenges, to include; a lack of means to address invasive and overabundant species issues in the face of declining fiscal resources, associated reduced capacity to achieve management goals, and a need to garner public support in the wake of changing societal values and increasing human populations. Meeting these challenges requires building off the profession's successes and developing new paradigms and strategies to curtail the negative impacts invasive and overabundant species are having on our planet's natural resources. In the US, like our predecessors in wildlife conservation succeeded in initiating movements that have led to the recovery of many valued native species, now it is us who face comparable albeit somewhat opposite mandates. A primary charge is to curtail and reverse the further establishment and impacts of invasive species—crises for which we look to innovative colleagues worldwide for guidance, collaboration and synergy. Here I discuss some of the avenues of endeavour that US researchers and their partners feel hold much promise. I also present pertinent examples of current challenges and successes.

COMMUNITY-BASED INVASIVE SPECIES SURVEILLANCE: BRINGING INNOVATION TO INFORMATION SHARING AND IMPROVED MANAGEMENT

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Community-based pest surveillance technologies have evolved substantially in recent years. Mobile apps offer opportunities to improve community-based data collection, as well as provide greater support to communities and landholders with pest and weed management. As technology improves and as community involvement increases, arrangements for cross-platform and cross-agency data sharing becomes more crucial to enable effective management interventions.

The FeralScan community pest mapping program (with free mobile apps) now contains over 65,000 community records of pest animals, their impacts, local control actions and photographs supplied by over 25,000 people Australia-wide. It is currently being used by landholders, Landcare groups, pest control groups, private contractors, local governments, regional land managers, researchers and biosecurity authorities across Australia.

FeralScan offers an interactive free service for landholders and communities Australia-wide to support community surveillance of pests, as well as connect landholders to online resources to assist them with local action. Community group users benefit from using the program to collectively document pest problems, map control actions and track changes in their local area. New capabilities for community groups include alert-style notifications to automatically inform all landholders in a group about incidents, such as local wild dog attacks.

FeralScan now also alerts biosecurity authorities to changes in pest activity, such as new incursions of high risk species; expansion in the range of established or contained species, or significant incidents such as serious impacts. It is also currently being used as part of the national RHDV monitoring program in Australia's rabbit population, for data collection, communication and improved community support. It shares data with relevant stakeholders and connects biosecurity authorities to communities. It also offers for the first time, the capacity to develop metrics of pest activity at multiple scales for evaluating management interventions and the prioritisation of valuable resources.

Future directions for biosecurity, invasive species detections, biocontrol surveillance, and improved community support will be discussed.

FRONTIERS AND LESSONS IN ISLAND ERADICATIONS: THE CASE OF FOXES ON PHILLIP ISLAND

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Island species are over-represented in vertebrate extinctions due to their vulnerability to invasive predators. Eradication programs are increasingly used on islands to cost-effectively reduce the impact of invasive predators in the long-term. Large, inhabited islands are frontiers for eradication programs as these pose logistical as well as socio-political challenges, but the potential benefits are great.

Phillip Island is a 100-km^2 inhabited island connected to the Australian mainland via a bridge. A program to eradicate red foxes (*Vulpes vulpes*) was initiated to eliminate their impact on ground-nesting coastal birds, particularly little penguins (*Eudyptula minor*) (Kirkwood *et al.* 2014). The fox population has been reduced to undetectable levels, but it remains unclear whether successful eradication has been achieved. A Bayesian catch-effort model was developed to assess population size and the effectiveness of monitoring methods (Rout *et al.* 2014). This model now includes additional monitoring with camera traps and fox detection dogs, which increase the probability of detection, reduce the time without detections before a declaration could be made, and assist planning for future monitoring of fox incursions. We present common management principles and lessons learned that can guide other pest eradication attempts.

References

Kirkwood, R, Sutherland, DR, Dann, P, Murphy, S (2014) Lessons from long-term predator control—a case study with the red fox. *Wildlife Research* **41**, 222-232.

Rout, TM, Kirkwood, R, Sutherland, DR, Murphy, S, McCarthy, MA (2014) When to declare successful eradication of an invasive predator. *Animal Conservation* **17**, 125–132.

MAKING INFERENCE FROM WILDLIFE COLLISION DATA: INFERRING PREDATOR ABSENCE FROM PREY STRIKES

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Wildlife collision data are ubiquitous, though challenging for making ecological inference due to typically irreducible uncertainty relating to the sampling process. We illustrate an approach that is useful for generating inference from predator data arising from wildlife collisions. By simply conditioning on a second prey species sampled via the same collision process, and by using a biologically realistic numerical response functions, we can produce a coherent numerical response relationship between predator and prey. This relationship can then be used to make inference on the population size of the predator species, including the probability of extinction. A practical application of the approach for testing hypotheses about the distribution and abundance of a predator species is illustrated using the hypothesised red fox incursion into Tasmania, Australia. Results support the inference of Caley *et al*. (2015), namely an absent or highly restricted fox population as far back as 2013.

References

Caley, P., Ramsey, D.S.L. & Barry, S.C. (2015) Inferring the distribution and demography of an invasive species from sighting data: the red fox incursion into Tasmania. *PLoS ONE,* **10,** e0116631.

ADVANCING REMOTE ACOUSTIC SURVEILLANCE TECHNOLOGY AT A 'REAL-TIME' INVASION FRONT

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There is an acute need for increased, targeted, surveillance for starlings in Western Australia (WA). In October 2016, a two year old female was trapped—representing the first detection of starlings along the state's south coast in four years. This discovery comes after recent Bayesian modelling indicating at least 40 starlings are likely to exist undetected throughout WA's south coast. Left undetected, starlings have the potential to reproduce rapidly and at carrying capacity (12.5 million individuals) could cost the WA economy up to $176 million annually in losses. Dawn recordings were manually downloaded from ten SM2 units placed in the vicinity of the starling capture from November 2016 – February 2017. Despite known limitations, we reviewed this field data using 'Tweetfinder1' software for evidence of further starling presence.

Building on previous R&D into acoustic surveillance and detection for starlings, we are now seeking to advance this technology to a point where false positive detections are minimised, data processing occurs in close to real time and results are accessible remotely. Using new approaches such as Kaldi and Deep Neural Networks, we are developing and verifying 'Tweetfinder2', with the aim of reducing false positive detection rates.

A pre-processing starling algorithm is also being designed to be integrated internally with new acoustic recognition sensors for field deployment. We aim to develop field units that will record, pre-process data and only send via the cloud the small fraction of data considered highly likely to contain starling calls. Pre-processing on the individual units reduces costs associated with transferring large volumes of data remotely and will then allow 'Tweetfinder2' to rapidly process high risk data and automatically inform end-users of positive detections in close to real time. Ultimately, this technology can be applied to multiple invasive and conservation significant species that produce distinctive calls.

USING WILDLIFE CAMERAS FOR INVASIVE TURTLE SURVEILLANCE

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Following a highly credible report of an invasive red-eared slider turtle (*Trachemys scripta elegans*) in a Victorian river system, the Department of Economic Development, Jobs, Transport and Resources trialled using camera trapping to compliment other traditional surveillance activities, to determine if it was an effective and efficient technique. As there have been very few published studies that utilise camera trapping for studying reptiles (only 3% within Australia and 1.1% globally), a variety of camera settings, platforms, camera placements, angles and fields of view were trialled.

As part of the response, a red-eared slider turtle was repeatedly detected using both camera traps and more traditional surveillance techniques, highlighting both the benefits and limitations to using camera traps in this type of incursion response. This presentation will discuss the learnings from the trial of this technique, which will continue to be utilised as an important tool in future surveillance activities.

References

Meek, P. D., Ballard, GA. and Fleming, P. J. S (2015) The pitfalls of wildlife camera trapping as a survey tool in Australia. *Australian Mammalogy* 37: 13-22

Burton, A. C., Neilson, E., Moreira, D., Ladle, A., Steenweg, R., Fisher, J.T., Bayne, E. and Boutin, S. (2015) Wildlife camera trapping: a review and recommendations for linking surveys to ecological process. *Journal of Applied Ecology* 52:, 675-685

DEVELOPMENT OF A NSW TILAPIA INCURSION RESPONSE PLAN: FAILURE TO PLAN IS A PLAN TO FAIL

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Mozambique tilapia (*Oreochromis mossambicus*), commonly called tilapia, are one of the world's worst invasive fish species impacting native fauna at a global scale (Lowe et al, 2004). The life cycle traits of tilapia that ensure their success as a pest also make them a successful species for aquaculture, with tilapia now classed as the most important aquaculture fish of the 21st century (Shelton, 2002). In Australia, wild populations of tilapia were first detected in Queensland in the 1970s and spread rapidly across many Queensland inland and coastal waterways. Once established, tilapia are nearly impossible to eradicate from a waterway. Most, if not all, tilapia translocations in Australia occur through human movements (Ovenden et al, 2014). This finding suggests targeted communication and advisory efforts are the best tools available for controlling further spread of tilapia. In December 2014, the first NSW population of tilapia was confirmed in Cudgen Lake. NSW Department of Primary Industries is responding to this incursion with targeted communication efforts and the development of a NSW Tilapia Incursion Response Plan. This presentation outlines the risks tilapia pose to NSW aquatic ecology, considers future management options across NSW and highlights the need for a national strategy to manage this threat to the Murray Darling Basin and its high value native fish.

References

Lowe, S., Browne, M., Boudjelas, S. and De Poorter, M., 2000. 100 of the world's worst invasive alien species: a selection from the global invasive species database

Ovenden, J.R., Macbeth, G.M., Pope, L., Thuesen, P., Street, R. and Broderick, D., 2015. Translocation between freshwater catchments has facilitated the spread of tilapia in eastern Australia. *Biological Invasions*, *17*(2), pp.637-650.

Shelton, W.L., 2002, February. Tilapia culture in the 21st century. In *Tilapia Farming in the 21st Century, Proc. Int. Forum on Tilapia Farming in the 21st Century* (pp. 1-20).

CYPRINID HERPESVIRUS 3: A POTENTIAL BIOLOGICAL CONTROL AGENT FOR CARP IN AUSTRALIA

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Carp (*Cyprinus carpio*) is one of the world's eight most invasive fish species and, by public opinion, it is the fourth most significant vertebrate pest in Australia. Carp are associated with degradation of the Murray-Darling Basin (MDB) river system, where they may, in places, constitute up to 90% of the fish biomass. The Invasive Animals Cooperative Research Centre has investigated a number of potential controls for carp in Australia including the use of cyprinid herpesvirus 3 (CyHV-3; formerly koi herpesvirus) as a biological control (biocontrol) agent. At the CSIRO-Australian Animal Health Laboratory we have used our experience with viral biocontrol of rabbits to address a number of important questions about the safety and efficacy of CyHV-3 including: (1) Is widespread release of CyHV-3 safe, not only for humans, but also for a wide taxonomic range of other non-target species? (2) Will CyHV-3 be effective, either alone or in conjunction with other broad-scale controls? (3) Are there cross-reactive viruses in carp that could mitigate the effectiveness of the virus? (4) Can modelling be used to develop a strategic release plan for CyHV-3 in the MDB, and will modelling aid in predicting the ecological consequences of virus release? An additional interesting question is: what is the origin of the virus?

GENE DRIVE AND THE POTENTIAL TO CONTROL VERTEBRATE PESTS

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Natural gene drives have been known about for decades, due to their becoming over-represented in a particular population of organisms. Their mechanisms of action have been studied but they are limited in their adaptability and thus have been of limited value. However the advent of the CRISPR/Cas9 gene editing tools has seen the development of highly adaptable artificial RNA guided 'gene drive' elements. These have the potential to be adapted to almost any vertebrate pest animal. Genetically encoded biological payloads can be attached to them, emerging as traits in the phenotype of the individuals that inherit them. A gene drive has its function when in a heterozygous state (existing, for arguments sake on a paternal chromosome) by causing a CRISPR/Cas9 directed break in the homologous maternal chromosome. Homology directed DNA repair uses the paternal chromosome to patch the broken maternal chromosome and in doing so directs a copy/paste duplication in that maternal chromosome. The individual is now homozygous for the gene drive. The result is that all of its offspring will carry the gene drive—each of those will experience the duplication event and all of their offspring will carry the gene drive. This inexorable process means that once introduced into a population a gene drive, after several generations have passed, will appear in all individuals. This supra-Mendelian inheritance pattern is predicted to continue even in the face of a significant fitness penalty (provided it does not impair sexual reproduction). This opens the door to the application of gene drives for the control of pest animal species. There is much international debate and much still to learn about gene drives and their application in vertebrate pest animal control. If the technology is designed and applied with care, firm regulation and strong control it has great potential for the future.

IMMUNE RESPONSE OF COMMON CARP, *CYPRINUS CARPIO,* TO *CYPRINID HERPESVIRUS* 3 INFECTION: IMPLICATIONS FOR VIRAL BIOCONTROL

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Common carp, *Cyprinus carpio,* is a major pest species in Australian waterways, in some instances comprising 90% of all fish biomass. This results in the dislocation of native species, increased water turbidity, loss of aquatic vegetation, and alterations in zooplankton and benthic invertebrate diversity. A potentially useful biocontrol agent for carp is *Cyprinid herpesvirus* 3 (CyHV-3), which specifically infects carp and induces high mortality rates. However, carp immune responses and mechanisms of resistance to CyHV-3 are not well understood. These data are important for predicting susceptibility changes in wild carp populations as the virus spreads over time, and for developing long-term control strategies. We used high throughput sequencing of carp messenger RNA (mRNA) during different phases of CyHV-3 infection to detect the gene expression dynamics of both host and virus simultaneously. During acute CyHV-3 infection, the carp host modified the expression of several thousand genes that were involved in a range of immune systems and detoxification pathways. These activated pathways indicated that a humoral immune response, rather than a cell-mediated response, was preferred by the carp. Interestingly, the type of immune response mounted by the carp may have been influenced by the virus itself through the expression of a captured interleukin-10 homologue, thereby favouring virus survival. In addition, many immune-related genes were duplicated in the carp genome, and often these were expressed differently across the infection phases. This genetic redundancy may allow immune-related genes to evolve more rapidly, possibly improving the ability of carp to develop resistance mechanisms. Finally, the humoral adaptive immune response in carp was examined by assembling immunoglobulin transcripts. The carp immunoglobulin repertoire significantly diversified during CyHV-3 infection, which was followed by the selection of high-affinity B-cells, indicating a developing humoral immune response. These findings will undoubtedly contribute to the use of CyHV-3 as a biocontrol agent.

TROJAN Y GENETIC CONTROL OF *GAMBUSIA HOLBROOKI*: RATIONALE, PROGRESS AND CHALLENGES

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The history of trying to deal with destructive pest-fish species on large spatial scales has to date been ineffective with the problem likely to grow more severe around the world in the future. Genetic approaches could revolutionise the management of such pests but are subject to a range of technical, behavioural and ecological limitations and may face challenges of public acceptability. Our work on *Gambusia holbrooki* a pest fish of concern to Australia, takes a systematic approach of evaluating feasibility, assessing public acceptance and making technical advances on Trojan Y as a suitable genetic control option. Using a prototype generic model that incorporates both genetic and population dynamic determinants for the control of gonochoristic, bisexual vertebrate pests we show that the Trojan Y is not only the most effective—about 10 and 20 times more effective compared to a closest gender distorting recombinant approach in terms of time to eradication and cost for total eradication respectively—but also one that remains environmentally benign and socially more acceptable. Evaluation of behavioural tradeoffs, parametrisation of a model that is specific to a field site in Tasmania, design of a management strategy for evaluation, and generation of population and genetic tools for assessing the progress of introgression and eradication are under way and will be discussed.

THE APPLICATION OF DNA TO WILDLIFE SURVEILLANCE

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DNA related technology is changing rapidly making data generation easier, and in many cases cheaper. These advances hold the potential for application to wildlife surveillance but also hold risks and challenges. An important advance has been the adoption of ancient DNA approaches for the detection of eDNA—DNA that exists in the environment. All organisms shed DNA and much finds its way into the environment and can be detected by sampling water, soil, air, or faecal material. This approach provides a non-invasive approach to wildlife analysis and holds considerable promise for the detection of cryptic border arrivals, of species post arrival but in the early phase of the invasion curve, or of the impacts of post eradication treatments. The main risks lie in inadequate delineation of the limits of detection leading to the potential for incorrect diagnoses of species presences or absences and in the inadequate databases and systems to fully interpret the information that emerges from multispecies DNA profiles. A second key advance has been the development of high throughput genotype-by-sequencing capacity providing thousands of genetic markers with little development. These approaches provide the fine-scale genetics necessary to identify pathways of arrival, delineate species, monitor ecological effects of invasion, and analyse population dynamics of established invasive species. We will review progress in the application of these technologies illustrating with examples from our own research and identify knowledge gaps and opportunities that exist for the analysis of vertebrate pests into the near future.

FROM FAECES TO FOXES: USING GENETICS TO MANAGE AN INVASIVE PREDATOR FOR WILDLIFE CONSERVATION

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Genetic analysis of non-invasive samples is an important wildlife management tool, and is especially useful to inform management of rare or cryptic species. Here, we describe how genetic tools for species detection and individual identification can be applied within a management context, to find and monitor an invasive predator and understand its impacts on native wildlife. The introduced red fox (*Vulpes vulpes*) has been implicated in extinctions and declines of many Australian vertebrates, and fox management remains a challenge to conservation across much of the continent. The island of Tasmania was considered to be fox-free, but from the late 1990s increasing evidence pointed to a fox incursion. Tasmania is home to species that have declined or become extinct elsewhere in Australia and are at particular risk of fox predation. Since 2007, we have used genetics to study Australian foxes. We have conducted landscape-scale surveys for predator scats in Tasmania, and used a PCR and sequencing test to identify scats containing fox DNA. We have also used blind trials and bioinformatic tools to evaluate the sensitivity and specificity of this fox DNA test. Microsatellite and SNP genotyping have improved our understanding of Australian fox population structure, and we are developing better genotyping tools for non-invasive mark-recapture studies. Finally, DNA metabarcoding analysis of scats reveals the diets of introduced and native predators, including foxes, cats, Tasmanian devils and quolls.

SENSITIVE INVASIVE SPECIES SURVEYS USING ENVIRONMENTAL DNA

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Environmental DNA (eDNA) surveys provide a powerful tool to infer species presence in an environment. The capacity for extremely low-densities detection has allowed eDNA to identify invaders during the early stages of an incursion, when opportunities for eradication are possible. Like any survey method however, eDNA detection remains imperfect with the opportunity for false negatives (i.e., failing to detect a species when it is present in the environment) or false positives (i.e., apparent detection of a species when it is absent from the environment). In this talk, I will draw on examples from aquatic eDNA surveys to detect invasive species in Australian freshwater environments. In particular, I will focus on eDNA detection of an extremely low-density European carp population in Tasmania's central highlands. I show how the sensitivity or probability of eDNA detection can be quantified, allowing variation in detection sensitivity across sites or seasons to be identified. This allows sampling strategies to be optimised to increase detection sensitivity in addition to calculating costs associated with achieving adequate sensitivity for low-density detection. This talk will demonstrate how eDNA survey results can be interpreted to account for imperfect detection, which can lead to better informed and more effective management of invasive species.

IMPACT OF ENVIRONMENTAL VARIABLES ON EDNA DETECTION

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The use of eDNA as a tool for the detection of invasive aquatic species is a relatively new and promising tool. However, a range of environmental variables can impact on eDNA persistence with the effect of natural flowing systems being less known. Environmental DNA detection in lotic (rivers and streams) ecosystems is particularly complex because factors such as flow rate, discharge rate and stream morphologies are expected to add to the difficulty of determining appropriate eDNA sampling sites. How far eDNA can be detected from the source in flowing water is not well understood because stream flow could affect eDNA detection by diluting eDNA and complicating its transport (Goldberg et al. 2011). Investigating eDNA detection across space and time will aid in developing better sampling methodologies in streams and rivers. In this presentation, we show how eDNA detection changes over time and distance following the introduction and removal of a source population in a natural stream. Using the freshwater invasive species, the Oriental weatherloach (*Misgurnus anguillicaudatus)*, we have addressed the following questions: *How soon can eDNA be detected after the introduction of an invasive fish in a natural stream? How far can eDNA be detected from the source population over time? How long can eDNA be detected after removal of source population? Will the quantity of eDNA and the detection rate increase over time after introduction?* Outcomes from this study will aid in the deployment of eDNA as a standardised surveillance tool for invasive species management.

References

Goldberg CS, Pilliod DS, Arkle RS, Waits LP (2011) Molecular Detection of Vertebrates in Stream Water: A Demonstration Using Rocky Mountain Tailed Frogs and Idaho Giant Salamanders. *Plos One* 6

OPTIMISING SAMPLING PROTOCOLS FOR FISH COMMUNITY ASSESSMENTS THROUGH ENVIRONMENTAL DNA METABARCODING

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Accurate monitoring of species biodiversity is the fundamental basis for the management of invasive species. Recently, high-throughput sequencing of environmental DNA (eDNA metabarcoding) has proven to be a powerful tool for the monitoring of aquatic biodiversity (Valentini *et al.* 2016). The ability to detect species when they are present at low densities makes this method highly suitable to detect new incursion and spreading invasion front of aquatic invasive species. However, before this technology can be used in routine surveys a thorough understanding of the optimal sampling protocols is needed. As environmental DNA is heterogeneously dispersed within a water body, evaluating the number of samples that need to be collected and processed to determine the entire fish community is critical. Additionally, the required sampling effort is likely to increase with an increased complexity of the fish community. Within the Murray-Darling Basin (MDB) there is a general negative trend between species diversity and altitude. As such, we hypothesise that in high-altitude river systems fewer samples are needed to determine the whole fish community. To test this we have chosen 5 locations within the Murrumbidgee catchment ranging in altitude from 520-1303m. These sampling locations have been extensively monitored in the past and the fish biodiversity is expected to range between 2 to 15 species. Using expert knowledge, we constructed species lists for each sampling location. In addition, 12 2L water samples have been collected at each location and will be analysed using an eDNA metabarcoding approach. The results of this study will allow us to make recommendations for optimal sampling strategies and will form a basis for the future implementation of eDNA metabarcoding in routine monitoring surveys.

Reference

Valentini, A. *et al.* (2016). Next-generation monitoring of aquatic biodiversity using environmental DNA metabarcoding. *Molecular Ecology*, **25**, 929–942.

TARGETING 'GEN ONE': A SCALEABLE STRATEGY FOR DETECTING AND RESPONDING TO RAT INCURSIONS IN PREDATOR-FREE LANDSCAPES

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Current best practice for surveillance and incursion response on rat-free islands and mainland sanctuaries requires that every invading individual be intercepted and killed to prevent the possibility of population re-establishment. However, a single invading male or non-pregnant female rat in an otherwise rat-free area would cause minimal ecological damage to healthy native species populations, and without any mating opportunities, would be functionally extinct. Zero Invasive Predators (ZIP) are investigating the viability of an alternative strategy for incursion response at landscape scale, which will focus on detecting and responding to the first breeding ('Gen One') event, rather than single invaders. This strategy is based on the assumption that the collective dispersal 'footprint' of a breeding event (6–10 individuals) will be larger than that of a single invader.

The Gen One strategy relies on a highly sensitive and auto-reporting primary detection network, deployed at sparse density across a protected area. A single activation of a primary detection device triggers rapid deployment of secondary detection to 1) confirm whether the incursion consists of an individual or a population, and 2) determine the spatial extent of the affected area. Prompt spot-treatment follows to remove the nascent population. A key advantage of this strategy is that there is a longer window of opportunity to detect and respond to a Gen One event (~100 days from weaning of Gen One to potential weaning of Gen Two) than to a single invader (minimum of 20 days before potential Gen One is weaned). ZIP are currently working on recording the dispersal footprint of a young litter of rats in an otherwise rat-free landscape, and are developing tools for primary and secondary detection, as well as targeted removal response methods, that will be suitable for landscape-scale deployment.

THE RELEASE AND TRACKING OF RHDVS IN AUSTRALIA'S RABBIT POPULATION

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In 2009 the RHDV-Boost project began a search for an additional strain of rabbit haemorrhagic disease virus (RHDV) to release as a biocontrol tool into Australia's rabbit population. In May 2015 a new variant of RHDV—RHDV2 was identified in wild rabbit carcases and has since spread across the country. In 2016 the RHDV1 K5 strain was registered for release and in March 2017 that strain was released into the rabbit population at over 700 sites across the country, through a coordinated program involving all States/Territories. There has been considerable community involvement in the release of RHDV1 K5 and the ongoing monitoring of all RHDV strains across the country through the RabbitScan community mapping program. Without the monitoring program established for the release of RHDV1 K5, tracking the spread of RHDV2 across the rabbit population would likely have been more difficult. Here we discuss the monitoring of RHDVs across the country and present preliminary data on the impact of the release of RHDV1 K5 on Australia's rabbit population.

MAXIMISING THE IMPACT OF RHDV K5 IN VICTORIA

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The release of biological control agents for rabbit control have been a significant catalyst for management of this pest in the past. However, history shows that significant opportunities for achieving long term control were lost as community and government developed an over reliance on biological control to control rabbits.

In preparing for the release of RHDV K5, Victoria developed monitoring and release strategies to maximise any impact or benefits that RHDV K5 may provide.

The Victorian RHDV K5 monitoring and release strategy was developed around the harmonisation of approaches to citizen science, community led action, capacity building, and knowledge gap analysis.

The release strategy is underpinned by the Victorian RHDV K5 Communications and Engagement Plan. Both plans align, support and extend the national approach to RHDV K5 conditions, systems and communities.

The national release strategy provided opportunities for communities to express interest in becoming a release site. While the National RHDV Boost Operations Working Group developed criteria for release site selection, the Victorian release strategy and associated communication plan described the science, methodology and criteria used to select Victorian sites aligned to the national standard. This resulted in the strategic placement of virus release sites aiming to saturate Victoria in RHDV K5 virus.

This presentation will showcase Victoria's RHDV K5 monitoring and release strategy and the government's approach to understand the spread and impacts to inform community and enable future strategic management.

FLY TRAPS AS A TOOL FOR MONITORING RHDV

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Rabbit haemorrhagic disease virus (RHDV) has been a driver of rabbit mortality in the past two decades, providing billions of dollars in benefit to Australian agricultural industry and environment. We expect existing patterns of RHDV circulation in Australia to be considerably disrupted in the short term, given the recent spread of RHDV2 and the impending introduction of K5; two foreign strains with differing epidemiology to the currently circulating Australian strain. A baseline understanding of circulating RHDV strain variation is required, in order to assess the impact of new strain introductions.

Since flies are known to carry RHDV they provide an ideal opportunity for monitoring the virus. We set up fly traps at 5 sites in the Gawler/Barossa region for the duration of the 'outbreak season' in spring 2013 and 2014. RHDV presence was tested by PCR, and positive samples were sequenced to examine strain variation.

We found that wind-oriented fly traps provide improved detection rate and efficiency over carcass searches, and are less reliant on researcher expertise and rabbit density. This tool will therefore be ideal for simple wide-scale monitoring of RHDV introductions and evolution.

RHDV2 IN THE AUSTRALIAN LANDSCAPE: 2015-2016

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Rabbit haemorrhagic disease virus 2 (RHDV2) is a calicivirus, genus *Lagovirus*, that causes hepatitis, disseminated intravascular coagulation and death in susceptible European rabbits (*Oryctolagus cuniculus*) and a number of hare (*Lepus*) species. RHDV2 was first detected in France in 2010 and has subsequently become widespread throughout Europe and its islands, the UK, and Australia. Outbreaks have also occurred in Canada and Benin. RHDV2 is genetically and antigenically distinct from 'classic' RHDV, although the pathology appears to be similar for the two viruses. Unlike 'classic' RHDV, RHDV2 causes high case fatality rates in very young rabbits, and can overcome immunity to classical strains. Likely due to these factors, RHDV2 appears to be replacing previously circulating RHDV strains in Europe.

RHDV2 was initially detected in Australia in May 2015 in Canberra. Fortuitously, the existing national RHDV monitoring program designed to measure the impacts of the pending release of the new Korean 'K5' RHDVa strain was already in place during that time, greatly facilitating the monitoring of the initial spread of this new virus. Within 18 months of initial detection, RHDV2 had spread to NSW, Victoria, South Australia, Northern Territory, Tasmania and Western Australia. In May-July 2016, RHDV2 was also detected in deceased European brown hares (*Lepus europaeus*) in Australia. From May 2015 to the present, RHDV2 has become the dominant circulating strain, replacing 'classic' RHDV in all areas except Tasmania. The presence of RHDV2 may have wide-ranging implications for rabbit biocontrol, in particular on the planned release of RHDVa K5. Ongoing surveillance in both wild and domestic rabbits and hares is critical to understanding the interactions of the various lagoviruses in Australia and their impacts on lagomorph populations. Comparing and contrasting the epidemiology of this strain in Australia and in Europe will provide valuable insights into RHDV epidemiology relevant to both continents.

RECOVERING THE EPIDEMIOLOGY OF WILDLIFE DISEASE FROM VIRAL SEQUENCE DATA: THE PHYLODYNAMICS OF THE RABBIT HAEMORRHAGIC DISEASE VIRUS

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Recently, efforts have been made to extend phylogenetic birth-death models in order to estimate parameters relevant for epidemiological studies. In these models, the rate of transmission and recovery can be inferred from molecular sequence data allowing the calculation of the basic reproductive number (R_0) (Stadler, et al. 2012). Further developments of these models, aimed at relaxing limiting assumptions and conjugating evolutionary processes with epidemiological dynamics, now constitute a very active field of research known as 'phylodynamics'.

Currently, phylodynamic models have mainly been applied to understand the epidemiology of human viral diseases and applications in wildlife diseases have been very limited. Hence, there is a need for further investigation of phylodynamic models to determine their accuracy for recovering the epidemiology of wildlife disease.

This study aims to provide a field validation of phylodynamic methods by analysing available Rabbit Haemorrhagic Disease Virus (RHDV) molecular data to reconstruct the first RHDV epidemic in Australia. The Australian RHDV outbreak offers a unique opportunity as the temporal-spatial spread of the epidemic was well described (e.g. Kovaliski 1998).

A secondary aim is to retrieve additional epidemiological parameters such as R_0, infection and recovery rates with a particular focus on the detection of recent changes in naturally occurring strains. As a result, this study will evaluate whether these approaches can be applied as monitoring tools for the efficacy of the new RHDV strain, planned for release in 2017.

References

Kovaliski J. 1998. Monitoring the spread of rabbit hemorrhagic disease virus as a new biological agent for control of wild European rabbits in Australia. *Journal of Wildlife Diseases* 34:421-428.

Stadler T, Kouyos R, von Wyl V, Yerly S, Böni J, Bürgisser P, Klimkait T, Joos B, Rieder P, Xie D, et al. 2012. Estimating the Basic Reproductive Number from Viral Sequence Data. *Molecular Biology and Evolution* 29:347-357.

THE DIFFERENT ROLES OF MYXOMATOSIS AND RHDV IN SUPPRESSION OF THE TURRETFIELD RABBIT POPULATION

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Myxomatosis and rabbit haemorrhagic disease virus (RHDV) have been primary biological control agents in Australia for pest European rabbits (*Oryctolagus cuniculus*) since 1950 and 1995, respectively, when both spread rapidly across the country and caused major declines in rabbit abundance. In May 2015 RHDV2, a new RHDV related lagovirus identified in Europe in 2010, was detected in Australia and has also spread rapidly, even though the Australian rabbit population now has widespread immunity to RHDV. RHDV2 impact has also been significant, being detected in the carcasses of wild rabbits, and vaccinated and unvaccinated domestic rabbits.

On 30 April 2016 three intact rabbits, two adult females and a sub-adult male, all seronegative for myxomatosis antibodies, were found dead at Turretfield showing symptoms of myxomatosis. All three tested negative by rt-PCR for RHDV or RHDV2. In May/June 2016 three adult female rabbits with an established history of high anti-RHDV antibody titres were found dead at Turretfield. One freshly dead rabbit showed pathology consistent with RHDV and tested positive by rt-PCR for RHDV2. Two more significantly decomposed rabbits also tested positive by rt-PCR for RHDV2.

The impacts of RHDV2 and myxomatosis on the 2016 Turretfield population has been varied, and somewhat difficult to assess. Myxomatosis appears to have been a primary factor in eliminating successive 2016 breeding cohorts, however both RHDV2 and myxomatosis appear to have significantly reduced the breeding population. In the June 2016 trapping the Turretfield population numbered as few as 29 rabbits, the lowest population recorded in the 20yr project, with previous peaks being 367 in September 1999 and 342 in October 2011.

These observations support the capacity for RHDV2 to cause, and have caused, declines in wild RHDV-immune rabbit populations both in Australia and in Europe, and the continuing capacity of myxomatosis to have population level impacts on the Australian rabbit population.

DEVELOPMENT OF THE RAT-SPECIFIC TOXIN NORBORMIDE

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Norbormide is a rat-specific toxicant. It causes vasoconstriction (narrowing) of small arteries and vasodilation (widening) of large arteries in rats, which causes a rapid fall in blood pressure. Death is thought to result from circulatory disorders and heart failure due to irreversible coronary constriction. The constriction of small blood vessels is rapid and unique to rats. The lack of toxicity of this compound to mice is a disadvantage but in terms of other non-target species its specificity is a considerable advantage. It was developed in the 1960s, but its use was discontinued as anticoagulant toxins became more popular. In the past taste aversion limited its effectiveness and field efficacy results were poor. Methods of overcoming taste aversion to norbormide have been investigated including encapsulation and the development of analogues. Recent research by Connovation Ltd and the University of Auckland has identified an effective method of synthesising norbormide without the taste aversion in Norway and ship rats. Cage trials have proven this formulation to be both effective and fast acting. Field trials are scheduled in New Zealand and Europe and registration dossiers have been filed with the NZ Environmental Protection Authority and the Ministry for Primary Industries. The ability to target rats with a very low risk of impacting non-target species will enable both widespread rat control across remote locations and targeted control in sensitive areas like islands and in close proximity to urban areas.

FERAL PIG CONTROL AND SECONDARY POISONING RISKS USING PIGOUT®

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Feral pigs represent a significant threat to both agricultural and biodiversity resources throughout Australia. Commonly used methods of managing feral pig impacts include trapping, shooting (both ground and aerial) and poisoning with sodium monofluoroacetate (1080) baits. Poison baiting is the most cost effective control technique for broad-scale management of feral pig populations; however, there are risks associated with the concentrations of 1080 required to meet a lethal dose for feral pigs. PIGOUT® baits developed by the Invasive Animals CRC are designed to make baiting more readily accessible for landholders, by reducing non-target uptake and environmental contamination risks associated with a feral pig 1080 baiting program. Bait trials in southwest Western Australia resulted in a knock down of 72% of feral pigs visiting toxic bait stations. The length of time that PIGOUT® baits were present in the environment was negatively related to bait take with strong evidence of bait-shyness (the majority of feral pig visitations resulted in no bait take even though PIGOUT® baits were present). Additionally, numerous non-target species were detected interacting with and consuming PIGOUT® baits: macropods, quolls, possums and corvids. Monitoring of feral pig carcasses identified multiple species (quolls, varanids, skinks, corvids, as well as other pigs) scavenging on feral pig carcasses from <1-56 days post mortem. Feral pigs only fed on carcasses in advanced stages of decomposition. Varanids and quolls were observed scavenging intestinal tissue, representing the highest risk material associated with 1080 poisoned pig carcasses; however, secondary poisoning risk posed by pig carcasses is dependent upon the residual 1080 concentration of intestinal tissues at the time of ingestion.

ANTICOAGULANT RODENTICIDES IN THE ENVIRONMENT: EXCRETION AS A RESIDUE TRANSFER PATHWAY

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Worldwide, anticoagulant poisons have an important role in the cost-effective management of rodents and other mammalian pests. In some countries they are widely available over the counter for household rodent control and in others used to reduce field pest populations in agricultural production or conservation contexts. There is now well-established evidence that residual concentrations, particularly of the 'second-generation' anticoagulant compounds, can persist long-term in living animals and be transferred to non-target animals through trophic pathways (e.g. scavenging, predation) in natural environments. Less well established is the role of excretion by animals in the environmental transfer of anticoagulant residues. In a laboratory trial, we measured faecal excretion of the second-generation anticoagulant bromadiolone by wild-caught Norway rats (*Rattus norvegicus*). Rats that were offered a commercially-available bromadiolone bait formulation over 24 hours ate 14-22 g of bait and excreted 9.10-19.35% of the total bromadiolone eaten during the 4-6 days before death through poisoning. Rats that had the bait available constantly ate 55-105 g of bait and excreted 6.60-9.32% of the total bromadiolone eaten during the 5-6 days before death. The results indicate that faecal excretion of anticoagulants by target rodents is likely to contribute to wider environmental residue burdens, especially where target animals have wide ranging movement before death. Our results also showed that Norway rats, at least, can consume far in excess of a lethal amount of anticoagulant when bait is constantly available, and excrete a proportion of this excess amount in faeces before poisoning mortality occurs.

TARGET SPECIFICITY OF FELIXER GROOMING TRAPS

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Recent evidence suggests that conventional baiting and bait-based trapping programs are rarely able to provide sustainable control of feral cats, especially those efficient and skilled individuals that can exert disproportionate predation pressure on some threatened species. Grooming traps have been developed to improve specificity and sustainability of localised feral cat control by targeting cats that are not attracted to food lures and/or those individuals that avoid conventional traps. These traps operate by squirting toxin onto the fur of an unrestrained animals that ingest the poison whilst grooming and die remote from the automatically-resetting trap. Felixer grooming traps photograph all activations, which can be compared with camera trap data to determine target specificity.

Felixer grooming traps distinguish target cats and foxes from non-target animals and objects by comparing the sequence that strategically positioned lasers are broken. Non target species considerably smaller than adult cats (eg rabbit, western quoll, bilby) pass underneath activation sensors and fail to trigger the devices, Considerably larger non-targets (dingo, kangaroo, person) break a higher blocking sensor which deactivates the Felixer. Here we present data on activation rates of non-target species of similar size to feral cats and foxes (brush-tailed possum, wallaby, malleefowl) but which have a body shape or walking patterns that can be distinguished by a purpose-built algorithm. Updates will also be provided on current field trials of this developing tool for humane and target specific feral cat (and fox?) control.

CATASTROPHIC CAT PREDATION AND THE 1080 IMPLANT THAT SHOULD STOP IT DEAD

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For over 20 years reintroduction programs have been aware that as few as a single feral cat can completely extirpate relict or reintroduced populations of small to medium-sized fauna. This catastrophic predation has been encountered in the reintroduction of the western quoll (*Dasyurus geoffroii*) to the Ikara-Flinders Ranges National Park (SA), where deliberate targeting of a cat during each spate of deaths has found that large male cats were effecting the predation of up to three quolls before their capture. While often found to be impossible to achieve, when successful, killing the offending cat has often taken extensive resources and time, sadly and very frustratingly while other animals continue to be killed in the vicinity. A strategy to overcome this predation, and stop it at the first event, is the idea of 'toxic trojans'. Building upon the possibility that the 1080-producing *Gastrolobium* plants of south-west Western Australia could make 'toxic trojans' of their native herbivores and granivores, the idea was developed to encapsulate and implant 1080 to make 'toxic trojans' of implanted fauna. This tool is considered most applicable for the translocation and monitoring phases of fauna reintroductions, implanting founders and their subsequent offspring. The idea utilises the pH differential between the subcutaneous implant site (pH ~7.0) and that found in the stomach of the predator (pH ~2.0), as well as the 1080 tolerance differential between introduced predators and Australian native predators and 'trojans'. A prototype implant has been developed by collaborating polymer chemists at The University of South Australia and polymer safety trials in house mice show no significant or long-term physiological issues at the implant site. Efficacy trials are planned under a collaboration with Arid Recovery near Roxby Downs (SA) in a section where radio-collared feral cats are being monitored.

DEVELOPING AN AERIAL PAPP BAIT FOR LANDSCAPE STOAT CONTROL IN NEW ZEALAND

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Stoats were introduced to New Zealand in the 1880s in an attempt to control rabbits, but were quickly implicated in the decline of native birds and are still having a devastating impact. Landscape control of stoats is needed to protect a wide range of threatened species, including kiwi, takahe and rock wren. In New Zealand, para-aminopropiophenone (PAPP) was approved in 2011 for use in minced meat baits in bait stations to target stoats and feral cats. The toxic effects of PAPP appear to be related to the rapid formation of methaemoglobin in some species, which leads to a rapid and lethal deficit of oxygen in cardiac muscle and the brain. Carnivores appear to be much more susceptible than birds, so it potentially has a high target specificity, at least in the New Zealand context. Rabbit is a preferred bait for stoats but supply of large quantities of rabbit can't be guaranteed, especially if needed for landscape control. Bait trials have been undertaken with captive stoats and minced chicken meat was preferred over beef, horse or mutton; however there is a potential disease risk associated with chicken, depending on what is used e.g. whether it includes skin and/or bone. Aerial delivery of a meat bait will also present potential non target issues if native species are susceptible to PAPP and non-lethal trials to assess PAPP susceptibility will be undertaken. Discussion with the NZ Environmental Protection Agency has also highlighted potential data gaps which need to be filled, such as developmental studies in rats and soil degradation of PAPP. We anticipate that it will take at least 6 years to collect the data needed for registration but once registered, aerial PAPP will be a useful additional tool to protect our threatened species.

NATIONAL WILD DOG ACTION PLAN 2014-2019

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The National Wild Dog Action Plan (2014-2019) has guided stakeholders to work together to achieve coordinated, effective, safe and humane management of wild dogs at a landscape scale. It is an industry-driven initiative in response to increased number of wild dogs, their impacts on agricultural, environmental and social assets, and the need for nationally coordinated, strategic and risk-based solutions.

Wild dogs are a problem shared across landscapes and between stakeholders. Impacts include predation on livestock, native fauna and domestic pets and the spread of disease. Koala and pure-bred dingo populations are under threat and the emotional distress of dog affected landholders is similar to other types of trauma. Wicks et al. (2014) conservatively costed nil control scenarios from three case study areas at $513 million over 20 years.

The Plan details shared solutions at local, state and national levels promoting participation in coordinated management programs, coordination across jurisdictional and tenure boundaries, and consistency between State methodologies and tools. Its goals are to:

- provide leadership and coordination for the adoption of nationally consistent approaches
- increase awareness, understanding and capacity building in best practice
- mitigate the negative impacts of wild dogs and
- monitor, evaluate and report enabling continuous improvement.

Strengths under these goals are nationwide commitment, involvement in consultative processes and investments in standardised monitoring and evaluation, pest animal controller skills, promotion of best practice and community engagement. The Plan provides private and public sector stakeholders confidence that their investments in wild dog control will deliver long-term solutions.

As the Plan expends its 2017 second phase funding, we report the outcomes achieved and highlight future investment priorities and strategies for its final two years.

References

S Wicks, K Mazur, P Please, S Ecker and B Buetre (2014) An integrated assessment of the impact of wild dogs in Australia. Research report no. 14.4. ABARES

INTEGRATING ECOLOGICAL RESEARCH AND HUMAN DIMENSIONS: IMPROVING FERAL PIG MANAGEMENT BY FOSTERING INNOVATIVE COMMUNITY ENGAGEMENT

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Significant advances have been made using the biophysical sciences to improve our knowledge of feral pig (*Sus scrofa*) ecology and management. Limited implementation of such knowledge by land managers remains a major barrier to achieving landscape scale control. While this situation creates a suite of interrelated problems, it presents the opportunity to test whether blending ecological research with community engagement approaches can improve the effectiveness of on ground management practices.

This study integrates human dimension research with biophysical research on feral pig ecology to create more effective management and extension tools. There is significant value in bridging the gap between research and extension to encourage greater participation in feral pig control. I am implementing an innovative approach that aims to improve the participation of the community in coordinated feral pig management at a landscape scale—using applied science to achieve community-led action.

In conjunction with individual land managers, Arrow Energy, Santos GLNG, Northern Tablelands and North West Local Land Services, NSW National Parks and Wildlife, and the Queensland Murray-Darling Committee, this project uses innovative research techniques to investigate feral pig movement ecology, whilst also creating a strong interface for community ownership and change.

GPS tracking collars are fitted to feral pigs on four sites to assess movement and habitat use, to guide control techniques and most importantly promote ownership and interest from the community in the project. I have employed treatment and control sites in the community to evaluate whether ecological research can create community ownership and commitment to address the feral pig problem. Community engagement will be evaluated using the 'most significant change' method of measuring attitude change across and within the study sites. This presentation will discuss the implications and learnings to date in implementing an integrated scientific and community engagement approach.

FACILITATING THE STRATEGIC MANAGEMENT OF WILD DOGS THROUGHOUT AUSTRALIA: HOW ARE WE TRACKING AFTER TEN YEARS?

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Commencing in 2007 the Invasive Animals CRC project entitled 'Facilitating the strategic management of wild dogs throughout Australia' was seen by some within the organisation as a significant risk due to its departure from the traditional applied research and invasive species control product development that the CRC was based upon. However despite this concern, the project was extremely successful in developing collaborative approaches to wild dog management based on the nil tenure approach in the first five years of the project. The role of the national wild dog management facilitator, the first position of its type for a vertebrate pest, in developing relationships and networks across all levels of government, industry and at the stakeholder level saw significant support for the continuity of the project when the IACRC won its fourth round funding bid in 2012.

Despite the wild dog problem being ongoing there have been significant advances in management at the policy and operational scales, with numerous reports and surveys undertaken that indicate that the strategic approach to management of wild dogs as advocated by the project is delivering outcomes for all stakeholders across a range of levels. These advances and results are often skewed by popular media and the never-ending 'bad news sells stories' mentality, however the tide is turning as stakeholders gain confidence in control programs we are seeing far more positive reporting of wild dog management outcomes that we have in the past. In this presentation I will discuss some of the developments in wild dog management that have occurred across the country since inception of the project, with a particular emphasis on the results over the past five years, including statements from stakeholders, comparisons between reports and insight from the national wild dog management facilitator and numerous participants.

SHARED PROBLEM SHARED SOLUTIONS: A REVIEW OF PEST ANIMAL MANAGEMENT IN NEW SOUTH WALES

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The NSW Natural Resources Commission is an independent body established to help government find evidence-based solutions to complex natural resource problems. The Commission undertook a comprehensive, independent evaluation of vertebrate pest animal management arrangements in NSW in 2016. The review included consultation with a broad range of stakeholders with nearly 600 submissions received.

The review commissioned research that updates the assessment of the economic impact of vertebrate pest animals. The national annual production losses attributed to wild rabbits, carp, pigs, foxes, dogs, goats and introduced birds may be as high as $612 million.

The Commission found that although there has been progress in vertebrate pest animal management further improvement is required. The risks of future pest animal incursions is significant and increasing. The capacity for early detection and rapid response must continually improve to ensure these risks are managed effectively

Coordinated action at the landscape scale is critical to the management of widespread pest animal species. Changes to the current institutional arrangements and program delivery are necessary to enable community based, collective action and to ensure that all landholders public and private are held accountable for meeting their pest management obligations.

The Commission found that there are opportunities to improve:

- governance, planning and accountability at the state and regional levels
- risk management, surveillance and rapid response to threats
- engagement and education of all landholders across tenures
- resourcing and oversight of public land managers
- consistency in legislation and regulations (treating deer and cats as pests)
- research and information management.

WHAT IS THE VALUE OF NATIONAL PEST MANAGEMENT DATASETS?

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Pest animals pose serious management concerns in farming systems in Australia. To better understand this national problem, the Department of Agriculture and Water Resources commissioned ABARES in 2016 to collect a national dataset of landholders' views on managing pest species, including wild dogs, rabbits, deer, pigs and cats amongst others. With responses from over 6000 landholders across 53 natural resource management regions in Australia, this was the largest single data collection ever run by ABARES. The survey provided a national picture of the extent of pest species problems across Australia: the impacts on production systems, the effort and cost landholders incurred in managing pest animals on their land and the types of control actions conducted by landholders and local management groups. This paper highlights key results from the 2016 survey of landholders and looks at long term trends in pest management by comparing results from similar data collections a decade ago. The potential for this dataset to be integrated with other national invasive species datasets and how this can add value to research and policy will be discussed.

ASSESSING THE EXTENT AND ABUNDANCE OF PEST ANIMAL POPULATIONS ACROSS NSW THROUGH EXPERT KNOWLEDGE

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The distribution and relative abundance of 14 pest animal species was assessed across all regions of NSW. Consultation surveys were conducted with NSW Local Land Services (LLS) biosecurity staff and NSW National Parks and Wildlife Service pest management officers to collate expert knowledge about local pest animal populations, current numbers, and changes since the last survey conducted in 2009.

Participants were asked to contribute their knowledge by recording information on paper maps. Once collated across all regions, datasets and a series of detailed pest animal maps were provided for each NSW LLS region, representing a geospatial resource enhancing their capacity to define and understand pest animal problems in the context of regional planning activities.

The NSW Natural Resources Commission review of pest animal management in NSW identified the value of tracking pest animal distribution, density and impacts. This mapping project contributes to long-term pest animal datasets in NSW that are a valuable resource for a range of operational, strategic and policy activities. State-wide pest animal mapping has been conducted in 2002, 2005 and 2009, with this survey representing the fourth state-wide assessment involving expert field staff from across the State.

These consultation surveys provided a valuable opportunity for staff to share their expert knowledge and contribute to the development of improved maps of current pest populations throughout their local area. Regional datasets also revealed trends in pest species over time, which is particularly important for species still extending their range, for instance deer.

Data and findings are presented here along with a discussion of the methodological approach, achievements and hurdles experienced during the 2016 consultation process.

WHY DON'T THEY JUST LISTEN TO US?

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Research into different public values shows that there are many members of the community who just don't have a science-centric view of the world, and are not particularly engaged by science as a topic of interest. Added to this, modern communication channels have allowed for contested perceptions of scientific facts, alternative truths, and reinforcement of ideas, no matter how fringe. This keynote will look at the different segments of the population that exist, and to show what amount of people are not much interested in science, why they are not – and importantly what types of things can be done to better engage them.

WHAT WILL IT TAKE TO FUTURE-PROOF SHARED RESPONSIBILITY AS THE GOVERNANCE APPROACH TO THE CONTROL OF ESTABLISHED INVASIVE SPECIES?

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This paper draws on extensive empirical research of the legal and institutional factors that will affect the success of implementation of shared responsibility obligations to control established invasive plants and animals. The studies upon which it is based include (1) studies conducted in six countries for the IUCN on the variables that impact on the implemented effectiveness of environmental law principles (2) theoretical and experimental investigation of the technical legal challenges of stewardship duties of care (applied to the general biosecurity obligation); (3) in-depth studies conducted by the Invasive Animals CRC on the institutional factors impacting on effective citizen action to control invasive animals (4) evaluation conducted for the Australian government on invasive animal control projects funded under the Caring for Our Country program; and (5) a number of other studies conducted on contemporary and emerging challenges of rural natural resource governance. The identified variables are examined in the context of trends that will affect implementation, and the paper outlines the key challenges and possible responses that might be adopted. It identifies the implementation issues and possible strategies leading to more effective governance of established invasive species. In doing so it outlines the most significant research and engagement issues that must be addressed to create an effective approach to shared responsibility.

BEYOND THE BORDERS: TAKING INCURSION MANAGEMENT TO THE NEXT LEVEL

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Invasive species pose a constant and costly threat to Australia's native ecosystems, economies, public health and cultures. Preventing incursions of these potentially harmful species is considered important, yet we are still challenged by the ability to secure support, funding, and relevant awareness to appropriately address the threat. Industry and public engagement continues to be commerce-, culture- and species-dependent which leaves gaps in our current incursion coverage. More consistent research funding is required, but a bigger problem is generating political and social support to organise an effective, comprehensive operational structure, including early-warning/rapid-response systems. Consequently, there is a growing need for an integrated approach to incursion management that fills gaps in the current system, facilitates support, and prioritises risks, threats, and responses across all sectors.

To reduce the risks posed by new and emerging vertebrate pests, Australia's government agencies, through Invasive Plant and Animal Committee (IPAC) have undertaken a commitment to progressively improve national incursion management through adaptation of existing processes and the development of new and innovative approaches. To be successful, we need to develop outside the box of what we have always done. Among the activities that are receiving the most attention and that have the most promise for incursion management are risk assessment, pathway and vector management, early detection, and emergency response. Here we explore how we strengthen incursion management to garner support, collaboration, funding, and public engagement through truly integrated and innovative approaches.

REMOTELY SENSED FERAL BUFFALO DAMAGE IN KAKADU NATIONAL PARK: COMPARING DRONE AND SATELLITE BASED IMAGERY FOR FUTURE MANAGEMENT

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Measurement of pest impacts is an important monitoring tool for any control strategy, however, surveys can be laborious and expensive. Unmanned Aerial Vehicle (UAV) and satellite technologies are becoming more affordable every year, and these technologies have the scope to revolutionise measurements of impacts and large sale landscape monitoring. In addition, the extensive information produced by these methods may hold the key to developing effective remotely sensed density-damage functions, a task which is often difficult and time intensive.

This research examined whether UAV and satellite imagery can be used to identify and survey feral buffalo damage, and determine if the two methods can be used synergistically to survey landscapes and contribute to building a satellite based density-damage function.

Observable impacts at both resolutions were identified by sight and validated by groundtruthing. Once confirmed, these impact signs were applied to satellite imagery taken during the same year as feral livestock aerial surveys flown across the Top-End over the past decade. Using these matched estimates of density and damage, building a density-damage function was attempted.

Linking satellite and UAV imagery was inconsistent for some of the smaller scale impact types, although pads, wallows and water fouling were consistently identified at both spatial resolutions. UAV comparisons were effective in increasing confidence in the lower resolution satellite imagery. Application of the technique to archival satellite imagery revealed varied levels of impacts across various areas of the Top-End that broadly correlated with buffalo density estimates.

Future research and development should include establishing a connection between finer scale impacts and the larger scale impacts observable by satellite, reconfirm the density-damage function using controlled densities in cooperation with a land managers, and controlling for other feral ungulates that may be biasing results.

AN INVESTIGATION INTO THE USE OF THERMAL CAMERAS FOR DETECTING FERAL PIGS DURING AERIAL SURVEYS OF THE LOWBIDGEE FLOODPLAIN

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The Lowbidgee Floodplain in western NSW is listed as a wetland of national significance due to its size and the flora and fauna that it supports. Feral pigs (*Sus scrofa*) are a major threat to the area's biodiversity, causing damage through predation, habitat degradation, competition and disease transmission. They are also a considerable impediment to the regions sustainable agriculture and production activities. The floodplain maintains dense lignum, reed beds, river red gum forests, and shrublands, providing the ideal habitat for feral pig populations to thrive. To develop and monitor the effectiveness of a strategic feral pig management plan, it was important to gather an estimate of feral pig density and distribution. To achieve this, a Jenoptik HD1024 long-wave thermal camera was fixed to the camera mount of a Bell 206 Jetranger helicopter. A Sony 4K video camera operated alongside the thermal camera as a direct comparison. A total of 900 km of transects with 2 km spacing was recorded. In-flight observers were unable to detect the presence of feral pigs under the lignum canopy with their naked eye; however pigs were clearly visible through the thermal camera. The footage was analysed using four assessment criteria; animal shape, body temperature, style of movement and visual confirmation via the footage recorded by the Sony 4k video camera. The area surveyed using this methodology totalled 180,000 ha, with an average of 1 pig/21 ha recorded. The one limitation for using this equipment is the requirement for optimal weather conditions; cool, minimal wind, low UV and humidity. This requirement may therefore limit its application in some regions. However, the quality and accuracy of the data provides great scope for monitoring projects and strategic implementation of pest management plans.

ASSESSING THE FIELD EFFICACY OF HOGGONE® FERAL PIG BAIT, CONTAINING SODIUM NITRITE, FOR CONTROLLING FERAL PIGS IN AUSTRALIA

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Feral pigs cause considerable damage to agriculture and biodiversity in many countries around the world. They are also potential vectors of numerous exotic diseases that could threaten human, livestock and wildlife health in the event of an outbreak. Feral pigs are particularly problematic in Australia and the USA, where their populations have been estimated to be in the millions and they are spread over vast geographical ranges. Unfortunately, their populations continue to increase and expand in both countries today. While conventional tools are useful, when implemented appropriately, there is a real need to develop new tools to enhance control program effectiveness.

In 2005, an 'Achilles' heel search was undertaken to identify metabolic and/or physiological weaknesses in pigs, and to identify potential chemical compounds that could exploit those weaknesses. It was discovered that pigs are vulnerable to methaemoglobin inducers, as they are relatively deficient in protective methaemoglobin reductase. It was also found that sodium nitrite is a suitable methaemoglobin-inducer. A joint IACRC, ACTA, MLA Australian focused project began in 2009 that was expanded to include Connovation (NZ), United States Department of Agriculture and Texas Parks and Wildlife Department in 2012, to co-develop, test and register a feral pig bait containing sodium nitrite—called HOGGONE® in all three countries.

Over 90% knockdown has been proven in GLP pens studies even when captured feral pigs have access to alternate palatable feed. The mode of action is fast and humane and has negligible risk of bioaccumulation or secondary poisoning. This presentation will provide an update on the Australian field efficacy and non-target safety.

THE ECONOMICS OF MONITORING TRAPS WITH WIRELESS NETWORKS

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Over recent years there has been an increasing number of vertebrate pest control programs using permanent networks of traps to maintain pest numbers at low levels. At such low densities of pests, few traps are sprung, and staff or contractors often spend more time checking traps that are still set than dealing with captures. Consequently, there has been a growing interest in the potential of wireless systems for remote monitoring of traps to minimise the time and cost associated with checking them. In this paper we explore the economic factors that might determine whether wireless monitoring is economically viable, and if not, what critical factors need to be addressed to ensure the most benefits can be gained from using this new technology.

UPTAKE OF FERAL CAT BAITS IN EASTERN AUSTRALIA

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Feral cat (*Felis catus*) populations are notoriously difficult to control. While coordinated 1080 baiting programs are the most cost-effective option for the broad scale reduction of wild dogs (*Canis lupus familiaris*), feral pigs (*Sus scrofa*) and foxes (*Vulpes vulpes*), the use of 1080 baits to specifically target feral cats is currently restricted and largely untested in eastern Australian environs.

We performed a feral cat baiting trial in Taunton National Park (Scientific) in central Queensland to (1) test the efficacy of the Queensland 'Curiosity 1080 Cat Bait', and (2) measure the uptake of baits by target and non-target species. Over 14 days, 54% of 50 individually monitored baits were removed by non-target species, with 46% removed in the first 4 days. Most baits were taken by birds, with corvids removing more than half of all baits taken. Cameras used to monitor baits did not detect any feral cats consuming or removing baits, although several cats were detected interacting with baits.

The lack of bait uptake by feral cats together with movement data obtained from cat-borne GPS collars suggests that track-based baiting operations using current deployment protocols for the Queensland 'Curiosity 1080 Cat Bait' are unlikely to be effective at controlling feral cat populations in these environs. We discuss the implications of our findings and recommend approaches to improve the efficacy of feral cat baiting programs in eastern Australia.

SEPARATING THE TWITTER FROM THE CHATTER: MONITORING AND FORECASTING MOUSE PLAGUES IN AUSTRALIAN GRAIN-GROWING REGIONS

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Management of mouse plagues has been notoriously difficult: they are episodic and difficult to predict, they can be localised or regional, and early intervention is needed to prevent agricultural damage and adverse social impacts. It is no longer feasible to use conventional scientific methods to monitor frequent changes in mouse abundance at the spatial scales needed to forecast mouse plagues. A new computer model has been developed for cropping systems in southern Australia. It predicts seasonal transitions between low, medium and high levels of mouse abundance, where the levels correspond to intervention thresholds for farmers. The model is also designed to work with observations recorded by farmers.

In 2014 we launched the *MouseAlert* web-site, later extended to a phone app, to collect observational data from farmers and to disseminate reports and forecasts of mouse abundance to farmers and agronomists. Despite running a 'National Mouse Census Week' in April 2015 that generated strong media interest, data input from farmers was sporadic. Analysis of 'Twitter' data showed that social media do not provide a useful substitute for *MouseAlert* reports.

Collecting information from a large sample of farms when mice are at low, as well as high, abundance is vital for local- and regional-scale forecasts. One approach to dealing with the limited number of reports via *MouseAlert* would be to develop new low-cost, remote monitoring techniques with the capacity to detect mouse activity corresponding to low, medium and high levels of abundance. These monitoring devices could be deployed widely to generate the data needed for regional forecasts. With adequate monitoring data, the new model will provide the early warning that is imperative for effective, proactive control measures.

WHAT IMPEDIMENTS ARE YOU FACING IN PERI-URBAN INVASIVE SPECIES CONTROL? INSTITUTIONAL EXPECTATIONS FOR INVASIVE ANIMAL MANAGEMENT IN PERI-URBAN AUSTRALIA

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Invasive animals are difficult to manage in peri-urban areas because effective action requires many institutions to work together. The intersection of jurisdictions and competing perspectives lead to isolated control approaches in peri-urban space instead of coordinated and collective action. Through initial scoping research (during April 2015 to October 2015), we identified key legal and institutional challenges for invasive animal management in peri-urban context. Taken in its broader sense, institutions include government organisations, market and community as well as socio-cultural arrangements. The specific legal and institutional challenges facing each peri-urban area differ according to its social, cultural, economic and environmental setting. This presentation draws on two case studies: a) peri-urban Sydney b) peri-urban Brisbane to verify institutional barriers that are required to be overcome for effective management of wild dogs and feral deer. Institutional impediments include overlapping administrative jurisdictions, limited resources, adverse public perception and potential risks of political or media criticism. Emerging legal and ethical impediments include restrictions on the use of lethal controls and imposition of personal liability for accidental harm to non-invasive species.

The objective of this presentation is to outline feasible approaches for the assessment of institutional challenges in implementing strategic pest control. The approaches may help policy makers and practitioners prioritise institutional interventions and design targeted, innovative programs to improve invasive animal management in peri-urban Australia.

TEST OUR ORGANISATIONAL LEARNING: AN EMPIRICALLY BASED T.O.O.L. FOR ASSESSING CONTINUOUS IMPROVEMENT IN THE MANAGEMENT OF INVASIVE SPECIES

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This work forms part of Program 4, Facilitating Effective Action, Invasive Animals Cooperative Research Centre.

Learning at all levels, from individuals, to work units, to organisations to multi-stakeholder networks is necessary for improving the management of invasive species, particularly as environmental challenges appear to be growing while public funding is in decline. Learning is an umbrella term that encompasses a range of approaches. Adaptive management is one example, and this approach may be relatively well understood, particularly when applied to examining the efficacy of technical interventions. The human counterpart to adaptive management is continuous improvement, and this approach may be less well known, especially in the public sector. This presentation will discuss the importance of continuous improvement and the development of an empirically derived 'T.O.O.L' to 'Test Our Organisational Learning' in order to improve our responses to invasive species. The 'T.O.O.L' is based on the research literature, two case studies conducted in work units in a major conservation agency in South Africa, and results of field testing in a state agency in Australia.

Previous work has indicated that work units may become 'cultural islands' of continuous improvement and positive transformation, within what can often be 'seas of bureaucracy' (Lipshitz, Friedman and Popper, 2007). The aims of my research were to identify the enablers of and barriers to continuous improvement in natural resource management work units. Key factors underpinning continuous improvement that I have identified include the important role of leaders in supporting and empowering staff, the value of informal learning opportunities, the need for an open and trusting culture, and continuous learning initiatives. The T.O.O.L. may be used to assess a work unit's current learning environment status, its continuous improvement profile, knowledge and information sharing, degree of collaboration, stakeholder engagement and interactions with the Department, as well as identify the potential for additional gains.

References

Lipshitz, R., Friedman, V., & Popper, M. (2007). *Demystifying Organizational Learning*. USA: Sage Publications Inc.

ESTABLISHED INVASIVE ANIMAL TRAINING PROGRAM: BUILDING ORGANISATIONAL CAPACITY AND THE NEXT GENERATION OF EIA MANAGERS

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History shows that in the absence of scientific evidence based best practice management, many established invasive animal control programs are likely to fail.

For many years gaps in government and community knowledge and understanding of best practice established invasive species management was not identified as a major barrier in achieving long term control benefits.

The Victorian government identified a need to build internal and community capacity and knowledge and have designed and are delivering a nationally accredited established invasive animal training program.

The course includes both practical and theoretical components that covers essential knowledge and the practical skills required in pest animal management activities. Including how to plan, support, advocate, and implement established invasive animal management projects.

The foundation course was originally designed for Victoria's biosecurity officers, and has now incorporated other government public land managers, such as Department of Environment, Land, Water and Planning and Parks Victoria. The course has also been customised to meet other organisational and specific needs for managing the impact of invasives in a variety of environments, landscapes and circumstances.

Here we provide an overview of the training program and how Victoria is working with other agencies and the community to maintain critical technical skills and create a succession plan that ensures skills necessary to the role of government and community in pest management are maintained for future generations.

MINJERRIBAH'S MOST WANTED: MULTI-STAKEHOLDER APPROACHES TO CONSERVATION, PRIORITISING ACTIONS TO PRESERVE OUR NATURE

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There is a need to increase knowledge and understand the preferences of the different stakeholders when developing conservation priorities that aim to protect threatened species and/or prioritise management actions to control invasive species. While it is well-known that including the interests of the different stakeholders may lead to better conservation outcomes, this is not a common practice due to the challenges in achieving a consensus (e.g. timeframe, existing plans, and clashing objectives). The literature describes several techniques to engage the private sector and government agencies in conservation planning, but these usually involve an individual assessment and then a unique manager taking the decisions. In this project, we identified and incorporated the various perspectives of the different stakeholders in North Stradbroke Island, in relation to environmental challenges, such as the protection of threatened species, key cultural species, and invasive species. We assessed the priorities of multiple stakeholders in North Stradbroke Island in a spatial and time explicit way. Using this approach reduced the gaps regarding the expected outcomes of the different groups in terms of management actions, hence facilitating the development of a unified management plan for invasive and threatened species.

WHAT IS MISSING FROM FERAL PIG MANAGEMENT: COMPARISONS BETWEEN USA AND AUSTRALIA

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Feral pigs have been present in Australia and the USA for more than two hundred years but in recent decades pigs have increased their range and density, with commensurate increases in agricultural damage, habitat disruption and disease threats for livestock production animals and humans.

The expansion of range and density has occurred despite the application of conventional control and some harvesting over many decades it is now widely recognised that new tools are needed to properly address the rapidly emerging problem. A companion paper describes recent progress to this effect with the use of sodium nitrite in HOGGONE bait.

However, a tool is not the answer alone and there must be systematic and careful application to achieve the impacts required.

While the USA and Australia have similar geographical and numerical pigs problems, there are critical differences in non-target risks operational manpower and regional and local organisation that mean that the USA has a greater chance of success that does Australia.

This paper highlights these differences and looks at some practical issues around the application and regulation of pig management options with some suggestion for where emphasis might change.

FERTILITY CONTROL FOR WILDLIFE MANAGEMENT: GOOD, BETTER, BEST

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Effective management of wildlife and pest species is becoming increasingly necessary throughout the world. At present, some of the most effective methods of wildlife population control are achieved through the use of increasingly controversial lethal methods, including poisons that are also becoming more highly regulated. The use of fertility control as a tool to aid in wildlife management strategies is considered to have numerous benefits and has attracted substantial attention. Even so, the greatest benefits from the use of wildlife fertility control will be realised when it is used in conjunction with other tools in an integrated program. In the United States, two different contraceptive vaccines have been registered for use in wildlife. Both vaccines have been shown to be effective in suppressing fertility in individual animals of a number of species, and have also been used successfully for the management of small, isolated populations of deer, horses and goats. Whilst the implementation of these vaccines and other methods of fertility control have provided important evidence in support of fertility control for wildlife management, it has also highlighted the need for new vaccines or direct-acting reagents (i.e. chemosterilants) that are better able to cause permanent sterility, and the need for more effective methods of delivery. The challenges associated with the use of fertility control are not only technical in nature, but social, political and cultural aspects are also important.

LABORATORY EVALUATION OF THE EFFECTIVENESS OF THE CONTRACEPTIVE BAIT, CONTRAPEST®, ON WILD-CAPTURED BLACK RATS (*RATTUS RATTUS*)

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Rapid rates of reproduction allow commensal rodents to quickly rebound from traditional lethal measures of population control, leading to increased interest and research in fertility management. ContraPest® (CP), a liquid, oral contraceptive product, successfully reduced litter production in wild-captured Norway rats (*Rattus norvegicus*). As a result, a similar laboratory experiment was conducted with black rats (*Rattus rattus*). Wild black rats were captured in Hawaii and randomly assigned to either placebo (n=10 males, 10 females) or active (n=10 males, 10 females) treatment groups. CP (placebo or active) was presented to the male and female rats ad libitum, along with unlimited food and water, for a total of 50 days. After the first 15 days of treatment, females and males from the same group were paired for breeding for 21 days. Males were removed and the females were monitored for 21 days for birth of litters. After parturition, new randomly assigned breeding pairs were housed together. At this point, active CP was replaced with placebo to assess the duration of the treatment effect. This process was repeated for three breeding rounds. In a fourth breeding round of the same duration, the animals were cross-bred in treatment-placebo pairs. Total pup numbers were reduced in the treatment group through the first three breeding rounds (0, 0, 6 respectively) versus the placebo group (30, 23, 24, respectively). By the fourth breeding round, 107-128 days post-baiting, fertility was restored in both treatment groups (38 pups born to placebo females, 27 pups to treatment females). This duration of infertility represents a significant portion of a wild rat's reproductive lifespan. These preliminary data suggest that CP has potential for reducing reproduction of treated black rats; however, further work is needed to determine the population level effects.

MANAGING MACROPOD POPULATIONS IN PERI-URBAN SITUATIONS: REMOTE DELIVERY OF A FERTILITY CONTROL VACCINE

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Fertility control has potential for maintaining the desired level of abundance of free-ranging populations of eastern grey kangaroos, *Macropus giganteus*, and is especially attractive for peri-urban sites where annual shooting may be problematic. Although several viable fertility control options are currently available for kangaroos, these agents require that individuals be captured for treatment, largely limiting their application to small numbers of animals and those in contained populations. The development of an efficient system for remote delivery of a long-lasting fertility control agent is essential. A previous trial has demonstrated that GonaCon Immunocontraceptive Vaccine injected by hand causes infertility in female eastern grey kangaroos for at least eight years. In this project we have trialled a dart delivery method for administering the GonaCon vaccine to female eastern grey kangaroos. Since September 2015, 145 female kangaroos across five sites in the ACT have been treated with GonaCon, administered either by hand injection or remotely by a dart, in order to compare the efficacy of the two methods. The effects of GonaCon at the population level are being investigated by comparing population growth and fecundity between treated (n=2) and untreated (n=7) sites. In Year 1 of the study, GonaCon injected by hand prevented subsequent breeding in 87% of the treated animals. Population level fecundity decreased to below 19% following the treatment of over 90% of females in two populations, while remaining above 65% in untreated populations. Dart delivery of the vaccine commenced in July 2016. We have demonstrated that GonaCon can be effectively expelled from a dart into the target muscle, however data on efficacy will not be available until mid-2017. If long term efficacy of dart delivered GonaCon is high, this approach could provide an efficient and more cost-effective method for managing kangaroo populations in peri-urban locations.

IMPLEMENTING IMPLANTS: EFFICACY AND EFFICIENCY OF LEVONORGESTREL FOR FERTILITY CONTROL OF PERI-URBAN EASTERN GREY KANGAROOS

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The eastern grey kangaroo (*Macropus giganteus*) is often overabundant in peri-urban parks and reserves, leading to collisions with vehicles, aggressive encounters with people and dogs, faecal contamination of water and heavy grazing of native vegetation. Management of these populations is constrained by strong public opposition to lethal control. Fertility control of females, using long-acting hormonal implants, offers an acceptable alternative.

We tested the efficacy of levonorgestrel implants at Anglesea Golf Club. In 2008, we captured 41 habituated adult female kangaroos using a pole syringe, treating 18 with three 70-mg implants and marking them with ear-tags and collars, and marking 23 others as controls. Fertility of treated females was low (≤ 11%) for 5 years after treatment, but increased to 25% after 8 years.

We implemented this technique at two peri-urban sites: Serendip Sanctuary and Gresswell Forest. We treated all female kangaroos with five 55-mg implants and marked them with ear-tags. In autumn 2013, we captured 76 females by spotlight over seven nights at Serendip, using a CO_2-powered dart gun fired from a vehicle. Capture rate (1.8–3.7/h) declined by 11% per night. Most untagged females were culled a month later. Fertility of treated females has been low (≤ 2%) in the three years since treatment, allowing further culling to be deferred. At Gresswell, we captured 56 females over eight days in spring 2015 and 2016. We used the same dart gun, but worked on foot in twilight and darkness. Capture rate (0.3–1.1/h) declined by 5% per night. Monitoring at Gresswell will commence next year when existing young have left the pouch.

Although levonorgestrel implants require handling individual kangaroos, capture and treatment can be achieved by a small team for reasonable cost. We conclude that this technique can be implemented efficiently at a management scale in peri-urban reserves.

CAN LONG-TERM FERTILITY CONTROL OF OVERABUNDANT KOALA POPULATIONS MITIGATE THEIR IMPACTS ON *EUCALYPTUS* FORESTS?

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Overabundant koala (*Phascolarctos cinereus*) populations severely defoliate and sometimes kill manna gum (*Eucalyptus viminalis*) trees in southern Australia. Lethal control is not a socially acceptable management option for koalas and fertility control has been proposed to reduce overabundant populations of this species and their impacts on manna gum trees. Here we evaluate the effectiveness of two long-term fertility control programs to reduce overabundant koala populations and their impacts on manna gum trees. These management programs were undertaken in Victoria (Mount Eccles National Park; MENP) and in South Australia (Kangaroo Island; KI) for 10 and 17 years, respectively. At both sites, koala abundance was estimated annually and detection histories were constructed for marked and released koalas from resightings during subsequent capture sessions. The survival and defoliation status of permanently-marked manna gum trees was evaluated every second year. We combined the abundance and capture-resight data into an Integrated Population Model for each site to evaluate the effect of the fertility control on the survival, recruitment and densities of the koala population. We used a multistate Markov transition model to determine if changes in koala abundance altered manna gum defoliation and survival. At MENP, average apparent survival rates were higher for sterilised (0.78) than non-sterilised (0.72) adult females. Fertility control reduced koala recruitment such that koala population densities more than halved during the management programs. Manna gum mortality rates were significantly reduced at MENP, and trees with light or moderate defoliation recovered at both sites. Our results indicate that population-level fertility control can significantly reduce overabundant koala populations and some of their impacts on manna gum trees. More generally, our study has demonstrated that fertility control can reduce overabundant mammalian herbivore populations, but that sustained and long-term effort is required.

EVALUATION OF A POTENTIAL FERTILITY CONTROL BAIT FOR WILD PIGS

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Wild pigs carry over 30 zoonotic diseases and are a major source of crop destruction, with associated damages estimated at $1.5 billion annually in the U.S. Current mitigation techniques such as trapping and shooting are rendered ineffective due to the high fecundity of pigs. Recent population models suggest that decreasing fertility would result in sustainably reduced populations of wild pigs. No fertility control product currently exists for wild pigs, although the combination of triptolide and 4-vinyclohexene diepoxide (VCD) in ContraPest, a rat contraceptive product, shows considerable promise. The objective of this project was to evaluate fertility control bait (FCB) containing triptolide and VCD for its potential use in pigs. To evaluate the effects of this FCB on boar fertility, males (n=5) were provided active FCB twice daily for 15 days. Semen parameters were monitored before (D0) and after treatment (D37, D45, and D60). Significant decreases ($p<0.05$) in sperm viability, morphology, and progressive motility were observed at D37 and D45 in males that freely consumed the FCB, indicating decreased fertility. By D60, parameters began to trend upwards and histological evaluation of the testes showed normal spermatogenic activity, suggesting a transient effect on spermatogenesis. To evaluate the effects of this FCB on gilt fertility, females were provided placebo (n=6) or active (n=5) FCB twice daily for 15 days. Thirty days after cessation of the treatment period (D50), ovaries were collected from all females. A significant decrease ($p<0.05$) in both ovarian mass and prevalence of pre-ovulatory follicles in treated females suggested a decline in ovulation rate. Histological studies found significant reductions ($p<0.05$) in all immature follicular stages suggesting a prolonged decline in fertility. The results of these studies suggest the potential for developing an FCB, utilising the combination of triptolide and VCD, to reduce fecundity in both male and female wild pigs.

'THE COMMUNITY WON'T BE IGNORED': LESSONS FOR COMMUNITY ENGAGEMENT FROM CASE STUDIES OF WILD DOG MANAGEMENT GROUPS

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How do people organise to collectively manage wild dogs? This paper answers this question through three in-depth case studies of wild dog management groups. These case studies explore individual and group experiences of wild dog management groups and share the lessons from these experiences.

- In Queensland, the Mt Mee case study describes a local government program that supports local landholders to participate in coordinated control in a challenging peri-urban landscape. The Mt Mee example shows how local government leadership can support landholders to increase participation in wild dog control.
- The Western Australian Northern Mallee DSG (NMDSG) case documents challenges faced by a single-species wild dog action group in a changing policy context. A looming State government reform to the funding and management regime is seen to threaten the group's long running and well-tested model of community-led action. In the NMDSG case the increased responsibilities and workloads that come with formalised group structures are clearly illustrated, raising important questions about how to strike the best balance between community-led action and support for coordinated management programs.
- The neighbouring communities of Ensay and Swifts Creek in Victoria face similar threats from wild dogs but are shown to respond in very different ways. This case study reveals how local context influences the way an issue is understood by different communities. A significant connection between knowledge of the issue and power to steer the agenda is identified.

The paper concludes with recommendations for translating these findings into a framework for analysing and planning for community action. This framework could form the basis of a best practice guideline for practitioners to determine where best to focus efforts in developing community responses to wild dog threats.

HAS FIFTEEN YEARS OF PERSEVERANCE LEAD TO THE EVOLUTION OF SUCCESSFUL COMMUNITY INVOLVEMENT IN VERTEBRATE PEST MANAGEMENT?

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Effective cooperative management has long been recognised as a major component of successful pest management at the landscape scale. Predation by foxes is recognised as a key threatening process in NSW and the impact of both wild dogs and foxes on sheep grazing can be devastating on both economic and social scales. The development of land holder groups to address these impacts in the Goonoo area of central west NSW has significantly changed over the last fifteen years and will require still further evolution to deal with the re-emergence of wild dogs in the area.

The facilitation of the development of land holder groups to address fox and wild dog issues has required significant input from the Local Land Services and NPWS. Identification of common achievable goals through a cooperative approach across the landscape and willingness to contribute has encouraged landholders to participate and invest in both reactive and proactive management programs. This has required skilful assistance and support to empower community groups with the knowledge and confidence to persevere when at times interest and commitment seemed questionable.

A number of baiting groups have been established and have undertaken regular baiting programs over a number of years supporting both ecological and agricultural outcomes. Links with management agencies and public land managers have developed into effective channels of communication and trust, essential to the effective implementation of landscape management programs.

Whilst success can be measured in the degree of cooperation and participation, or the provision of information in a timely way there are still a gaps in these programs. The collection of empirical evidence to support and inform management actions is still very limited and often only anecdotal. If we only do today what we were doing yesterday then we will be quickly outsmarted by our adversaries.

COMMUNITY PEST CONTROL: THE SUCCESSFUL CANBERRA EXPERIENCE WITH THE COMMON MYNA

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The Canberra Indian Myna Action Group Inc (CIMAG), formed in 2006, shows the impact that an innovative, concerted community-based program can have in tackling a highly successful invasive pest species. The common myna has attributes—it is sedentary, commensal, social, conspicuous, omnivorous and attracted to dog food—and is highly loathed that make it suitable for community trapping. The CIMAG Indian Myna Control Program model has features that make it suitable for adoption by communities: it is low cost to members, has low administration costs, using simple, cheap and easy to operate traps, easy disposal method, and importantly has high impact.

Over ten years CIMAG has demonstrated, contrary to some dubious commentators, that a broad-based 'community-action' approach can substantially reduce the numbers of the common myna in a location. This is particularly so in urban 'islands' such as small cities and towns where there is reduced opportunity for large scale intrusion and re-introduction by external myna populations. Such an 'island' city is Canberra.

In ten years Canberra's community-action program has reduced common mynas from the third most common bird in Canberra down to the 18th. The change is profound.

UNDERSTANDING INACTION: WHY DO LANDHOLDERS FAIL TO PARTICIPATE IN PEST ANIMAL MANAGEMENT?

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Again and again we hear that many of the problems associated with invasive animal management are really problems of human behaviour. Whatever toxins, guns, or other technologies are used to control pest animals, we still need people to lay the bait, pull the trigger or install the ejector. Sometimes they do. Often they don't. We conducted a random digit dial phone survey of landholders sampled from five NRM regions in Western Australia. Profiling analysis revealed four main types of landholders: (1) a Disengaged group who engaged in little or no pest animal control activities on their properties (50%), (2) Solo Controllers who engaged in individual control but did not participate in group control activities (13%), (3) Group Controllers (28%) who engaged group control activities but not individual control, and (4) an Engaged group that participated in both individual and group control (9%). Regression analyses indicated that landholders were less likely to engage in individual pest management activities if they: did not rely on their properties for the main source of their household income, did not believe pest animals were an important problem, and believed that they did not have the time and/or skills to control pest animals. Non-participation in group management activities was associated with a similar set of predictors to those above, and also small property areas and non-participation by neighbours. Implications for improved targeted engagement are discussed.

IMPROVING PARTICIPATION THROUGH THE APPLICATION OF HUMAN BEHAVIOURAL APPROACHES: A CAT MANAGEMENT CASE STUDY

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Many invasive animal management (IAM) problems can be moderated if people adopt appropriate behaviours. An important challenge for policy makers and practitioners is to improve their understanding of the range of factors that influence people's decision making and behaviour. Such an understanding will help them select more appropriate policy strategies and design more effective interventions to achieve their objectives. This paper will present an integrated framework to guide IAM intervention development, based on the principles from the behavioural sciences. This framework is not meant to provide a quick solution, but instead offers a systematic, methodical approach for tackling complex behavioural problems. We will demonstrate the utility of this framework in a cat management case study.

Free-roaming domestic cat (*Felis catus*), whether they are owned or wild-living, can cause harm to ecosystems and human and animal health through predation, competition and disease transmission. In Australia, an estimated 65% of the 3.3 million pet cats roam freely (Animal Alliance 2013). Getting cat owners to manage their pets effectively would minimise their impacts, yet many policy makers and practitioners are unclear about the best ways to get cat owners to change their behaviour. We show how our integrated framework can address this and related pest-management problems. Using a voluntary approach to behaviour change has important advantages over purely regulatory solutions which are often ineffective and costly to implement and police.

References

Animal Health Alliance (2013). Pet ownership in Australia. Canberra, ACT: Animal Health Alliance.

USE OF PUBLIC BIRD COUNTS TO ASSIST IN SURVEILLANCE FOR EXOTIC BIRDS

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Many bird watchers utilise online and mobile application based databases for their bird counts to record and share birds observations. Due to the number, skills and knowledge of bird watchers and bird watching groups, the credibility of sightings can typically be considered higher than those made by the general public. It is this type of data, which is often referred to as 'citizen science', that was utilised to assist with validating a false report of an Indian house crow (*Corvus splendens*) in Melbourne during 2014.

Geospatial bird count data was used to identify locations that were surveyed regularly by bird watchers in the lead up to, and following, the report of an Indian house crow. Conversely, bird count data was used to identify locations lacking bird count data which required further surveillance for delimitation. Information on historical detections of Indian house crows from around Australia also provided valuable insight into the likely habits of this species. Historically, Indian house crows have been reported to congregate with native ravens and crows, therefore locations of previous records of corvids were targeted for active surveillance. This presentation describes how collation and analysis of this data was used to select locations for passive and active surveillance, and to target engagement of stakeholders in a specific geographic area.

RABBIT ERADICATION AT MULLIGANS FLAT WOODLAND SANCTUARY

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Mulligans Flat Woodland Sanctuary is a 484 ha area of endangered box-gum grassy woodland situated adjacent to the north-eastern border of the ACT, which has been fenced to exclude introduced predators since 2009. Since this time, a number of locally extinct native bird and mammal species have been reintroduced to the area as part of a grassy ecosystem restoration project established collaboratively by the ACT Government, AN, The Woodlands and Wetlands Trust and CSIRO.

Until recently, and despite over six years of eradication efforts, a breeding population of rabbits has remained within the sanctuary. The concept of eradication however is now shifting from a pipe dream to a tentative reality, thanks to the combined intelligence of a range of innovative rabbit detection methods including the use of fixed and mobile wildlife camera surveillance, thermal cameras, and night vision scopes and a dedicated rabbit buggy, community volunteers, detection dogs, PCR testing for RHDV, VHF collared Judas animals. With these techniques and many long hours significant progress is now evident in the quest to eradicate rabbits in a publically accessible, predator free, temperate ecosystem, without non-target effects on common or reintroduced native species.

Some realities faced and lessons learned throughout this process will be presented, hopefully alongside some long awaited good news regarding a successful eradication outcome.

OUTCOMES OF THE 2016 NATIONAL WORKSHOP ON MANAGEMENT OF WILD DEER IMPACTS

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Wild deer are present in all Australian states and territories, and there is increasing concern about their economic, environmental and social impacts. In response to these concerns, the Invasive Animals Cooperative Research Centre (IACRC) hosted a workshop in Adelaide on 17–18 November 2016. The aim of the workshop was to identify national actions and priorities for research and innovation to improve understanding and management of wild deer impacts in Australia. Twenty-nine people, representing all states and territories except NT, participated in the workshop. This presentation will summarise the key outcomes of the workshop, including the research and innovation actions identified by participants as critical for addressing knowledge gaps in four main areas: (i) deer impacts, (ii) deer management tools and systems, (iii) monitoring deer distribution and abundance, and (iv) community engagement, use and awareness of deer and their impacts.

MANAGEMENT OF AN EXPANDING CHITAL DEER POPULATION IN NORTH QUEENSLAND

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Chital deer (*Axis axis*) were introduced to Australia in the early 1880s on a property approximately 140 km north-west of Charters Towers. Unlike many other invasive vertebrate species, the distribution of chital from the point of release has remained relatively localised. However, in the last 20 years, landholders have reported an increase in chital deer abundance and an expansion of their range.

Aerial and ground surveys have determined the distribution and abundance of chital deer in the upper Burdekin region north of Charters Towers. These surveys revealed relatively high chital deer densities in areas close to homesteads and permanent water. Such densities are causing impacts for landholders through grazing competition with cattle, while trespassing by hunters is also a problem. A questionnaire survey of landholders has indicated the extent of the concern and timing of their spread. Landholders are increasingly viewing this species as a pest more than a resource.

Dry conditions over 2014-2016 have seen deer abundance decline markedly with annual declines of 65-83% recorded on two properties. This reduction, coupled with the concentration of animals, provided a strategic opportunity to further reduce deer numbers. Ground shooting had reduced their abundance on some properties with 36% of the population removed in five days on one property. Aerial culling has now been used to depress populations further on five properties, with ground shooting planned as a follow-up. The maximum rate of increase of chital deer is sufficiently low (~43%) for it to be feasible to hold populations at low densities, but coordination among properties will be required to gain landscape control.

WHAT DO SOUTH AUSTRALIANS THINK ABOUT FERAL DEER AND HOW DO THEIR VIEWS INFLUENCE MANAGEMENT?

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Feral deer are declared animals under the Natural Resources Management Act 2004 in South Australia. They compete with native herbivores for pasture, consume crops, browse native plants, can cause vehicle collisions and carry livestock diseases. In 2005, concerns that feral deer numbers were increasing, prompted the development of a state feral deer policy to reduce deer numbers and impacts. The policy focused on the confinement of farmed deer and the control of unconfined feral deer by landholders because of the high public benefit to do so. Despite control efforts by landholders, feral deer populations have increased in parts of South Australia over the last 12 years. The state policy is being reviewed and all management options are being considered. The review is being informed by stakeholders through formal consultation mechanisms, and by the community through a state-wide phone survey. The community survey targeted over 500 landholders in areas where feral deer are known to exist. Questions focused on deer sightings, attitudes towards feral deer, their perceived impacts, acceptance of control options and the proportion of feral deer populations that should be reduced. This is the third time the survey has been conducted in parts of South Australia. The survey augmented our knowledge of deer distributions, which will inform coordinated control efforts. It also indicated the level to which the community accepts the need to control feral deer, and carry out control measures on private land. The survey highlighted a range of knowledge about the impacts of deer, which will inform how and where to focus community education. This targeted community consultation will ensure the updated policy is relevant to those who are impacted by feral deer and to ensure the policy is adopted and implemented by both stakeholders and community.

FIDDLING WHILE ROME BURNS: 'COMPASSIONATE CONSERVATION' IS NEITHER

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Compassionate conservation is a rapidly growing international and cross-disciplinary pseudoscientific populist movement that promotes the protection of wild animals as individuals within conservation practice and policy. Although a worthy and admirable ideal, unfortunately, the rights of one individual or group of animals may mutually exclude the rights of others. Invasive animals do exactly that, often having catastrophic effects on the survival of other animal and plant species, and completely restructuring ecosystems.

When the compassionate conservationists call for European wild rabbits to be left alone for compassion's sake, and ecologists support such drivel with modelling papers it behoves us to make a stand. Rabbits are a main player in degradation of Australian ecosystems. In this presentation, we use rabbits as a case study to show that being 'compassionate' to the individual animal has individual and population consequences for small mammals and plant regeneration, leading to homogenisation and trophic downgrading of Australian ecosystems. Doing nothing or relying on introduced predators to do the job for us cannot push rabbit population growth into negative *r* or reduce the population density below damage thresholds. We discuss the different ethics and moralities at play in the debate and conclude that doing nothing in the hope of some response is abrogation of responsibility to clean up the ecological mess caused by post-settlement Australians. Oftentimes, humans have to kill individuals of one species to achieve conservation of broader intrinsic, economic and environmental values.

IMPLEMENTING EFFECTIVE PEST MANAGEMENT

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You have developed a pest management plan—how, when and where will you implement it? For example, where should pest management start? It is tempting to begin where the pest is causing most damage, but this is not always the best option. Often it is best to test the plan with a group of cooperative stakeholders on a small area, a pilot program. This helps to check how the plan is to be delivered, and to help resolve any problems before embarking on the full pest management program.

There are other factors to consider in selecting the area:

- make sure that all of the stakeholders are ready and willing to work on the program
- check that there is not another issue that is more important to the stakeholders than managing the pest
- find out whether putting most effort into pest management is going to give best value for the money that will be spent, or whether other actions might be more relevant.

Several factors are essential for effective implementation of the program:

- ensure that the group has a clear and common vision
- develop an appropriate implementation and reporting structure
- secure and maintain support from key agencies and individuals
- maintain group vision, enthusiasm and participation.

I will expand on these points in the presentation.

WILD DOG MANAGEMENT GROUPS IN AUSTRALIA: HOW WELL ARE THEY FUNCTIONING?

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Participatory wild dog management groups are seen as a key approach to managing wild dogs and reducing their impacts on sheep and cattle farming systems in Australia. While community-driven action has been recognised as vital, there has been limited research into the factors that make wild dog management groups successful. This paper highlights results from a 2014 national survey of landholders about the characteristics of wild dog management groups, how they operate and what helps or hinders the groups in achieving coordinated and effective wild dog management. The survey found a quarter of respondents had participated in wild dog management groups, with about 120 different groups identified. A majority of landholders thought their group had contributed to reducing the wild dog problem in their region, and provided support for affected landholders. Landholders identified factors they thought influenced the functioning and effectiveness of their wild dog management group. Two key factors emerged as contributing to groups reducing dog problems: the *internal functioning* of the groups (including decision making processes, level of participation, conflict and cooperation); and the group's *resources and support* (e.g. funding, planning, scientific research and specialist skills). This result provides guidance on where effort and investment could be directed, that is towards cooperative participation in groups and in securing long-term funding, strategic planning, access to specialist skills (for example mapping, surveying, data collection and monitoring), and building relationships with industry and government agencies. The paper also highlights two contrasting examples of community-driven wild dog management and the characteristics and features of these groups.

WILD DOGS IN NORTH-EASTERN NSW: HOW DID WE GET HERE AND WHERE ARE WE GOING?

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Between 1964 and 1993 predation of livestock by wild dogs in the north east of NSW was within limits that were acceptable to most producers. This was likely due to a concerted community-driven effort and effective control achieved with aerial baiting, which was the front-line control tool. However, a perfect storm of events, commencing with the demise of the Wool Reserve Price Scheme in 1992, has seen major changes in tenure, landuse, and pest management capacity and policy. There has been a major restructuring of livestock industries in the region, and tenure and policy changes in public lands where control had traditionally been most intense. All of these factors combined to produce reduction and fracture of control effort, and increased predation, frustration, distress and discontent. In 2006, the IACRC's Wild Canid Management Demonstration Site and the National Wild Dog Facilitator projects commenced the process of facilitating community-led restorative action based on evidence-based strategic approach to current best practice. We show how community-based management plans that have been implemented since 2010 and the Northern Tablelands Wild Dog Facilitator project have increased participation in wild dog control efforts. Simultaneously, the Predators, Prey, Plants and People, Aerial Bait Rate and Wild dog Alert projects have provided ecological evidence and raised capacity for a major upscaling of control effort across the region. In future, we will be expanding and monitoring community-based predator management at the appropriate temporal and spatial scales to achieve real triple bottom line outcomes.

PROMOTING COMMUNITY REPORTING OF PERI-URBAN WILD DOGS: A PARTNERSHIP APPROACH TO BEHAVIOUR CHANGE

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Wild dogs contribute to a range of negative economic, environmental, social-psychological and public health impacts in Australian peri-urban regions. There are limited conventional control options in these environments. A behaviour change project has been undertaken in the Gold Coast area to promote community participation in peri-urban wild dog management.

Following the guidelines of Community-Based Social Marketing we consulted with experts to identify 15 behaviours that could be adopted by the community to reduce impacts of wild dogs in peri-urban areas. Each behaviour was assessed on: (1) expert-rated effectiveness, (2) likelihood of community adoption, and (3) current penetration rates within the community, and were ranked in terms of overall projected impact. The top-ranked behaviour, 'Reporting wild dog sightings and impacts to local council', was the target behaviour selected for the project. A barriers and benefits analysis identified that two main perceived benefits driving reporting were beliefs that reporting would benefit native wildlife and community safety. Two main barriers to reporting were beliefs that reporting takes too much effort and wild dogs should be left alone. Based on these results a Communications Strategy field experiment was developed to focus on shifting social norms about reporting wild dogs, framing messages around protecting native wildlife and making reporting easier to do. We will be reporting on the impact of the field experiment in this presentation.

Effective behaviour change projects take the form of research partnerships that transcend formal disciplinary boundaries, explicitly acknowledge that many different perspectives are relevant to the resolution of complex problems, and actively involve the users of research. Robust partnerships with local and regional government bodies are therefore required. We will report on the examination of processes, behaviours and relationships that fostered collective learning and decision-making in this project.

INSIGHTS INTO FACILITATING COOPERATIVE APPROACHES FOR RABBIT MANAGEMENT

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The European rabbit (*Oryctolagus cuniculus*) is one of Australia's most destructive pest species, undermining our ecosystems, the productivity of our landscapes, and is often a point of contention within regional communities. With the evolution of government policies and frameworks on biosecurity issues, there is a renewed call for more collective approaches for managing established species, such as rabbits. This shift requires a movement away from the more orthodox institutional-led approaches towards more cooperative approaches. Within these, communities and landholders are not seen as passive recipients of technical knowledge and programs, but as being actively engaged in developing approaches that work for them in their particular locale.

Here we report on the implementation and evaluation of a democratic, participatory systems mapping approach to strengthening the rabbit management system in Victoria. This approach was important for facilitating and integrating a diverse array of voices and perspectives to define the problem, test ideas and linkages, and deliberate on potential solutions. There were some tensions between the different actors involved in the process however, establishing clear principles and processes allowed the actors to work across these for a more collaborative response to rabbit management. Through the establishment of the Victorian Rabbit Action Network, the systems mapping process assisted in informing the co-development of a series of interventions to strengthen the rabbit management system, which will be further outlined. The results will be of interest to practitioners and policy makers grappling with the complexities of wicked issues and managing widely established species.

HOW LATE IS TOO LATE? MANAGING THE IMPACT OF WILD DEER ON PRIVATE LAND IN THE UPPER MURRAY

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Introduced deer, fallow (*Dama Dama*) and sambar (*Cervus elaphus*) are becoming a point of tension for communities in the Upper Murray region of Victoria. In this presentation we will explore how the Upper Murray community has been able to work with adverse range of stakeholders to facilitate a proactive response in managing these tensions. From 1998, through catchment planning processes, the community identified the emergence and threat of the wild deer populations. By 2014, the community flagged deer as a critical issue, detrimentally impacting on agricultural and forestry industries. They noted increased browsing and impacts on native vegetation on public and private land, wallows in sensitive wet areas, fence and pasture damage and difficulty in establishing native re-vegetation. A consequence of these increased numbers is illegal shooting and anti-social behaviour. In response, the Upper Murray Landcare Network convened a forum, with an invitation for all land managers and other secondary agencies, with 75 people attending. The objective was to find out what the local concerns were and what land managers needed to be able to better manage deer on their properties. We identified key priorities in our deliberations and explored how to address these priorities in collaboration with interested parties, across multiple agency and community. In a collaborative effort, we produced an information kit, educational material and developed an informal network to proactively manage illegal shooting. Here we share our key findings to assist communities, land managers and policy makers to understand this emerging invasive species challenge in a bid to encourage others to pursue more cooperative arrangements.

HOME RANGE AND HABITAT UTILISATION OF FERAL CATS (*FELIS CATUS*) IN CENTRAL QUEENSLAND

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Feral cats (*Felis catus*) threaten many native species through predation, competition and the spread of disease (Department of Environment 2015). Managing feral cats and their impacts, however, is difficult. Effective monitoring and management strategies require a sound knowledge of how feral cats utilise their environment, although key aspects of habitat use will often vary in different environs.

We fitted GPS collars to 9 feral cats (5 male, 4 female) at Taunton National Park in central Queensland to investigate how they utilise their environment. We calculated home ranges for each cat using 12 hourly fixes from May to July 2016. Habitat utilisation within each home range was assessed to identify if cats showed preference for particular vegetation type or landscape features.

On average, home ranges of males were around three times larger than those of females, with spatial overlap evident, both between and within sexes. While the larger home range of males is consistent with other studies, home ranges of both sexes were substantially larger than those of feral cats in similar environs.

Our findings highlight the importance of obtaining site-specific ecological information to ensure local monitoring and management strategies are effective. Extrapolating from studies in similar environs may inadvertently lead to inappropriate management outcomes.

References

Department of Environment (2015) 'Threat abatement plan for predation by feral cats.' (Commonwealth of Australia: Canberra.)

RED FOX MOVEMENTS AT A FLATBACK TURTLE ROOKERY IN THE PILBARA, WESTERN AUSTRALIA

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Depredation of nests and hatchlings can have major implications for the recruitment and recovery of threatened marine turtle populations. The introduced European red fox (*Vulpes vulpes*) is known to be a major predator of marine turtle nests and hatchlings along the Pilbara Coast of Western Australia, with reports of nest depredation at a number of Marine turtle rookeries in Western Australia. There is also evidence to suggest that emergent hatchlings are highly susceptible to the threat of depredation by foxes. Despite the impact foxes have at marine turtle rookeries in the Pilbara, there is still much to be understood about the behaviour and ecology of foxes in this area. In September 2016, GPS/Iridium collars (Telemetry Solutions, USA) were fitted to five foxes (2 females, 3 males) in the vicinity of a substantial Western Australia flatback turtle (*Natator depressus*) rookery at Mundabullangana Station (60 km south-west of Port Hedland). These data are being used to examine home ranges and changes in space use around the current flatback turtle nesting season. Understanding movement patterns will help to develop location-specific mitigation strategies for fox control to mitigate damage caused by these predators on marine turtle nests and hatchlings in this and similar nesting areas.

DEVELOPING A MONITORING PROGRAM FOR AERIAL AND GROUND SURVEYS OF WATERFOWL IN NSW

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Long-term ecological monitoring programs are vital as they allow researchers and managers to assess temporal changes in animal populations. However, monitoring programs can sometimes focus more on collection of data without specifically identifying what data is required and how it will be analysed. This has implications for use of these data at a later stage, as sources of bias and methodological errors can greatly reduce the value of these datasets.

We are in the early stages of trialling waterbird surveys in NSW. This presentation will summarise our recent surveys and outline the key considerations we are integrating into a waterbird monitoring program.

The survey aims to;

- reduce costly time in the field (office-based image processing)
- ensure survey methods are repeatable between different observers
- reduce issues related to observer fatigue and inattention during field surveys
- minimise observer errors related to misidentification and counts of birds 'on the fly'
- improve accuracy and precision of waterbird surveys with concurrent surveys.

The techniques we are using to address these aims will be discussed, specifically:

- automating processes—collection of video footage for ground, air and UAV surveys and a custom developed program to process video files with potential for automatic recognition in future to reduce processing time
- multiple survey methods, including new technology, to deal with method-specific visibility and accessibility issues and for comparisons between techniques to estimate detection probabilities and account for birds not seen.

FEEDING ECOLOGY OF AN INVASIVE PREDATOR ACROSS AN URBAN LAND USE GRADIENT

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Urbanisation poses a major threat to biodiversity, often resulting in the decline or local extinction of native species. Urban and peri-urban areas, in general, contain a mosaic of fragmented natural habitats in which native species can find refuge. While, the persistence of native species is often tenuous in such refuges, little is known about how introduced predators, such as the European red fox (*Vulpes vulpes*), affect native prey in urban Australian environments. This study aims to address this knowledge gap by assessing the diet composition of foxes along an urban landuse gradient, transecting the Greater Sydney Region. It is anticipated that the findings from this study will result in better informed management practices to help preserve native species in urban refuges in Australia.

UNDERMINING POSSUM-CENTRIC ERADICATION OF BOVINE TUBERCULOSIS FROM WILDLIFE: ARE FERRETS SOMETIMES INDEPENDENT HOSTS?

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New Zealand's agricultural industries aim to eradicate bovine tuberculosis (TB) from wildlife by 2055. The current process for achieving that focuses on lethal control and TB surveillance of brushtail possums, implicitly formalising the notion that possums are the only true maintenance wildlife host able to independently sustain TB. Other wildlife such as pigs, deer, and ferrets are seen as spillover hosts infected mainly by possums. Eradication progress has been good, with over 2m ha declared free of wildlife Tb since 2011 (20% of the affected area). However, in a few areas, TB continues to be detected in livestock and ferrets despite apparently adequate possum control. Here we summarise a recent case study confirming TB presence at low-moderate prevalences (3-17%) in ferrets in the Benmore area, Otago, where their year-round densities are moderately high (2.9/km^2). This persistence is despite possum densities (0.02/ha) being extremely low relative to the threshold density below TB does not usually persist in possum. That threshold density is believed to exceed at least 0.50 possums/ha. This, with other circumstantial evidence and previous modelling of host status-density relationships in ferrets, highlights a potential need to broaden the possum-centric strategic focus of the eradication campaign to include ferrets. In particular, there may be a need to include a process for declaring TB freedom in ferrets as well as in possums and livestock. Without that, the campaign could ultimately fail, or (more likely) be substantially inefficient in ferret-prone habitats.

UNDERSTANDING RED FOX (*VULPES VULPES*) HABITAT IN URBAN ENVIRONMENTS

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The European red fox (*Vulpes vulpes*) has been listed as a key threatening process where this invasive species occurs across Australia. Predation by foxes is considered a major contributor to the decline of a number of native species. Currently fox populations are being controlled, with varying degrees of success and in selected locations, by using conventional techniques such as shooting, poisoning and fencing. To date, the focus of fox research and management has been on agricultural and wilderness areas. Consequently, we have a limited understanding of fox ecology in urban environments. If fox management strategies are to be effective, it is essential that we develop a better understanding of fox ecology in an urban context. Over the first year of this study nine foxes have been fitted with GPS transmitters across the Sydney region. Their home ranges have been calculated using dynamic Brownian bridges (Kranstauber, Kays et al. 2012) to better understand the movement behaviour of urban foxes. Home ranges of urban foxes varies between 82–356 ha. Furthermore, their home ranges have been segmented using Bayesian partitioning of Markov models in order to identify and characterise their hunting, loafing and denning habitat preferences. This information will aid the development of effective management policies and help raise community awareness regarding urban foxes.

Reference

Kranstauber, B., R. Kays, S. D. LaPoint, M. Wikelski and K. Safi (2012). 'A dynamic Brownian bridge movement model to estimate utilization distributions for heterogeneous animal movement', *Journal of Animal Ecology* **81**(4): 738-746.

A PROTOCOL FOR ESTIMATING DINGO/WILD DOG ABUNDANCE AND DENSITY

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There is much interest in understanding the roles of dingoes/wild dogs in agricultural and natural ecosystems, but currently there is not a protocol for robustly estimating the densities and abundances of dingoes/wild dogs in any habitat. We evaluated a method for estimating the density and abundance of dingoes/wild dogs in Gudgenby Valley, Namadgi National Park, Australian Capital Territory, during spring 2015. Dingoes/wild dogs are not controlled in this area. We used an array of 50 camera locations on a 800-m grid; this spacing was chosen based on prior information about home range sizes of dingoes/wild dogs in this area. Two Reconyx cameras and an olfactory lure station were placed at each of the 50 locations. The cameras were active for 64 consecutive days, with batteries, memory cards and lures replaced fortnightly. Each camera image was assessed for the detection/non-detection of dingoes/wild dogs, and we assembled a photographic catalogues of individually identifiable dingoes/wild dogs. We created a daily detection history for individually identifiable dingoes/wild dogs. A daily detection history was also created for unidentifiable dingoes/wild dogs. We used spatial capture recapture (SCR) models that utilised both marked and unmarked individuals to estimate dingo/wild dog abundance and density. The estimated adult dingo/wild dog density was 0.05/km^2 (95% credible interval = 0.02–0.09). The advantages and limitations of the approach will be discussed. We believe that our protocol can be used to robustly estimate dingo/wild dog abundance and density in most Australian habitats.

THE INFLUENCE OF WILD DOGS, HERBIVORES AND CLIMATE ON VEGETATION IN AUSTRALIAN ECOSYSTEMS

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Global concern surrounding the loss of large mammalian predators has increased scientific interest in the roles of carnivores in food web interactions. In Australia, wild dogs may have a role of key trophic influence, potentially able to change vegetation by altering herbivore consumption patterns. This is potentially important for biodiversity conservation, particularly for prey species that rely on vegetation for habitat and refuge.

However, the strong influence of climate on Australian ecosystem function and trophic interactions is likely to override predator effects. The potential for wild dogs to trigger trophic cascades that significantly affect both herbivores and vegetation is uncertain (Morgan et al 2016).

Our field studies, conducted in the New England Tablelands, are using grazing exclosures, camera traps and vegetation surveys to quantify the impacts of macropods on plant biomass, species presence and cover at sites with different wild dog management treatments. Here, we present findings from the research to date, to inform discussion around the roles of wild dogs, herbivores and climate, in Australian ecosystems.

References

Morgan, H. R., Hunter, J. T., Ballard, G., Reid, N. C. H., and Fleming, P. J. S. (2016). Trophic cascades and dingoes in Australia: does the Yellowstone wolf–elk–willow model apply? *Food Webs*, in press. doi: http://dx.doi.org/10.1016/j.fooweb.2016.09.003

WILD FOR TARANAKI: A COMMUNITY LED RESPONSE TO PROTECTING TARANAKI'S NATURAL TREASURE

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Over the last eight years Taranaki's environmental community have been on a mission to significantly advance the protection and restoration of biodiversity throughout the region. Led by the Taranaki Regional Council, 19 Iwi, community and government environmental groups drafted and signed up to a Biodiversity Accord. Following this a Regional Biodiversity Coordinator was employed to coordinate activities and provide a single contact point for members. In 2015 a Charitable Trust was formed aimed at increasing available funding, followed by the launch of the 'Wild for Taranaki' brand by the Minister of Conservation. Since this time trustees have developed a Strategic Plan setting the priorities out to 2020 and welcomed 15 new member groups.

One of the priorities was to 'develop a collaborative, high value, flagship regional project'. 'Restoring Taranaki' will see Wild for Taranaki members working with iwi and landowners, to turn their land into 'my little piece of paradise'. While the initial focus will be on predator control, pest plant removal, native planting, fencing-off streams and creating QEII covenants complete the project. Over time areas will connect until the whole region is restored.

The development of this program involved. Using available data to determine high value biodiversity areas, mapping member's current pest control programs, running member forums, to review information, identify priorities and discuss preferred approaches to protection on a landscape scale predator control.

A report on the discussions was produced, with the final operational plan being decided by trustees, supported by technical experts. Fundamental to this decision was engagement of local people. The involvement of the Taranaki community is seen as crucial to long-term success.

Wild for Taranaki's project will align and grow members already significant pest control operations. Restoring Taranaki will be by far the largest conservation project in the Taranaki region.

COMMUNITY INVOLVEMENT IN PEST CONTROL: A CASE STUDY OF ACCREDITED VOLUNTEER SHOOTING PROGRAMS

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Community involvement is often essential to successful pest management. Landholders and other community groups are an important resource that many land managers can use to achieve their project goals. So too is the access to a wide variety of pest control tools to cater for different situations. Volunteer hunting, culling or shooting is one tool that, by itself or in conjunction with other pest control methods, can deliver positive social, economic and environment outcomes through the removal of grazing and/or predatory pest animals. The Sporting Shooters' Association of Australia (SSAA) has a proud history of engaging volunteer shooters to use their unique skill set to undertake pest control activities for both conservation and asset protection purposes. The SSAA Conservation and Wildlife Management (CWM) Branch has been in operation since 1992. The efforts of CWM on public land in the Flinders Ranges of South Australia have been a cornerstone in the success of Operation Bounceback (a coordinated pest control program). This project led to the recovery of the yellow-footed rock-wallaby and more recently the reintroduction of the western quoll. The recent rollout of the SSAA Farmer Assist program across the country has the potential to engage even more volunteers to assist landholders with pest animal control for both asset protection and environmental reasons. This particular program offers a unique online portal that allows landholders to seek help from accredited shooters in a matter of minutes, 24 hours a day, seven days a week. These programs reaffirm the SSAA as a credible and important stakeholder in the management of pest animals in Australia and a willing partner in conservation.

WHO IS CONTROLLING WILD CANIDS?

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Wild canids—foxes and wild dogs—are a huge problem for Australian livestock producers, causing over $70m annually in livestock losses. Despite the damage that canids cause, many landholders still show limited engagement with canid control. To some degree this may reflect inadequate skills or experience in using these methods, but the cost and risks to landholders that are associated with canid control may also limit engagement. We distributed an online survey 'Control of wild dogs and foxes' addressing issues around wild canid control. We received responses from 195 landholders, 83% of whom currently run stock (cattle 63% of responses; sheep 57%; goats 18%; pigs 4%). The majority of the respondents (96%) indicated that they have experienced negative impacts from wild dogs and/or foxes (principally loss of livestock). 68% of respondents indicated they were concerned about wild dogs and 70% indicated concern regarding foxes (only 4% were not concerned about either). 83% of respondents currently control wild canids, principally via shooting and baiting, while 'doggers' and dog-proof fencing were also considered effective management options. 89% of respondents believe that more action needs to be taken to manage wild dogs but identify time and financial constraints as well as a lack of coordinated community action and incentives as major hurdles to participation. Landscape-scale control requires information to engage participants. This survey is a first step towards starting this conversation.

ARE WE READY TO GO ONLINE? COMMUNICATING THE NATIONAL RELEASE OF RHDV1 K5

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In 1996, the release of the RHDV1 Czech strain to manage rabbits was undertaken prior to mainstream internet and email usage. Communication relied on the large-scale distribution of printed materials, strong media intervention and on-ground resources to communicate the messages (N Byrne 2016, pers. comm.).

In 2017, just over 20 years later, we are well and truly in the digital age. In Australia alone, there are 15 million Facebook users, close to 5.5 million WordPress internet sites and 2.8 million active users on Twitter (Cowling 2016). It is suggested that Australians own an average of three Internet-enabled devices which underlines our strong appetite for online activity (Sensis 2016). However, how well connected is the agricultural and rural sector? The *2015 Regional Wellbeing Survey* stated that critical infrastructure, including telecommunications, was underserviced in regional Australia, and 50% of those surveyed reported internet access as 'very poor' or 'inadequate' (Schirmer et al., 2016). In knowing this, are we ready to fully communicate our messages online, or should resources be adequately focused towards printed materials and on ground resources such as extension officers?

Since 2015, along with a series of face-to-face community roadshows, the majority of communication relating to the national release of RHDV1 K5 has been online, through our website portal, e-newsletter and digital media (Invasive Animals CRC 2016). From October 2015 to October 2016, the web portal received 7362 page views, and 1040 emails subscribed to our regular *RHD Boost* e-news updates.

While it could be argued many Australians have access to online materials, can we maintain strong engagement through this mechanism? This paper will discuss the success of our current online engagement strategies undertaken as part of the national release of RHDV1 K5, and make recommendations for future pest animal communication campaigns which may wish to utilise online engagement tactics.

References

Cowling, D. (2016) Social Media Statistics Australia—August 2016. Social Media News. www.socialmedianews.com.au/social-media-statistics-australia-august-2016/

Invasive Animals CRC (2016) The Healthier Landscapes web portal. Invasive Animals CRC. www.healthierlandscapes.org.au

Schirmer, J., Yabsley, B., Mylek, M., and Peel, D. (2016) Wellbeing, resilience and liveability in regional Australia: The 2015 Regional Wellbeing Survey. University of Canberra. www.canberra.edu.au/research/faculty-research-centres/ceraph/regional-wellbeing/survey-results/2015

Sensis (2016) Sensis Social Media Report 2016. Sensis www.sensis.com.au/assets/PDFdirectory/Sensis_Social_Media_Report_2016.PDF

RHDV BOOST: COMMUNITY PARTICIPATION ON A NATIONAL SCALE

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An additional rabbit biocontrol agent, RHDV1 K5, has been tested for release to continue the suppression of rabbit populations across Australia. To ensure the virus is distributed widely across the country, the RHDV Boost team asked the Australian public to submit an expression of interest (EOI) to nominate as a possible release site. Free vials of virus were offered as an incentive for participation, in return for participants recording and submitting spotlight count data and collecting samples from dead rabbits. EOI's were open from December 2015 to 31 May 2016 and submitted online through the Invasive Animals CRC PestSmart web page. Over 750 EOI submissions were received, with some submissions proposing multiple release sites, taking the total suggested sites to over 900. To facilitate the collection of spotlight and disease data from the EOI sites, additional functionality was included in the RabbitScan App, which can be used on mobile and desktop platforms. Additional features have also been added to enable any landholder to request sampling kits for dead rabbits they find on their property. This resource allows the community to view rabbit sightings on the RabbitScan maps, learn about control methods and track virus, and provides the RHDV Boost team with valuable information on rabbit population dynamics and disease characteristics nationally. Here we discuss the EOI process, the elements that worked well and areas where improvements could be made. Overall, RHDV Boost provides an excellent example of how researchers, facilitators, stakeholders and the wider community can better communicate and work together to improve the management of pest species at a national scale.

ONLY AN ENGAGED AND INFORMED COMMUNITY CAN LEAD THE WAY TO SUSTAINED LONG-TERM RABBIT CONTROL

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The proposed national release of RHDV1 K5 has been described as a once in a generational opportunity to control rabbits in Australia. Previous biocontrol releases achieved significant nation-wide knock down. However the potential to achieve sustained long term control was missed due in part to growing resistance, the lack of follow up with conventional control and the over-reliance on chemical and biological control.

Evidence suggests that to achieve a sustained reduction in rabbit numbers following the release of RHDV1 K5 in Victoria there is a need to gain community ownership and involvement in both the release and conventional ongoing management at a landscape scale.

To maximise the impact and potential opportunities associated with the release in Victoria, Agriculture Victoria have developed and implemented a comprehensive engagement package to engage Victorian land managers. Key aspects of the plan were to establish clear messages and actions aligned with the national approach. Using established community forums provided opportunity to find appropriate conduits into communities where awareness, involvement and ownership could be developed.

This presentation outlines the steps taken to engage the Victorian community in this important opportunity and the measures put in place to maximise the effectiveness of the first release of a biocontrol agent for rabbits since 1995.

SELF-EMPOWERED PERI-URBAN COMMUNITY LED PLANNING FOR INVASIVE ANIMAL MANAGEMENT

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Peri-urban zones surrounding our cities and towns just beyond their built up limits are highly dynamic and constantly changing former rural areas that are now home to a very diverse range of largely former urban dwellers who have moved there principally for lifestyle reasons and who are dependent on nearby urban centres for employment, education, economic, social and cultural needs.

Increasingly, peri-urban areas are under threat from influences ranging from invasive animals and plants to continued land use conversion pressures. How peri-urban landholders respond, individually and collectively, to these pressures and impacts are crucial for the future sustainability of these areas. Principal amongst the invasive pest animals has been the wild dog. This study has used the wild dog as a platform to explore the impact and the perception and response to external threats that wild dogs pose on peri-urban resident's quality of life.

These issues were explored through extensive interviews and focus group workshops involving peri-urban residents in two case study areas in Moreton Bay Regional Council and Sunshine Coast Regional Council areas of South East Queensland. The paper will report on the differences between various categories of peri-urban residents in terms of their awareness, understanding and response to the occurrences of invasive wild dogs in their residential areas. The study has also provided some insight into the barriers to overcome and preconditions necessary to initiate self-empowered community led planning for invasive animal management.

This phase of a much larger potential study has commenced to identified the roles that community led action can play in the management of invasive animals and how this can this be addressed through a community-led planning process.

COMMUNITY ENGAGEMENT FOR INVASIVE SPECIES MANAGEMENT: TAKE-HOME MESSAGES FROM A FOUR-YEAR COLLABORATION

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People working with community members to achieve coordinated invasive species control are usually trained in aspects of wildlife ecology or environmental management. They hold great expertise in pest control techniques and understand the biophysical, social and economic impacts of pests on agricultural and ecological communities. However these practitioners encounter challenges in facilitating coordinated control. Meeting these challenges extends beyond pest species expertise and requires an understanding of social, political, and behavioural dynamics.

The IACRC has invested in a range of tools to build practitioner expertise in the human dimensions of invasive species management. A key focus of this work has been catalysing and supporting community engagement activities, with the specific aim of promoting collective community-led action for management at the landscape scale. This requires development of a particular *philosophy of community engagement* that builds and supports the individual and collective capacity necessary for community-led action and encourages emerging leaders to establish community engagement as a valued component of invasive species management.

This work is guided by principles of critical reflection, skill sharing, and co-creation of knowledge involving close working relationships among community and research partners. As researchers, we strive to model a community engagement praxis that recognises and mitigates the cultural and political tension between expert and non-expert knowledge; articulates the creative possibilities inherent in this tension; and enables front-line invasive species practitioners to see their work as vital in brokering interaction between these ways of knowing. This interaction is the necessary ingredient for building community, and a vital step towards realising the promise of community-led action.

This presentation will introduce the key concepts and practical tools developed as part of a four-year research program. These tools include online training modules, face-to-face Masterclass training and a strategy for building communities of practice at the local, state and national scale.

MANAGING PESTS WITH EXCLUSION FENCES: PROGRESS AND POTENTIAL BIODIVERSITY BENEFITS

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Historically, wild dogs were extirpated from Australia's sheep growing regions using the same control techniques that are available today: poison baits, trapping, shooting and fencing. In the last half century wild dog management has focused on laying cost-effective, target-specific and humane poison bait, principally coordinated 1080 baiting programs. Unrepaired netting fences, inadequate participation in, and variable efficacy of, 'coordinated' baiting programs, and the ability of wild dogs to disperse hundreds of kilometres has allowed wild dogs to infiltrate and recolonise sheep production regions. Faced with these and other economic and environmental challenges, sheep production in Queensland has contracted dramatically. Improved fence materials and designs, more favourable economic conditions for sheep production, government incentives and formal agreements designed to ensure the private maintenance of fences in perpetuity have renewed interest in exclusion fencing. Based on a study that commenced in 2013 in southwest and central-west Queensland, this paper reports the progress two cluster fence groups are making towards reducing pests and increasing productivity.

THE APPLICATION OF GENETICS TO IMPROVING PERI-URBAN WILD DOG MANAGEMENT

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The impacts of wild dogs (*Canis lupus dingo* and their hybrids) are increasingly being felt by producers and residents throughout the fragmented landscapes of peri-urban areas of north-eastern Australia. Management options are limited in such environs, and confounded by a lack of knowledge of wild dog ecology. Genetics of wild dog populations has been studied generally, but limited information is available from the peri-urban areas. Tissue samples (n=812) were collected from wild dogs euthanised from control or research programs conducted in peri-urban and more rural areas. DNA was extracted, seventeen microsatellite loci examined, and allelic data analysed using methods including the Average 3Q score, Paetkau assignment, and Cavalli-Sforza Distance and Nei's standard distance matrices. Collectively, these results were used to determine the degree of hybridisation of dog populations, and compare the genetic profile of geographically-distinct dog populations. We use the hybridisation distribution of dingoes, hybrid wild dogs, and domestic dogs to determine whether domestic dogs are a major contributor to peri-urban wild dog populations. The genetic profile of geographically distinct populations were compared to determine if a region is likely to be a single/multiple demographic management unit, hypothesise patterns of movement between subpopulations, and examine the potential for any source/sink populations. More importantly, defining subpopulations is useful to determine the appropriate scale and location of management units, to improve the long-term effectiveness of control. Finally, in a novel approach, we examined the identity of the species, genotype, individual, and number of individuals responsible for predation events on wildlife species. Determining the 'identity' of individuals preying on wildlife is an increasingly available means to define the problem and thus develop more targeted solutions. This study is part of an Invasive Animals CRC research project, to document the nature, distribution and impact of peri-urban wild dogs, and develop alternative management approaches.

POPULATION REDUCTION IS MORE IMPORTANT THAN LIMITING IMMIGRATION IN A PROPOSED LARGE WILD DOG CELL

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Wild dogs pose a significant threat to livestock enterprises in Western Australian rangelands. A suite of control techniques are available for controlling wild dogs including: trapping, ground and aerial baiting, and use of licensed pest management technicians. However, difficulties in achieving effective, integrated wild dog control in the southern rangelands have led to producer groups investigating the use of 'cell-fencing' as a control option. One such proposal is the Murchison Regional Vermin Cell (MRVC) which includes over 50 pastoral properties and an area greater than 80,000km^2.

We conducted a management strategy evaluation based on spatially-explicit population models to forecast the role of the MRVC in assisting wild dog control. We used several wild dog control scenarios varying in intensity within the cell. We examined 'no control', 'current control' and two additional increased control scenarios with, and without, the proposed closure of the MRVC.

The modelling showed that reproduction of wild dogs within the cell area contributes more to the population than immigration into the cell. As such, only minor differences were apparent in wild dog population trajectories between control scenarios with and without the MRVC completed. Control of wild dogs to a level acceptable to landholders could potentially be achieved within the cell area through increased control effort without closure of the cell. This work raises the issues of scale and internal subdivision of cell fencing as critical matters that need to be addressed in planning of wild dog control measures.

DO DINGOES SUPPRESS FERAL CATS? SPATIAL AND TEMPORAL ACTIVITY OF SYMPATRIC FERAL CATS AND DINGOES IN CENTRAL QUEENSLAND

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Feral cats (*Felis catus*) are notoriously difficult to control effectively using traditional management approaches. Dingo (*Canis lupus dingo*) reintroductions have been proposed as a novel approach to the broadscale control of invasive mesopredators such as feral cats and foxes (*Vulpes vulpes*). However, the ability of dingoes to suppress feral cats and protect species threatened by cat predation remains unresolved.

We used camera traps to investigate the spatial and temporal activity of sympatric dingoes and feral cats in Taunton National Park, home to the only significant remnant wild population of the endangered bridled nailtail wallaby (*Onychogalea fraenata*).

Feral cats and dingoes exhibited marked overlap in spatial and temporal activity across the park, indicating coexistence between these predators at this site. There was no evidence of dingoes excluding cats from any areas, with cat activity higher in areas where dingoes were active. Time and distance between individual predator detections were negatively related, suggesting within-night avoidance of dingoes by cats. However, cats remained active, abundant and widespread across the park, with evidence of cats hunting and breeding successfully in areas occupied by dingoes.

These findings suggest that feral cats can coexist with dingoes, without significant suppression of cat abundance or fitness. Proposals to reintroduce dingoes should be evaluated on a site-by-site basis, as the ability of dingoes to suppress feral cats and protect species of conservation significance will likely be context dependent.

DOES WILD DOG CONTROL ALTER FERAL CAT ACTIVITY?

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There have been a number of studies in the ecological literature applying the mesopredator release hypothesis to interactions between introduced eutherian predators in Australia. Interactions between wild dogs and feral cats have been of particular interest, firstly due to the negative effects of wild dogs on livestock production, and secondly due to the negative effects of feral cats on native prey species. Due to their impact on livestock production in pastoral regions, wild dogs are often subject to landscape-scale periodic control programs, causing marked temporal changes in wild dog density and activity. Such changes will impact on intra-guild interactions between wild dogs and cats. Feral cats were monitored as part of an investigation into the control of wild dogs on two pastoral stations in the southern rangelands of Western Australia. Using a before-after control-impact (BACI) study design, we recorded wild dog and feral cat activity over 18 months before and after four wild dog control events. 180 motion sensing cameras were placed on tracks and an additional 17 motion sensing cameras were installed where animals congregated around water access points. Primarily, the hundreds of feral cat and wild dog 'activity events' were nocturnal over a 24 hour period with the exception of some months. Activity of feral cats and wild dogs differed seasonally over the 18 month study period. For example, over the summer months wild dog activity was significantly reduced, inversely feral cat activity was at its highest. Knowledge of times of heightened predator activity can inform future control events (i.e. the time of year) to maximise control effectiveness. Additionally, control events themselves altered the number of 'activity events' captured. Here we discuss the findings of this longitudinal survey of wild dog and cat activity and implications for management.

A NEW PARADIGM FOR INVASIVE SPECIES MANAGEMENT: APPLICATION OF A SYSTEMS STRENGTHENING APPROACH

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The Victorian Government has recognised that managing established invasive species requires a new approach, particularly given the on-going changes in the role of government and the fabric of rural communities. Working with the Invasive Animals Cooperative Research Centre, the University of New England and Pennsylvania State University, Victoria developed and implemented a systems-strengthening approach to managing rabbits as part of the National Rabbit Facilitator Project. The intervention has strengthened the rabbit management system in Victoria, empowering community-led action, improving resources flows and built collaborative working relationships.

This approach marks an important shift in the management of established invasive species. It provides a framework around understanding the 'system' itself in its entirely, and to guide strategic investment. For established invasive species, this means mapping who are the key players (and who is missing), understanding what influences the funding flows and points of influence, and identifying what is being done well and not so well. It identifies and assists the various actors within the system to work across their differences (eg. a researcher's perspective may be different to a compliance officer, and both perspectives may differ from the views of the diverse set of land managers). This disciplined approach leads to a shared understanding, which is critical to overcome inertia and managing expectations. Our success with rabbits, coupled with funding from the Australian Government's Agriculture Competitiveness White Paper, has enabled us to enhance the approach for rabbits in Victoria and apply it to three established weed species (gorse, serrated tussock and blackberry). Here, we provide an overview of the the process we are using in the White Paper funded project and describe how we are working with the community to ensure they are front and centre in the design, implementation, monitoring and improvement of the system strengthening approach.

FERAL TALES THAT MAKE ENGAGEMENT HAPPEN: HOW STORIES CAN SHAPE OUR VIEWS, OUR ACTIONS, OUR LEARNING

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Creative story telling shapes how people listen, react, learn and pass on information. As engagement specialists in pest management, we often engage with those directly involved in the pest management activity and we commonly 'preach to the converted'. Techniques to better engage the unknown and the unfamiliar community need more attention, innovation and development.

Educating primary school aged kids from across the country and helping them to express their stories with words and illustration has created an impressive suite of published feral animal story books. Not only have these books been published and printed, their power as an engagement tool has gone beyond expectations and provided multiple layers of engagement with multiple stakeholders.

This presentation will summarise the process of creating feral Enviro-Stories across Australia and discuss the unforeseen engagement outcomes at a local and national level

EVALUATION OF THE IACRC PRINCIPLES-BASED MULTIDISCIPLINARY RESEARCH PROGRAM TO IMPROVE THE HUMAN ISSUES OF INVASIVE SPECIES MANAGEMENT

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A great deal of ink is spilled about multidisciplinary and applied research, supported by relatively little empirical analysis. There is also a long history of social research being conducted that is intended to be useful, but which is ultimately not adopted into use. Thus, the question arises what approach to managing and conducting social research is likely to result in the greatest practical value to end users.

From the outset of the IACRC Program 4E, specific principles (based on research and experience with multidisciplinary applied research), were adopted to ensure the maximum effective adoption of research ideas into useful practice. These principles were substantially informed by advanced practices within technology intensive industries, to maximise the economic value of their investment in research. As the program progressed we conducted regular surveys of internal and external stakeholders to identify the degree to which these 'research to adoption' principles were being implemented, and the extent to which our researchers and our adopting partners were seeing research translated into useful outcomes. We also tracked some of the end application of the knowledge that was developed through the research activities, to identify the probable end use value from the social research.

This paper presents those research management principles, the evidence of the degree to which they have been adopted and of the impacts that they had upon the delivery of valued outcomes to adopting partners. It also presents provides evidence of the outcome value from the work that has been conducted within the program (subject to the limitations that evaluation practice in the social aspects of invasive species management is underdeveloped, and that many of the application projects are in relatively early stages of implementation).

Based on this evidence we propose further principles for the conduct of applied social research that can be implemented and further tested, In order to provide a sound basis for improved research management and better outcome value from social interventions. Finally the paper considers the challenges of reliable evaluation of social intervention programs and social research in natural resource management.

A BIO-ECONOMIC DECISION PROCESS FOR BROAD-SCALE ERADICATION OR CONTAINMENT OF INVASIVE PESTS

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Pest eradication and containment in broad-scale mainland areas are logistically and financially challenging because the entire area usually cannot be treated in one attempt. Eradication and containment are conceptually similar because their ultimate objective is confirmation of complete pest absence in a specified area. In eradication, individuals are removed from subset areas until the entire area can be declared eradicated with a one-time and final decision. Similarly with containment, individuals are removed from localised areas and the broad-scale area is assessed for successful containment. Two critical questions are the same for both management objectives: have we successfully removed all individuals from a subset area, and ultimately has that been achieved over the entire broad-scale area? I describe a 2-stage decision process to identify cost-optimal surveillance strategies for assessing progress and declaring success. Stage I coincides with or follows population control in a subset area or management zone (MZ). A probability of freedom for a MZ is quantified to inform an operational decision about success and the reallocation of resources to other MZs. Importantly, freedom declared in all MZs individually does not necessarily mean a high probability of success over the broad-scale area, because each MZ will have its own probability of being erroneously declared free. Stage II surveillance aims to detect MZ-level failures and to quantify an overall probability of eradication/containment by estimating broad-scale surveillance sensitivity. I demonstrate these processes for the example of the proposed eradication of predators from New Zealand. I assess the following: (1) the balance between local surveillance intensity and spatial coverage; (2) the number of years to declare success; and (3) the optimal strategy given variation in the starting-over cost, should a MZ be erroneously declared free.

PRINCIPLES OF APPLIED ECOLOGY: A TRANSFORMATIVE IDEA FOR VERTEBRATE PEST MANAGEMENT?

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Robust knowledge in science is often expressed as 'principles' describing useful and unifying general patterns and processes. We propose a set of 22 *prescriptive principles* defined as general guidelines for research and management, plus 3 *empirical principles* defined as broad, testable, generalisations based on replicated observations and experiments. These principles are applicable to a broad range of conservation, pest and sustainable harvest issues. Particularly important is one empirical principle, the effort-outcomes principle, which states that there is a cause and effect relationship between the desired outcomes of management and the effort applied (the inputs), but with diminishing returns. A question addressed by this relationship is: *how much management effort is enough to achieve a desired outcome?* We evaluate the relationship, present an explicit conceptual framework that connects management efforts, ecological intermediate steps, and outcomes, and provide some empirical examples. We show that the relationship, under a variety of names, has been described three ways (stylised graphs, computer models, observations) and estimated empirically though only occasionally. We recommend a fourth way of estimating the relationship by using manipulative experiments to estimate the relationship's parameters. Explicit common principles and an empirically determinable relationship between effort and outcomes, have the potential to transform vertebrate pest management.

TRANSFORMING CONFLICT INTO COLLABORATION: NEW TOOLS FOR OLD PROBLEMS OF STAKEHOLDER ENGAGEMENT

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People are important in invasive species management. After years of focusing on the pest species we are now placing greater emphasis on how to engage with our stakeholders to achieve collaborative approaches to manage their impacts. However, working with communities on invasive species management is a unique space and requires a deeper understanding of a community over a long term than conventional community engagement techniques promote. This presentation will consider how a conservation conflict transformation (CCT) framework can assist land managers to generate collaborative approaches to invasive species problem.

Conservation Conflict Transformation (CCT) as described by Madden and McQuinn (2014) utilises principles developed from the peace building field. It provides an approach that allows natural resource management practitioners to identify, understand, prevent and reconcile conflict amongst stakeholders in order to create a space where all the players feel they are equally involved in the decision making process. In contrast to conventional community engagement, CCT advocates for long-term and sustained engagement in order to focus on building relationships and understanding the context of the issue at hand. CCT also recognises that the current dispute or material conflict being dealt with is often a manifestation of less visible and more complex social conflict between individuals or groups. Current community engagement practices rarely acknowledge these more complex social conflicts at play when working with communities. They do not create opportunities to transform or reconcile these conflicts, which is essential if stakeholders are to adopt change or participate in management programs to control invasive species.

In this presentation I explore the principles of CCT in relation to managing stakeholder conflict and use examples from current work in the field of wild dog management. I will explain how these principles can inform practitioners when working with community groups to deliver collaborative invasive species outcomes.

KANGAROOS AND CONSERVATION IN THE BUSH CAPITAL: IT'S NOT ROCKET SCIENCE

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Management of eastern grey kangaroos in Australia's 'bush capital' has been a controversial undertaking since conservation culling began in 2009. Estimating the number of kangaroos to remain in conservation areas, and hence the number to cull, has to date been based on pasture growth models coupled with vegetation type stratification to achieve site-specific target densities. Additional data relating to the relationships between kangaroo density, pasture off-take (grazing pressure), ground layer vegetation structure and measures of biodiversity have been collected across lowland grassy ecosystems in the ACT since 2012; and have been recently analysed to further inform kangaroo management for biodiversity outcomes. The results and implications from this research will be discussed.

MOVEMENTS OF EASTERN GREY KANGAROOS IN CANBERRA: IMPLICATIONS FOR MANAGEMENT AND CONTROL

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Urban wildlife is increasingly coming to the attention of wildlife managers because of unique challenges involved in their management. The eastern grey kangaroo (*Macropus giganteus*) (hereafter EGK) is a native herbivore tolerant of living within urban landscapes. In the Canberra area, high densities of EGKs are subject to control to protect nationally threatened grassland and woodland ecosystems. In addition, there are almost 14k motor vehicle collisions with EGKs across the region each year. How EGKs utilise space across both reserves and the urban matrix will determine the scale at which management actions will be the most effective—for example should control activities be conducted at the patch, reserve or connected reserve scale, or across the whole of the Canberra region?

To answer questions about urban home range and movements, we used GPS collars to help characterise and quantify EGK movements and habitat use. During the 2-year study, movement data was collected from 16 female and 19 male EGKs; with 292 to 14356 usable fixes collected for each individual EGK. Male home ranges were significantly larger than females, and day home ranges were larger than night home ranges. The influence of season and year on home range size was examined. There was an overall preference by EGKs for woodland, grassland and open forest habitats, however, while forests were preferred over areas of open urban space during the day, at night open areas of urban space were preferred over forested habitats. The distance between day and night centroids will be discussed.

This research aims to assist management agencies to make evidence-based decisions about future kangaroo management, including population control programs.

NATIVE PEST MANAGEMENT: KANGAROO OVER POPULATION

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Particularly in urban settings, people do not normally start to consider management options until they have felt the direct negative impacts of an interaction with an animal. Urban development encroaching on natural areas is exacerbating the pressure on wild populations of animals. In the case of kangaroos, aggression, vegetation damage or over population tend to trigger initial complaints. The human connection to animals, either native or introduced, within an urban setting are emotive and differ greatly to those in more rural populations. We tend to call it the 'Skippy factor'. People love the animals in their environment. In some situations, the overwhelming desire is protect every individual animal, with full consideration of conservation and sustainability impacts. Culling programs often generate protests and negative media attention for land holders even when they are simply attempting to alleviate pressures on their property.

To prevent these concerns, it is beneficial to implement a conservation management strategy, developed in consultation with key stakeholder groups including the land holder, neighbours, government regulators and interest groups. Over the years, Naturecall has been involved in numerous macropod conservation projects. Culling of small mobs or targeting a specific demographic within a larger population is often the most economically viable and arguably the most effective conservation management strategy. Some key stakeholder groups refute this proposition. It is responsible to explore all practicable management and conservation strategies and to implement a consultative management approach. Through this presentation, we aim to demonstrate the methods which we have utilised to manage urban and semi-rural kangaroo populations. We will highlight the successes and downfalls of each method.

TOWARDS A FERAL CAT MANAGEMENT STRATEGY FOR HATTAH-KULKYNE NATIONAL PARK: ESTIMATION OF CAT DENSITY, BAIT UPTAKE RATES AND COMPARISON OF MANAGEMENT STRATEGIES

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Feral cats are a significant predator of mammals, birds and reptiles and are identified as a major threat to endangered fauna. Currently there is no feral cat management strategy for Victoria.

The aim of this project was to provide information which could be used to develop effective strategies for the management of feral cats in Victoria at a future date. We assessed feral cat density, home range and non-toxic bait encounter and consumption rates at Hattah-Kulkyne NP, north-west Victoria in autumn 2015. Non-toxic baits were placed in front of camera traps and bait uptake rates were recorded. We combine this with predictions of home range size and movement models to assess various management scenarios to reduce cat populations. We also assessed feral cat body condition as a measure of food stress during the same period.

Estimated abundance of cats within the 331 km^2 study area was 91 with a corresponding density estimate of 0.27 cats/km^2. The estimated home range size was 7 km^2. The daily probability of detection was 0.040. One male and five female feral cats were captured from 1540 cage trapping nights. All cats were assessed to be in good or very good body condition.

For simulated aerial baiting strategies, high population reductions (> 75%) were achieved for bait densities of at least 30 baits/km when transects were no more than 1 km apart. Baiting densities of ≤ 10 baits/km always resulted in low-moderate population reductions (< 60%) regardless of the spacing between transects. Low population reductions also occurred when spacing between transects was 2 km or more. For ground baiting, high (>75%) population reduction was unlikely to be achieved, even at high bait densities (50 baits/km). At 50 baits/km when placed on the available road network, a ≥ 75% population reduction was only likely to be achieved 13% of the time (i.e. 13 out of 100 attempts).

DESTRUCTION OF DROUGHT REFUGE RABBIT WARRENS TO CONTROL RABBITS ON BULLOO DOWNS: FINISHING A 20-YEAR-LONG PROJECT

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Bulloo Downs, a large cattle station in south-west Queensland, was one of the first properties overrun by rabbits in Queensland. Even after the introduction of myxomatosis the rabbit population supported over 100 commercial rabbit hunters. The property was believed to have 25% of the Queensland rabbit population in the early 1990s and it was the only arid site where RHDV failed to reduce rabbit numbers within the first three years.

Destruction of 58000 rabbit warrens by ripping within one kilometre of permanent water between 2001 and 2004, coinciding with extreme drought, suppressed rabbit numbers by around 99% and the reduction in damage to cattle production and the environment has lasted now for over 11 years. However, rabbits were found to survive the drought near Jerridah Waterhole. This area had not been ripped thoroughly because Jerridah Waterhole is not a permanent supply of water. Rabbits did survive there and by 2006 even with below average rainfall they had increased in numbers and spread out to 10 kilometres from Jerridah Waterhole. Between 2012 and 2016 a total of 2069 warrens were ripped within 10 kilometres of Jerridah Waterhole completing efforts to destroy all warrens in rabbit drought refuge areas. However, before this work commenced rabbits had moved further than 10 kilometres from Jerridah Waterhole colonising about 1800 warrens. These clusters of active warrens could provide a large starting rabbit population for recovery if left unripped and a run of good seasons occurs.

There is no sign that warrens ripped in the period from 2001 to 2004 have been reopened. Ripped areas are virtually free of rabbits and rabbits should never again survive severe drought on Bulloo Downs in large numbers. Once all warrens within high density clusters are destroyed by ripping, rabbits should no longer be a problem on Bulloo Downs.

OPPORTUNITIES TO IMPROVE PEST SPECIES MAPPING THROUGH THE USE OF ULTRA-HIGH-DEFINITION AERIAL SURVEY TECHNIQUES

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European rabbits (*Oryctolagus cunniculus*) threaten 304 species of native plant and animal, along with sustainable agricultural and production activities. Current management practices recommend targeting the warren as the key in the rabbits' defence, however, searching for, locating and marking rabbit warrens prior to ripping is time consuming and prone to observer error. On the Hay Plains in south-west New South Wales we trialled the use of helicopter survey using 4K ultra-high definition video imagery as an alternate warren mapping method. We surveyed 122,000 ha and identified 3,445 warrens in 42 flight hours with a cost of $0.90/ha. In comparison, on-ground assessment of the same area was estimated to take 6.5 years with a cost of $950 000 or $7.80/ha. This aerial survey method allowed for the rapid production of area maps, at both the property and regional level, providing invaluable information to landholders and government departments and allowing a strategic, targeted and coordinated approach to rabbit management in the region. Additionally, this method can be applied to multiple species, simultaneously recording native and introduced vegetation distribution along with signs of target pest animals. These aerial surveys have demonstrated how innovation can enhance efficiency and expand on achievable outcomes, whilst meeting productive and environmental goals.

RABBITS DO LOVE THEIR VEG! RABBIT IMPACTS ON HORTICULTURE IN QUEENSLAND

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The rabbit-proof fence maintained by the Darling Downs and Moreton Rabbit Board has protected much of south-east Queensland from the impacts of rabbits. The horticultural industry in the Lockyer Valley region has benefitted greatly from this protection. In the last seven years, an incursion of rabbits has entered this horticultural region from the north, having come around the top of the rabbit-proof fence. Landholders have no experience in dealing with rabbit impacts and the level of the impacts is unknown. Currently rabbit numbers are relatively low and extensive warrens are yet to be established. Rabbits are inhabiting farm buildings and overgrown river banks and feeding on adjacent lawns and crops. The close proximity of farms and townships and the nature of habitat use by rabbits leads to challenges in managing this pest. Until the last couple of seasons, rabbits had been present without causing noticeable damage to crops. In the last two years however, landholders are seeing significant crop losses. The impact of rabbits to the horticulture industry is potentially very large, however the exact costs due to rabbits is unknown. We use a combination of pen trials, damage simulation trials and field trials to estimate the damage that rabbits could cause to a number of horticultural crops. We also measured the impact that different control techniques had on mitigating the crop losses.

HABITAT MODELLING OF PREDATORS IN TASMANIA INFERRED BY DNA-BASED DETECTION OF CARNIVORE SCATS

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Identifying species from non-invasive samples (e.g. faeces, scats) provides one way to survey for cryptic or rare introduced and native animals, without the need to capture animals. One constraint on the application of this approach to Australian mammal predators has been the lack of a genetic marker that can reliably detect DNA from all relevant species (cat, dog, fox, devil and quolls). To address this problem, we have developed a new DNA sequencing test that can distinguish among all species, and have applied it to predator scats of known-origin to test its ability to discriminate among all of the large mammalian predators in Australia, including cats, dogs and foxes as well as native species such as Tasmanian devils, eastern and spotted-tail quoll. We have subsequently applied the test to over 500 predator scats collected systematically from eastern Tasmania in the autumn of 2014 and use those samples to develop a presence map for each species and to model their distributions relative to landscape features. We aim to use these models to predict patterns of co-occurrence of some of the best represented predators in our samples, including feral cats and Tasmanian devils, and detect populations of concern that might require monitoring or management action into the future.

For the first time we can use a single DNA test to reliably discriminate among trace samples from all the large predators in Australia, including cats, dogs, and foxes as well as the previously difficult to distinguish eastern and spotted-tail quoll scats. Our approach provides a broadly applicable, cost effective and time-effective non-invasive tool for identifying trace samples left by mammalian predators in the Australian environment and provides the opportunity for the conduct of systematic presence/absence surveys across time and space without animal trapping.

DOES THE HYBRIDISATION OF TASMANIAN AND MAINLAND AUSTRALIAN BRUSHTAIL POSSUMS INHIBIT DISPERSAL IN NEW ZEALAND? IMPLICATIONS FOR MANAGEMENT

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The common brushtail possum (*Trichosurus vulpecula*) was introduced between 1837 and 1924 to New Zealand from mainland Australia and Tasmania for fur. This species is now one of New Zealand's most serious threats to biodiversity and is the main wildlife host of bovine tuberculosis. In New Zealand, there is wide acceptance of the single species status of *T. vulpecula* but differences (including coat colour and susceptibility to the poison sodium fluoroacetate) exist between the Tasmanian and mainland forms which are also considered to be different subspecies. It has generally been assumed that possums in New Zealand breed indiscriminately with respect to their Australian origin, but recent microsatellite DNA population level analyses at a site in Hawkes Bay, suggested that these two subspecies have formed a hybrid zone with the zone acting as a barrier to dispersal. The management implications here are high if contact zones do affect dispersal because there are more than 90 sites on the North Island of New Zealand alone that carry mixed populations of the two subspecies. Here, we use the mitochondrial DNA (mtDNA) marker cytochrome c oxidase 1 (COI) and high resolution genotype by sequencing (DArTseq) to uncover the nature of the hybridisation between Tasmanian and mainland Australian possums. Our preliminary data suggest that hybrid possums form a distinct and discrete hybrid swarm that has very little interaction with possums of non-hybrid origins. Our analyses provide the opportunity of rare insight into newly formed hybrid zones and their possible role the management of dispersal across landscapes.

MAINTAINING THE CAPABILITY PIPELINE: IA CRC BALANCED RESEARCHER PROGRAM

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Maintaining the education and training pipeline to ensure that the next generation of scientists are sufficiently trained and ready to enter the workforce to fill roles arising through the retirement or movement of experienced staff is a challenge facing most industries. It is accepted that without an adequate supply of scientists, the capacity of many industries to meet their core aims and goals will be diminished. It is also widely recognised that graduates now require more than just high quality academic based research capability to be both competitive in the employment marketplace and to be able to resolve the complex conservation management problems they will face in the workplace.

The Balanced Researcher Program was developed with the specific aim of producing exceptional multi-skilled industry-ready PhD graduates that have gained professional, strategic and vocational skills in research leadership and management, stakeholder and community engagement and have developed contacts, collaborations and networks beyond those gained during a traditional researched based doctoral program.

Fundamental to this program is the integration of industry knowledge and experience into the doctoral research process. Students have an at least one industry based supervisor and are required to complete at least 20 days of placement within an industry body to gain an understanding of the internal mechanisms that guide that industry. This placement also enables students to create networks and collaborations that may not be available during a traditional PhD project.

Students receive training in areas of leadership, management, business and entrepreneurial skills that complement and enhance their research training in their chosen field. The Balanced Researcher Program has not only increased completion rates well above the national average, it has allowed graduating students to better prepare for the industry workplace, develop networks before graduation and has encouraged a strong sense of belonging to a common community.

DUNG DISTRIBUTION: THE FIRST STEP FOR PILLIGA FERAL HORSE MANAGEMENT

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Feral horses derived from forestry snig horses persist in the Pilliga West State Conservation Area and Pilliga West National Park. The habitat appears unsuitable for horses due to a lack of open grassland but population size and trends are difficult to obtain due to lack of visibility in the closed forest. The impact these animals may be having on the Pilliga environment is unknown. In recent years on occasion feral horses have posed collision risks or have been hit by vehicles travelling local roads. In order to support informed decision making and future management of the feral horse population an understanding of population dynamics and distribution is essential. This paper describes a method of dung counts to obtain measures of horse activity, which can be used to direct management actions, and potentially be used to estimate the feral horse population size.

The 'Pilliga Forest' is approximately 500,000ha of relatively flat or gently undulating land dominated by closed forest consisting of white and black cypress, and a number of eucalyptus and casuarina species. Feral horse distribution was determined by surveying dung along existing roads and tracks in July 2016.

The survey showed that horses use a large proportion of the area surveyed but their activity was concentrated in one particular area. This concentration of horse activity corresponded to that determined during a previous survey conducted in 2012. This area perhaps provides the best food supply for horses in close proximity to drinking water. Fencing watering points to prevent horse access may be a suitable method to manage the distribution of horses to reduce any negative impact or risk. However, any management action must be carefully monitored to detect unexpected, undesirable consequences.

DENSITY-DEPENDENT EFFECTS OF RABBIT BROWSING ON AUSTRALIAN NATIVE VEGETATION

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European wild rabbits, *Oryctolagus cuniculus*, cause severe damage to Australian native vegetation but the problem is under-reported due to the very early age classes removed by rabbits and the lack of simple methods to estimate rabbit impact in native vegetation. We established simple quantitative sampling methods to detect differences in critical characteristics of vegetation communities affected by rabbits: size cohorts of perennial shrubs and trees, damage characteristics in juvenile shrubs and trees, and pasture composition. Recruitment and damage in key perennial shrubs and trees were recorded in belt transects and pasture cover was estimated from small quadrats. Herbivore density was estimated from dung pellet density. The prevalence of rabbit browse on juvenile plants increased with increases in rabbit density. Increase was more rapid in species previously considered to be palatable to rabbits and livestock than in moderately palatable or unpalatable species. Highly palatable species had severe juvenile damage and missing cohorts in 0.3-1m height classes and 5-20 mm basal diameter classes at densities of 0.5 rabbits ha^{1}. Native pasture cover declined at high rabbit density due to declining cover of widespread species and reduced occurrence of species with restricted distribution. High kangaroo density had no discernible negative effect on pasture composition. This methodology can be used to set target densities below which rabbits must be managed to maintain natural plant recruitment and ecosystem function in conservation reserves and pastoral grazing properties of southern Australia.

Poster 14

WHAT CAN CAMERA TRAPS AND HUNTER BAGS TELL US ABOUT THE GROWTH AND SPREAD OF DEER POPULATIONS?

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Wild deer populations and impacts are expanding in many parts of Australia. Two important constraints on our ability to suppress them are a limited range of effective control tools and a widely-applicable and practical means of estimating the effects of control on population dynamics and spatial dispersion. This poster provides an example of how harvest records and camera trap surveys can be combined to evaluate the level of support for hypotheses in which recreational hunting helps to slow the growth and spread of fallow deer (*Dama dama*) populations.

Poster 1

APPLYING A STANDARD BIOSECURITY RESPONSE TOOL TO HIGH-RISK VERTEBRATE INCURSIONS

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Standardised debriefing and evaluation, post a biosecurity incident, is critical to ensuring evolution in the effectiveness of biosecurity agencies. Incursions of invasive species, like other biosecurity incidents, should carry out debriefing and evaluation, post a biosecurity incident. This is critical to ensuring continuous improvement in the efficacy of prevention activities and incursion responses. An After Action Review (AAR) is a simple post incursion review that allows all team members involved with an incursion response to formally recognise what was undertaken, express successes and challenges, overcome issues identified and address conflicts in opinions and actions. AARs are commonly used in animal and plant disease incursions and come in a number of formats that seek responses to questions regarding the planning, implementation and continuous improvement aspects of an incursion.

This poster highlights the benefits in undertaking AARs post new incursions and is the format currently used by the Victorian High Risk Invasive Animals team. The poster also highlights how AARs have shaped future incursion response activities.

Poster 16

A STRATEGY FOR EFFECTIVELY MANAGING FERAL PIG IMPACTS IN AGRICULTURAL ENTERPRISES IN NORTHERN QUEENSLAND

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Feral pigs (*Sus scrofa*) are arguably one of Australia's most devastating introduced vertebrate pests. In addition to agricultural impacts variously estimated to be between $100 million and $10 million (Bengsen *et al.* 2014) per annum, feral pigs are also listed as a threatening process under the *Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act)*, predominantly due to predation and habitat degradation impacts. Feral pigs are ubiquitous in the Wet Tropics of northern Australia and, with an abundant source of suitable habitat including water, food and refuge, have implications as vectors of exotic disease. Agriculture forms a relatively small proportion of land area in this region, with the result that agricultural enterprises are under continual pressure from surrounding feral pig populations.

Despite this pressure, assessed feral pig impacts on cane production have steadily decreased from $1.2 million to $200,000 in the last decade (Di Bella, 2016). In this paper, we discuss the strategies utilised to achieve this reduction and present the results of a study that monitored the efficacy and non-target impacts of the applied control methods.

References

Bengsen, A.J., Gentle, M.N., Mitchell, J.L., Pearson, H.E. and Saunders, G.R. (2014) Impacts and management of wild pigs *Sus scrofa* in Australia. *Mammal Review*, **44:**135-147

Di Bella, L. (2016) *The Management And Impact Of Feral Pigs In The Herbert Sugarcane Growing Region of North Queensland.* Poster presentation at the Queensland Pest Animal Symposium, Townsville, Australia.

Poster 15

CREEPING CATS CAUGHT OUT! USING ULTRASONIC DETERRENTS TO KEEP CATS OUT OF URBAN BACKYARDS

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Stray or pet cats which roam urban neighbourhoods, experience a variety of welfare issues (e.g. car accidents, uncontrolled breeding), and are the source of nuisance behaviour for the general public (e.g. cat fights, property damage, wildlife predation). Despite legislation requiring pet cats be permanently restricted to owners' properties in Western Australia, municipal councils are frequently asked to provide solutions which end nuisance behaviour on private properties.

The efficacy of two models of ultrasonic deterrents were trialled at 18 properties across Perth, Western Australia. 1-2 deterrents were installed on properties for three consecutive two-week trial periods (device off, on and off), along with infra-red cameras which continually monitored cat activity. For each period, camera images were pooled, sorted into sampling periods and assigned to individual cats. Two measures of activity were calculated for each cat (number trap events and trap duration), $\log_{10}$-transformed and analysed using repeated-measures ANOVAs.

Across trial periods, 77 individual cats were detected at 17 of the 18 backyards. Fifty per cent of these were sexed using pelage, collar-colour and—for males—the presence of scrotums. Thirty-one per cent of sexed cats were female and 69% were male (61% sexually intact). Across cats and sites, ANOVAs detected two significant effects: 1) activity duration was related to sampling period—decreasing significantly when both models of deterrent were activated; and 2) sex determined the time spent in front of cameras—with males more active than females or unsexed cats.

Ultrasonic deterrents effectively reduced cat activity across the trial periods however, activity was not prevented altogether. Cat owners who choose not to desex their pets and keep them confined to their private residences are promoting nuisance behaviour. For members of the public wishing to prevent cats from accessing their property, ultrasonic deterrents are effective and affordable devices which may be an ideal first-line-of-defence.

Poster 7

DIRECTED EXPERIMENTAL EVOLUTION OF RABBIT HAEMORRHAGIC DISEASE VIRUS

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Rabbit haemorrhagic disease virus (RHDV) is a calicivirus with a case fatality rate of approximately 90% in susceptible adult rabbits (*Oryctolagus cuniculus*). The RHDV strain V-351 has been widely used as a biocontrol agent in Australia since its release in 1995. However, the effectiveness of this strain in the field is limited by widespread population immunity and developing genetic resistance. It would be highly desirable to have a pipeline for the ongoing generation of novel virus strains that can overcome these impediments to sustainably control rabbit populations into the future.

We aimed to develop an experimental pipeline for the generation of novel RHDV strains. RHDV was serially passaged in rabbits under immune pressure conferred by administration of an RHDV-specific monoclonal antibody (mab), with the intent to create an immune escape variant. The resulting variant virus had two amino acid substitutions within the outer surface domain of the capsid protein, the region that governs antigenicity and host-receptor interactions. High doses of antibody administered concurrently with infection were still neutralising, suggesting only partial, if any, immune escape. Importantly, the variant was still highly virulent, with animals succumbing to terminal disease on average 67 hours post-infection (SEM 6 hours).

The competitiveness of the variant compared to the parental strain was assessed by infecting rabbits with a mixture of both viruses, and monitoring the proportion of each virus over time. The variant outgrew the parental strain within 36 hours post-infection in all animals, with and without selection, indicating it had a clear fitness advantage. Mab administered at 18 hours post-infection was able to significantly inhibit the growth of the variant between 24-48 hours, from $k = 0.55$ to 0.16 per hour ($p = 0.005$), confirming that the variant was still susceptible to antibody-mediated growth inhibition.

Poster 2

THE IAP2 SPECTRUM OF PUBLIC PARTICIPATION: A USEFUL TOOL FOR COMMUNICATION AND ENGAGEMENT ACTIVITIES IN THE PEST ANIMAL WORLD

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Effective communication and engagement with stakeholders is an essential element of incursion planning, particularly surveillance. A range of 'off the shelf' engagement tools are available which assist in identifying and analysing stakeholders, clarifying the goals and objectives of engagement activities and choosing the most effective tools to utilise in order to meet objectives.

The International Association for Public Participation (IAP2) has developed the Public Participation Spectrum, which clearly and logically describes the various levels of stakeholder participation that can be achieved through the use of a range of engagement tools.

The High Risk Invasive Animal team, within DEDJTR, has successfully used this IAP2 Spectrum as a basis to produce detailed surveillance plans for several recent incursions. The level of stakeholder participation required is highly variable, and can range from a goal of 'informing' the public by providing balanced and objective information to assist them in understanding the issues and potential solutions, through to 'empowering' stakeholders to share responsibility and accountability for making final decisions on planning and implementation of pest animal projects.

Two examples of recent incursions of exotic animals in Victoria are used as case-studies to illustrate the usefulness of the IAP2 Spectrum in developing surveillance activities. The first is an incursion of Asian black-spined toad in the northern suburbs of Melbourne. The second example was a suspected incursion of Indian house crow in the South Melbourne area.

Poster 22

OPPORTUNITY FROM A MENACE: FERAL PIGS TO FERTILISER

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Between 2009 and 2013, not a single marine turtle hatchling reached the water's edge on the beaches of their southern Wik homelands in Cape York. During turtle nesting season, every egg is eaten or smashed by feral pigs residing in the dunes. Despite millions of dollars spent on large-scale pig culling on the Cape, nests of the olive ridley and flatback turtle continue to be wiped out year after year.

Resource Recovery Australia, CSIRO and Cape York Partnership in collaboration with Balkanu Cape York Development Corporation, Kalan Enterprises and Aak Puul Ngantam have recognised the current approaches to feral pig management on the Cape aren't working.

By concentrating large numbers of feral pigs and using a modern take on an ancient method for food preservation, the collaboration seeks to develop a financially sustainable social enterprise that commercialises feral animal management for the benefit of local people. The social enterprise will create jobs, effectively manage pigs and protect our valuable endangered species.

Through the sale of feral pig fertiliser, backyard gardeners and farmers across Australia will have the opportunity to directly contribute to Cape York's environmental conservation and improve socioeconomic outcomes for people living in remote locations.

Whilst the project is being developed, tested and refined in Cape York, the collaboration aspires to create a model that can be implemented in communities throughout Australia and beyond.

Poster 21

1000 PICTURES IS WORTH HOW MANY WORDS?

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For the last 6 years, the Feral Photos competition has run as a nation-wide competition attracting people to submit photos of feral animals and their impacts in the Australian landscape. The range of images submitted has been vast. The images have been used across multiple media types, by various organisations and will remain as a legacy of the Invasive Animals CRC. Photos prove to be a powerful tool in engagement, especially to those who don't see first-hand, the impacts of pest animals in Australia.

The Feral Photos competition has proved to be more than just a competition—it is a source of information, it increases awareness, it creates a sense of ownership, it provides reward to participants, it engages, it showcases management and it says a lot about the magnitude of the Australian pest animal problem we are facing.

Poster 17

AN INTEGRATED AND COORDINATED LANDSCAPE-SCALE APPROACH TO VERTEBRATE PEST CONTROL AND MONITORING

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The Western Port Biosphere Reserve (WPBR) recognises that an integrated and coordinated landscape-scale approach to vertebrate pest control and monitoring is the key to efficient and effective results that protect biodiversity and prevent re-invasion of pests.

In 2014, WPBR engaged Ecology Australia to develop a 'Predator Control Strategy for the Western Port Biosphere Reserve'. This strategy applies the principles of strategic and integrated control to achieve a sustained reduction in pest populations and consequently, their impacts.

The strategy supports the implementation of the WPBR Growing Connections Project, supported by the Australian Government. The project aims to protect and enhance biodiversity across the WPBR, covering an area of approximately 3,600km^2 south-east of Melbourne. The development of a broad-scale, coordinated vertebrate pest control program is an essential part of achieving these aims.

An outcome of the strategy is the establishment of the Western Port Pest Animal Group (WPPAG), which, facilitated by the WPBR, was formed by various government and non-government agencies and industries working on the control and monitoring of vertebrate pest animals in the WPBR. Initially, fox control and monitoring are the focus of the group. However, it is envisaged that this will broaden over time to include other vertebrate pest species.

The group facilitates the coordination of works implemented by the member organisations in terms of control methods, protocols, timing, monitoring, data collection and analysis. This will ensure programs are undertaken in a standardised manner and gaps in on-ground work will be identified.

To support WPPAG and amalgamate data, WPBR has developed a Global Navigation Satellite System (GNSS) field data collection form and an associated online Geographic Information System (GIS) environment that allows input from industries, government and non-government agencies and individuals. This poster describes the system and how it will improve coordination and integration of vertebrate pest control and monitoring.

Poster 11

EXPLORING NATURAL AND ENGINEERED GENE DRIVES FOR ERADICATIONS OF INVASIVE RODENT POPULATIONS

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Invasive rodents impact island biodiversity, food production, and human health in a substantial and negative manner. The effects of these ubiquitous pests of human habitats have been measured in numbers of extinctions on islands, post-harvest crop loss, and rodent-vectored or -mediated disease incidence. Widespread rodenticide application has been the most effective tool available for eradicating invasive rodents on islands. Due to expense, non-target species mortality, and complexities of deployment on inhabited islands, this tool is reaching the limit of functionality. The Genetic Biocontrol of Invasive Rodents partnership is collaboratively developing and evaluating technology using an interdisciplinary approach. The technology includes the production of multiple strains of *Mus musculus* with a modified form of the native T-allele or a CRISPR/Cas9 based gene drive carrying sex determining genes. Both systems have the potential to skew the sex ratio in offspring to approach 100% male, which could reproductively collapse an isolated population. The partnership aims to develop multiple gene drive systems for evaluation, using elevated biosafety standards. It will identify mouse mating behavior necessary for male success in competitive breeding situations and perform modeling to inform technical development of these systems. Structured risk assessments will be performed, understanding and respecting stakeholders' values, with early engagement of regulatory authorities, all of which will be overseen by an external ethics advisory committee.

Poster 20

WHO HAS THE DATA?

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The ubiquitous use of smart phones/devices/applications and the advancement of DIY geo-apps has resulted in a significant expansion in data repositories. Information management is 'mission critical', particularly for those working in community based natural resource management (NRM) sector (RGC 2010). Significant changes have taken place since the last comprehensive assessment (West, 2008). The aim of this research was to demonstrate systems to collect, share and analyse data in near real time, with minimal setup and infrastructure costs (incorporating legacy systems and the humble field notebook).

An initial meta-analysis was conducted to profile who, how and what data has/is being collected in relation to Australian vertebrate pests. The very nature of the new breed of DIY geo-apps (quick, nimble, agile and possibly transient) make a comprehensive compilation difficult to document and update. Early investigations identified the need to also consider how to effectively and efficiently pseudonymise and de-identify personal/private information when sharing data between agencies, organisations and individuals. Consideration also needs to be given to varying data collection methods, not only between states, and jurisdictions, but also the individual projects. Added to this complexity is the need for robust data sharing practices and policies between different systems and organisations. These complex components are essential considerations when it comes a system that collates information at all scales (from a site inspection, to the national scale).

As a proof of concept live, interactive dashboards were created and displayed in augmented reality. Combined with a smartphone (or embedded touchscreen) and an internet connection it is possible to get multiples systems 'talking' together, to tell the broader story.

References

RGC (2010). Knowledge and Information Framework for Queensland regional NRM bodies. Regional Groups Collective, Toowoomba.

West P (2008) 'Assessing Invasive Animals in Australia.' (National Land and Water Resources Audit and Invasive Animals CRC: Canberra, ACT, AU). http://www.feral.org.au/assessing-invasive-animals-in-australia-2008/.

Poster 28

INTERPRETING ENVIRONMENTAL DNA METABARCODING RESULTS TO INFER BIODIVERSITY

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Biodiversity assessments provide valuable information for conservation management but traditionally involve multiple survey methods to detect diverse taxa and can be challenging and costly to implement in remote locations. Environmental DNA (eDNA) surveys rely on detecting trace amounts of DNA organisms shed into their environment, allowing detection of a diverse range of species, while the simple sampling method is well suited to use in remote locations. Metabarcoding provides a powerful next-generation sequencing approach for multi-species detection from environmental samples, but the lack of physical evidence for species presence and multiple avenues contributing to false positive error means that eDNA detection of species warrants due caution. We present an error-checking workflow to identify likely sources of error where taxon presence may be incorrectly inferred and demonstrate steps to mitigate or remove them.

We conduct eDNA surveys to detect vertebrate biodiversity at waterholes in central Australia. We show how eDNA metabarcoding is able to detect a diverse range of known species, including fish, amphibians, mammals and birds, but also detects multiple rare or unexpected taxa. We subject these outputs to the error-checking workflow, exposing likely error leading to false identification of several taxa. We discuss how future analyses can reduce or remove this error. We believe the application of this error-checking workflow will benefit conservation management by exclude false positive detection results, while identifying likely true detection of unexpected taxa. This can then guide subsequent management action, allowing follow-up surveys to focus scarce resources in a species-specific, site-specific manner.

Poster 4

ASSESSING THE EFFECTS OF FERAL DEER MANAGEMENT ON ENDANGERED ALPINE PEATLANDS: THE ALPINE NATIONAL PARK DEER CONTROL TRIAL

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A significant expansion of deer populations has been observed in the Alpine National Park (ANP) over the past decade, particularly increasing signs of deer activity at higher elevations. This corresponds with observed increases in the impacts of deer on significant environmental assets including endangered Alpine Peatland communities.

While some impacts have been documented in reports, photographs and through recording ad-hoc field observations, they have not been formally investigated or quantified. To develop a greater understanding of the impacts of deer and determine the best methods of mitigating them, Parks Victoria is implementing a Deer Control Trial.

The aim of the trial is to investigate whether ground shooting can mitigate deer impacts on high value assets, in particular peatlands, in selected parts of the ANP. Deer abundance and density, and deer impacts on alpine peatlands will be monitored pre and post control to determine whether activities are having the desired effect. The efficiency of the control techniques used and the effectiveness of each will also be evaluated as the trial progresses and following completion.

Strategically controlling deer to achieve conservation outcomes has not been attempted before in the ANP. Little is known about what level of control is required to achieve conservation goals, and which control approaches are the most efficient and effective. The trial will be a discreet, short-term 'experimental' program not intended to provide ongoing deer control, but which will adopt a structured 'learning by doing' approach to facilitate an adaptive, evidence-based assessment of options for deer management in the ANP.

Poster 26

ENGAGING THE COMMUNITY TO HELP PROTECT OUR NATIVE FISH FROM AQUATIC PESTS SUCH AS REDFIN PERCH

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Redfin Perch (*Perca fluviatilis)* are an aggressive introduced predatory fish native to northern Europe. Redfin Perch were first introduced to Australia in 1860s as a desired angling species, and have since established populations throughout parts of Australia. The impacts of Redfin Perch that have been documented include that both small and large individuals are known to consume native Australian species (Lintermans, 2007). Redfin Perch can also spread Epizootic Haematopoietic Necrosis Virus (EHNV) that some native fish, including endangered Macquarie Perch, have been shown to be susceptible to under laboratory conditions (Langdon, 1989). The impacts of pest fish species can be exacerbated through various human interactions such as illegal stocking of this species in both public and private waterways of NSW and illegal use of live fish as bait. Fish escapees from farm dams is a likely vector for new incursions of pest fish.

NSW DPI is working to develop a social research project that will engage the community to inform and encourage behavioural changes to help minimise the impacts of Redfin Perch and other aquatic pests. The impacts of Redfin Perch and the objectives of the social research project will be discussed.

References

Langdon, J.S. 1989. Experimental transmission and pathogenicity of epizootic haematopoietic necrosis virus (EHNV) in redfin perch *Perca fluviatilis* L., and 11 other teleosts. *Journal of Fish Diseases* 12:295-310

Lintermans, M. 2007, *Fishes of the Murray-Darling Basin: An introductory guide*.

Poster 23

KANGAROO ISLAND FERAL CAT CONTROL TRIALS 2016-2018: GUIDING AN ISLAND ERADICATION

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Kangaroo Island has been nominated as one of five Australian Islands earmarked for feral cat eradication by the Federal Environment Department. Building on years of local cat research, and with a supportive island community, stringent domestic cat by-laws and a highly successful feral animal control history, the island has embarked on the first of three stages of this ambitious project.

A comprehensive assessment of all available cat control techniques is being undertaken during stage one of the project. Cat trapping trials, non-toxic bait trials, lure trials, detector dog trials and intensive grooming trap trials will furnish information on the most appropriate combination of control mechanisms to deploy in the next stage of the project, which aims to eradicate cats on the Dudley Peninsula.

The control trials are focused on the narrow Dudley Peninsula isthmus where the island will be divided in two by a cat proof fence combined with a cat grid (either virtual or physical) on the main road. The efficacy of the fence and grid will be tested by radio tracking cats on either side of the fence.

The impacts of cat removal on native fauna and introduced rodents will also occur by conducting surveys before, during and after eradication.

This presentation will explain what has already been achieved during the project, as well as explore what challenges are likely to be faced.

Poster 13

THE DETOX-TOAD: COMBINING CRISPR GENE EDITING AND CONDITIONED TASTE AVERSION, NEW HORIZONS FOR GENE TECHNOLOGY IN CANE TOAD CONTROL

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The cane toad (*Rhinella marina*) is one of the best known and least loved of Australia's invasive pest animals. Conditioned Taste Aversion (CTA) has been recognised* as a valuable approach to mitigating the devastating impact of cane toads on predators as the invasion front encroaches on new territory. The convergence of new data from the Capon Lab on toxin biochemistry and genetics, together with the construction of a cane toad genome sequence by the White Lab and development of molecular genetics and gene editing to modify cane toads (Tizard Lab) have created a unique opportunity to bring new potential to the 'teacher toad' (CTA) strategy developed by the Shine Lab. This project aims to delete a key gene encoding an enzyme necessary to convert a mildly toxic precursor of the cane toad toxin to the lethal form that kills predators—the objective being to generate an adult toad that will not kill predators but that will teach them (by CTA) not to eat other toads, with fatal consequences. The project will use CRISPR/Cas9 gene editing to cause small mutations in the coding sequence both maternal and paternal copies of the key enzyme to knock-out its function and render the resulting toads non-lethal. These toads will still make the non-lethal precursor molecule and should therefore be valuable for the 'teacher toad' CTA approach. A variant gene construct will also be developed that could enable the 'Detox-Toad' to spread its non-lethal trait as a dominant heritable characteristic in local populations. If this is successful and deemed to be valuable a gene drive system, with broader ranging and more lasting beneficial impacts, could be considered.

* Prime Minister's Prize for Science 2016, awarded to Prof. Rick Shine for protecting Australian native predators from cane toad impacts, including teacher toads/CTA.

Poster 27

WILD DOG AWARE

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I am working on an innovation which uses art to communicate management issues to diverse audiences. Based on research and measurements of public perception of wild dog issues, the innovation focuses on the creation of new spaces where conversations about wild dogs can occur. It tests how art interventions can create cultural bumps to form spaces where people can have new conversations about wild dogs and issues surrounding their presence in the Australian landscape.

My study to date indicates that views on wild dogs are polarised between two extremes. One view would like every wild dog destroyed, the other end of the spectrum says that we shouldn't kill or harm animals. We are not targeting every dog, but management requires lethal control and to some segments of the community that is an unacceptable solution.

My art intervention aims to promote and encourage informed public conversations about wild dogs, especially in urban areas, and create awareness of impacts on livestock, people and wildlife. Art allows us reflect on the role culture and social mores play in the way we deal with environmental and biosecurity issues. These art opportunities can inform the public, address misconceptions, listen to personal opinions, support and inspire public participation. Art and media exposure will drive the conversations. Art offers a way to interpret and represent the world around us. It deals in the tangible, emotional, fantasy and reality and allows additional spaces to frame and reframe thoughts and opinions, facts and myths, conflict and resolve, which allows discussions to extend beyond black and white.

Working with a multidisciplinary team, *Wild dog aware* aims to help government and non-government bodies who manage wild dog issues, to better communicate with a diverse audience. This is complex process, which lends itself to systems thinking, adaptive management and complexity science approach.

Poster 29

DIETARY ANALYSIS OF FERAL PIGS FROM THE SOUTH-WEST OF WESTERN AUSTRALIA

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Feral pigs (*Sus scrofa*) cause significant habitat degradation and agricultural damage through grazing, ground rooting and predation. We identified the diet composition and frequency occurrence of food items consumed by feral pigs in environmentally sensitive areas in close proximity to agriculture in the southwest of Western Australia to quantify their impact. Dietary analysis was conducted on the contents of n=17 feral pig stomachs collected in late spring, summer, and autumn as part of a coordinated control program. Pigs were weighed, measured, sexed, and aged prior to their stomachs being removed. Stomach contents were processed using sieves and sorting trays to obtain a semi-quantitative record of food volumes; plant and animal items were identified to the lowest taxonomic level. Animal material was identified using taxonomic keys, reference material, and hair identification software. Plant material was examined microscopically and compared with reference material from the collection sites. Feral pigs were largely herbivorous, consuming both above and below ground plant matter, which made up >90% on average of stomach volume. Fibrous root material was present in all stomachs examined, indicating that feral pigs consistently forage beneath the soil surface a behaviour that is supported by the presence of forest toadlet (*Metacrinia nichollsi*) and lowlands earless skink (*Hemiergis peronii*) which are both fossorial species. Fruit (especially *Macrozamia* spp. fruit) made up a large volumetric percentage of the total volume when consumed. Invertebrates such as centipedes and worms were commonly recorded. Vertebrate prey included frogs, reptiles, and mammals. Findings of this study provide important evidence of habitat degradation in a global biodiversity hotspot and economic losses to agricultural landowners. These data provide evidence required by conservation land managers and private landowners to warrant more effective feral pig management to reduce environmental and agricultural damage.

Poster 5

THE IMPACT OF RHDV2 ON RABBIT POPULATIONS ACROSS AUSTRALIA

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Rabbit haemorrhagic disease virus 2 (RHDV2) is a calicivirus that affects European rabbits (*Oryctolagus cuniculus*) and some hare (*Lepus*) species. It is genetically and antigenically distinct from RHDV1, which has been repeatedly released in Australia to control wild rabbit populations since 1995. Although both RHDV1 and RHDV2 cause hepatitis, multi-organ failure and death in a high proportion of susceptible rabbits, RHDV2, unlike RHDV1, is able to infect young rabbits that are normally resistant to RHDV1. RHDV2 is also able to overcome immunity to RHDV1 strains, although there is likely to be some level of cross-protection between the two viruses.

RHDV2 was detected in the ACT in May 2015 and by September 2016 had spread to NSW, Victoria, South Australia, Northern Territory, Tasmania and Western Australia. RHDV2 is currently the dominant rabbit calicivirus circulating in all states except Tasmania. While there are anecdotal reports from landholders suggesting declines in rabbit numbers after the arrival of RHDV2, this requires further investigation. The national RHDV rabbit monitoring program, established to monitor the impact of the release of the K5 strain of RHDV (scheduled for release in March 2017), provides a unique opportunity to assess the impact of this virus on a national scale. We report changes in rabbit abundance coinciding with RHDV2 spread using 18 intensively (quarterly) monitored rabbit populations across Australia, with the support of the Commonwealth through the Invasive Animals Cooperative Research Centre and CSIRO.

Poster 6

DETECTION OF RHDV2 IN EUROPEAN BROWN HARES (*LEPUS EUROPAEUS*) IN AUSTRALIA

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Australia is home to only two species of lagomorphs, the European rabbit (*Oryctolagus cuniculus*) and the European brown hare (*Lepus europaeus*), both introduced as game species in the mid-nineteenth century. The distribution of hares is limited to the south east of the continent, mostly sympatric with rabbits, while rabbit distribution extends over a much wider area covering approximately 70% of the continent. Despite its use in Australia since 1995 to control overabundant wild rabbits, spillover infections of Rabbit Haemorrhagic Disease virus (RHDV) have never been observed in hares. In May 2015, a new calicivirus (Rabbit Haemorrhagic Disease virus 2, or RHDV2) was reported in Australia. In contrast to RHDV, which is strictly species-specific and restricted to *O. cuniculus*, RHDV2 causes a fatal hepatitis in rabbits as well as certain hare species, including *L. europaeus*.

Between April and June, five European brown hares were found dead during recorded outbreaks of RHDV2 in sympatric rabbit populations in Victoria and South Australia. All five hares were intact, outwardly healthy looking animals with no signs of decomposition. All displayed extensor rigidity, a posture similar to that described for rabbits with terminal RHDV. Liver samples were analysed using specific RT-PCR and partial sequencing. All five hares tested positive for RHDV2.

These results represent the first detection of RHDV2 in European brown hares in Australia. It is unclear at this stage if the five cases described here represent rare spillover events, the frequency of which is currently unknown, or if RHDV2 is now effectively spreading in hares in Australia, creating an additional disease reservoir and potentially leading to a reduction in hare numbers. It is important to extend national RHDV monitoring efforts to include hares, to further elucidate any role that hares may play in the epidemiology of caliciviruses in Australia's introduced lagomorphs.

Poster 8

ORIGINS OF THE BENIGN RABBIT CALICIVIRUS IN AUSTRALIA

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Rabbit haemorrhagic disease virus (RHDV) is a highly virulent lagovirus affecting the European rabbit (*Oryctolagus cuniculus*), and has been used since 1995 to control rabbit populations in Australia. While the initial release of this virus vastly reduced rabbit numbers in arid zones, it was less efficient in the more temperate regions of the continent. One of the underlying causes of the lack of RHDV effectiveness in these areas is the presence of a closely related benign lagovirus, rabbit calicivirus Australia 1 (RCV-A1), which can provide partial and transient immunological cross-protection to RHDV infection. Given the potential influence of RCV-A1 on the spread and disease impact of RHDV, it is important to understand the evolutionary history of this virus. Herein, we aimed to examine the evolution of RCV-A1 and elucidate the origins of this virus in Australia.

The full genome of 1 New Zealand and 43 Australian RCV-A1 strains were sequenced using Illumina Miseq technology and evolutionary analysis was conducted. The RCV-A1 strains sampled for this study were found to share a common ancestor in the late 1970s or early 1980s. This suggests that RCV-A1 was bought into Australia in the late 20th century and not with the first rabbits in the mid-1800s as previously suggested. It is likely that RCV-A1 was bought into Australia in domestic rabbits as screening for these viruses would not have occurred. Alternatively, a population bottleneck due to a massive reduction of rabbit numbers from myxomatosis may have led to the extinction of deeper lineages and accordingly, we have only sampled descendants from the surviving lineage. Phylogenetic analysis of RCV-A1 and other lagoviruses showed that the New Zealand RCV-A1 and European recombinant RHDV2 both cluster within the RCV-A1 clade, suggesting recent transfer of RCV-A1 into Europe and New Zealand.

Poster 9

DETECTION OF A RECOMBINANT RHDVA ISOLATE IN AUSTRALIA

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Rabbit haemorrhagic disease virus (RHDV) is a highly virulent calicivirus affecting European rabbits (*Oryctolagus cuniculus*), resulting in death in >90% of susceptible animals. A Czech strain of RHDV (CAMP V351) has been used as a biocontrol agent in Australia since 1995, and over the last 20 years, circulating RHDV1 field strains have evolved from this original release virus.

In January 2014, an exotic RHDVa strain (an antigenic variant of RHDV), was detected in domestic rabbits in New South Wales (NSW). From January 2014 to May 2015, RHDVa caused nine confirmed outbreaks of RHD in domestic rabbits and was also detected in a wild rabbit population in the ACT. The full genome of at least one isolate from each RHDVa outbreak was sequenced using Illumina Miseq technology. The capsid gene of the exotic variant was found to be related to an RHDVa variant from China described in 2012. Recombination and phylogenetic analyses of entire genomes indicated that this variant is a recombinant with non-structural genes related to benign rabbit caliciviruses. The parental strain was not identified, and there is no evidence that the recombination event occurred in Australia.

In contrast to RHDV2 (the second exotic RHDV strain detected in Australia, reported in May 2015) this first exotic RHDVa variant spread more slowly and cases were more localised, with most outbreaks reported in domestic rabbits. Although infection was also confirmed in wild rabbits, RHDVa did not appear to replace circulating RHDV1 field strains during this time. Nevertheless, it is critical that surveillance efforts are continued, to better understand the spread and interactions of this RHDVa variant with other circulating strains, and to monitor any potential impacts it may have on the pending release of the RHDV K5 strain.

Poster 10

BIOLOGICAL CONTROL OF TILAPIA: A POTENTIAL VIRUS

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Originating in Africa, tilapia have been farmed in over 135 countries with global production estimated at 4.5 million MT and valued at US$7.5 billion. By contrast, tilapia are considered an invasive species in Australia. They are currently a major problem in north Queensland rivers, and now threaten to enter the headwaters of the Murray-Darling Basin (MDB); gaining access to the MDB would be catastrophic. Tilapia lake virus (TiLV) may offer a broad-scale effective control measure for tilapia in Australia. Safety and efficacy, two major concerns for a successful biocontrol virus, need to be taken into consideration before the use of any exotic biocontrol virus is considered. Species-specificity is an important determinant of safety of a potential biocontrol virus. Although TiLV has only been reported to cause disease and mortality in tilapines, testing the susceptibility of a range of non-target species would be critical before considering the use of TiLV in Australia. Testing the susceptibility of Mozambique (*Oreochromis mossambicus)* and spotted tilapia (*Tilapia mariae*), the two major invasive tilapia species in Australia, will provide insights into the efficacy of TiLV as a biocontrol of tilapia in Australia. Virulence and transmission play a pivotal role in the efficacy of a biocontrol virus. TiLV causes disease outbreaks in wild and commercial tilapia farms, dropping the annual yield of tilapia in Israel by as much as 85%. The disease is contagious and spread through a waterborne route, an important transmission pathway for a potential biocontrol virus of fish. Based on our extensive experience with CyHV-3 as a potential biocontrol virus for carp, we propose a systematic approach for the use of TiLV as a potential biocontrol agent for tilapia in Australia.

Poster 12

DIFFERENTIAL DIAGNOSTIC OF RABBIT CALICIVIRUSES CIRCULATING IN AUSTRALIA

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Rabbit haemorrhagic disease virus (RHDV1) has been used for over 20 years to control wild rabbit populations in Australia, and field strains derived from the originally released virus cause regular disease outbreaks in wild rabbits. Recently, incursions of two exotic rabbit caliciviruses have been reported: in December 2013 an antigenic variant RHDVa was reported in NSW, and in May 2015 a second exotic rabbit calicivirus, RHDV2, was first reported in the ACT, and has since been spreading in both domestic and wild rabbits. In addition, the release of another antigenic variant RHDVa (RHDV K5) is planned for Autumn 2017 to boost rabbit biocontrol in Australia. The development of fast, robust and cost-effective differential diagnostic methods is absolutely critical for epidemiological studies investigating the spread, interactions and impacts of the growing number of rabbit caliciviruses in the Australian environment.

For quick and reliable differential molecular diagnostic tools, a one-step multiplex PCR assay was developed that differentiates between all three types of virulent caliciviruses currently circulating in Australia, as well as RHDVa K5, in a single reaction, detecting as little as ten capsid gene copies of each strain. For quantitative estimatation of virus capsid gene copies in tissues, a universal quantitative reverse transcription PCR assay was developed.

Differential serological diagnostic is more difficult due to the high level of antigenic similarity between the viruses and the resulting inevitable degree of cross-reactivity. Serological assays to specifically detect K5 are being investigated, but are technically challenging and not available yet. However, by using a combination of highly specific competition ELISAs for RHDV1 and RHDV2, and a highly cross reactive IgG isotype ELISA, serological profiles can be generated that may be used to infer if a population had been exposed to RHDV1, RHDV2, or RHDVa-type viruses.

Poster 18

THREAT ABATEMENT POLICY FOR THE ENVIRONMENTAL IMPACTS OF RABBITS

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There is a new threat abatement plan for competition and land degradation by rabbits. This is a statutory document under the *Environment Protection and Biodiversity Conservation Act 1999* to provide a national framework for rabbit management, research and education. A series of actions and strategies to manage the impacts of rabbits is set out, as well as a suggested timeline and prioritisation for activities.

The policy goal of the plan is to minimise the impact of rabbit competition and land degradation on biodiversity in Australia and its territories by protecting affected threatened species and ecological communities, and preventing further species and ecological communities from becoming threatened. To achieve this goal, the plan has four main objectives of: strategically manage rabbits at the landscape scale and suppress rabbit populations to densities below threshold levels in identified priority areas; improve knowledge and understanding of the impact of rabbits and their interactions with other species and ecological processes; improve the effectiveness of rabbit control programs; and increase engagement of, and awareness by, the community of the environmental impacts of rabbits and the need for integrated control.

While the plan aims primarily to abate the threat to key environmental assets, it also recognises that rabbits have wider impacts, particularly on primary production, and management actions to abate the threats need to be integrated across a broader area.

A background document accompanies the threat abatement plan to provide a summary of the known environmental, economic and social impacts, community perceptions, control methods, regulation and strategic management of rabbits. This document is intended to provide stakeholders with a holistic overview of the threat and an understanding of where they or their management actions sit in an Australian context.

The threat abatement plan and background document are available at:
www.environment.gov.au/biodiversity/threatened/publications/tap/competition-and-land-degradation-rabbits.

Poster 19

THREAT ABATEMENT POLICY FOR THE ENVIRONMENTAL IMPACTS OF FERAL PIGS

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A new threat abatement plan for predation, habitat degradation, competition and disease transmission by feral pigs (*Sus scrofa*) was recently made. This is a statutory document under the *Environment Protection and Biodiversity Conservation Act 1999* to provide a national framework for feral pig management, research and education. A series of actions and strategies to manage the impacts of feral pigs is set out, as well as a suggested timeline and prioritisation for activities.

The policy goals of the plan are to prevent further species and ecological communities from becoming threatened or extinct due to predation, habitat degradation, competition and disease transmission by feral pigs, and to improve protection for EPBC Act listed species and ecological communities threatened by feral pigs. The strategic framework aims to manage feral pigs within policy, legislative and planning frameworks; reduce the spread of feral pigs to new areas; manage feral pigs based on the protection of values and assets; build capacity for management; raise awareness and motivation for people to act on feral pig problems; and monitor and evaluate management efforts.

While the plan aims primarily to abate the threat to key environmental assets, it also recognises that feral pigs have wider environmental impacts as well as social, cultural and economic impacts.

A background document accompanies the threat abatement plan to provide a summary of the known environmental impacts, community perceptions, control methods, regulation and management and economic impacts of feral pigs. This document is intended to provide stakeholders with a holistic overview of the threat and an understanding of where they or their management actions sit in an Australian context.

The threat abatement plan and background document are available at:
www.environment.gov.au/biodiversity/threatened/publications/tap/feral-pig.

Poster 24

LESSONS FROM EXPERIENCE: A MULTIDISCIPLINARY RESEARCH TEAM PURSUING MAXIMUM VALUE TO END-USERS IN THE SHORTEST POSSIBLE TIME

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Over five years the authors of this paper have been energetically involved in developing or identifying best practices for managing the human and institutional issues involved in the control of established invasive species. The work has been conducted within a clear framework of principles developed from evaluation of an earlier applied multidisciplinary research program, that were expected to ensure the maximum applied value in the shortest possible time. These, and their implementation, will be reported in this paper. It was anticipated based on prior experience that implementation would involve many management and many personal (and possibly emotional) challenges. This paper documents some of these, based on the reflections of the individual researchers. Finally, it was anticipated that this implementation would result in refinement of the base principles, and additional lessons that could underpin action research investigations of this type.

The paper derives from the reflections of the individual researchers, consolidated into a set of lessons from experience, leading to recommendations intended to assist researchers conducting future applied multi-disciplinary research, and ideas about ways to make the journey both more effective and more enjoyable for those involved.

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NOTES

AUTHOR INDEX

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K

L

M

N

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P

17th Australasian Vertebrate Pest Conference

Canberra, 1-4 May 2017

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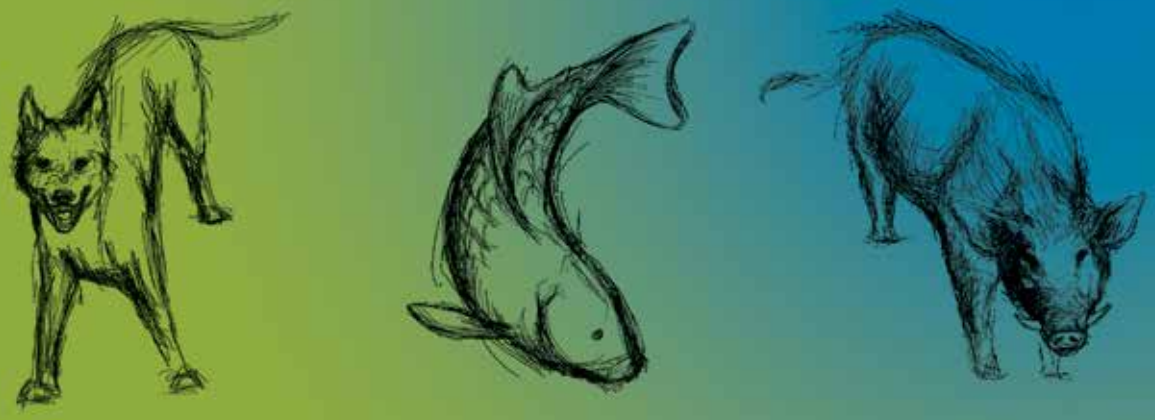

Australian Vertebrate Pest Conference

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17th Australasian Vertebrate Pest Conference
organised by

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