



CENTRE FOR
INVASIVE SPECIES SOLUTIONS

COLLABORATION

INNOVATION

IMPACT

2020-2021 ANNUAL REPORT





The Centre for Invasive Species Solutions gratefully acknowledges the financial contributions made by its members and partners in support of its activities.

Invasive Animals Limited governs and manages the Centre for Invasive Species Solutions.

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Designed by Yvette Cazabon.

Main image: Dr Alejandro Trujillo-González (University of Canberra) collecting dust samples from shipping containers using portable vacuum cleaners during operational testing trials to detect khapra beetle environmental DNA. Image by Juliana Holt. (See page 25 for our eDNA case study on Khapra beetles).

Small images (L-R): Egi Kardia, Postdoctoral Fellow with CSIRO, testing rabbit tissue samples in the lab in Canberra. Image by Yvette Cazabon. Greg Mifsud, National Wild Dog Management Coordinator, providing demonstration on best practice wild dog and fox management to the sheep farmers from the Less Predators More Lambs Producer demonstration site in Mansfield Victoria. Image supplied by Greg Mifsud.

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MESSAGE FROM THE CHAIR



There has never been a greater need for this company. Australia cannot afford to continue to have our primary industries, our environment, biodiversity, threatened species or our communities negatively impacted by invasive species, and yet we are going to be continually threatened by them as global trade, illegal imports, climate change and other challenges send them our way.

When I took on the role of Director and Chair of the board of Invasive Animals Ltd (IAL) and the Centre for Invasive Species Solutions (CISS) almost twelve months ago, I knew from experience the negative impacts invasive species have on Australia's economy, environment and communities. It was good to see this confirmed by independent analysis published in 2021. It was estimated that the cost of invasive species to Australia is huge, around \$24.5 billion every year.

The scale of this issue means we cannot rely on the systems and methods we've used in the past. We need to develop new systems and new methods to quickly identify invasive species. We need to develop better surveillance systems, treatments and management systems that empower Australians to eradicate or contain these pest species — that's why this company is so important.

Invasive Animals Ltd (IAL) and the Centre for Invasive Species Solutions (CISS) was purpose-built to bring together the best scientists, product developers and users from across Australia and the world to develop and deliver solutions, drive innovation, build efficiencies and plan for and deliver long term outcomes that address Australia's invasive species challenges.

Prior to joining the Board I had always been impressed with the work and the achievements of the company and its members and partners, and as we have prepared this annual report and the summary reports for our first five year RD&E portfolio (2017–2022), this has become even more evident to me. This company brings the best of the best together and supports them to achieve great things.

We intend to do the same in the future. To this end the company recently released a new Strategy on a Page for 2021–2027, our Invasives Species Solution 2030 Prospectus and Business Plan, and we are presently working closely with our members and partners on the next five-year RD&E portfolio. For those of you who are time poor, our Strategy on a Page summarises our vision, purpose, our strategic priorities and how we will achieve them.

The Company relies heavily on collaboration between our members, associate members and our partners so I'm pleased that we have increased the number of associate members this financial year. In addition to NRM Regions Australia, we were joined by Invasive Species Council, Wool Producers Australia and Rabbit Free Australia. Discussions with other possible members has also led to the Nature Foundation joining us in July 2021.

Thanks to everyone across the Company for all your efforts throughout the year. Despite it being a tough year once again with COVID, and large parts of our communities still dealing with the aftermath of disasters such as the fires, we have achieved so much.

A special thanks to Helen Cathles the Company's long serving Chair and Glen Saunders, who stepped down from the Board last year. The Company is a testament to their dedication and service.

Finally, my personal thanks to the Board, the Management team and staff, our Members, Associate Members and Partners for your support during my first year as your Board Chair.

A handwritten signature in dark ink, appearing to be 'Bruce Christie', written in a cursive style.

Bruce Christie

Chair

Invasive Animals Limited



Bruce Christie (Chair, Invasive Animals Limited) at the CISS Innovation Showcase, Parliament House, 10 February, 2021.

OUR MEMBERS AND PARTNERS

Full Members



Associate Members



Partners



OUR MEMBERS AND PARTNERS



CENTRE FOR INVASIVE SPECIES SOLUTIONS



CEO SNAPSHOT



As we steam into our fourth year, the costs and impacts of pests and weeds have been put into sharper relief and underscore the importance of the Centre's mission to deliver the new knowledge, tools, systems and strategies needed to give farmers and land managers a better edge in pest and weed management. Delivering on our mission will help position Australia to achieve, by 2030, the goals of building a \$100 billion a year agricultural sector, and stabilising and reversing the current extinction rate of over four native species per decade.

The importance of innovation pipelines: A key feature of the Centre is our role in enabling strategic, aligned, and sustained investment in large-scale collaborations that advance technology pipeline. Our rabbit biocontrol program is the most well-known. The 20-year pipeline strategy underpinning the program resulted in the first national rabbit biocontrol agent release in 20 years and continues to support the evaluation of biocontrol agents with future potential. The agent, released in 2017, was the culmination of eight years of R&D, and highlights that nearly all new management tools of significance result from years of R&D. Given that rabbits are Australia's most costly vertebrate pest, and also impact 322 national threatened species, there is a lot at stake.

The Centre has also led the nation in the field of genetic surveillance for over a decade. From an initial focus on vertebrate pests, this collaborative work led by the University of Canberra has now extended to breakthrough, real-time, in-field environmental DNA detection methods that detect major biosecurity risks such as Khapra Beetle.

Looking to the future, the Centre is also developing a strategic R&D roadmap to realise the potential of genetic biocontrol technologies that aim to transform vertebrate pest management in Australia. A decision framework, developed through a CSIRO-led collaboration is in its final stages, supported by two initial proof of concept projects to demonstrate the technology's for a pest fish and a mammal vertebrate.

Accelerating adoption of best practice management. The Centre has continued to consolidate and extend our national coordination approach, with the appointment of our new National Feral Cat and Fox Coordinator, the further development of our FeralScan and nascent WeedScan community monitoring and management systems, and the ongoing refinement and promotion of our PestSmart and WeedsAustralia best practice management web portals.

Working to convert research into innovation, and innovation into best practice, are the researchers and coordinators of our 22 member and partner organisations, supported by more than 60 other research organisations. We have featured some of them in this report, but all of them — and the Centre's management team — should be commended for their work in bringing better, smarter, quicker, cheaper innovations into being.

Thought leadership. This Annual Report also highlights the important role of the Centre in providing forums to share knowledge and innovations. For the first time, and in partnership with Agriculture Victoria, the 18th Australasian Vertebrate Pest Conference was held virtually attracting over 400 delegates. The Centre also cooperated with Animal Health Australia, Plant Health Australia and the Invasive Species Council to stage our Australian Biosecurity Workshop and held two innovation showcases at Parliament House Canberra and Adelaide's Prospect Town Hall.

Lastly, I would like to thank Dr Ian McDonald, our recently departed long-standing Communications Manager for his tireless effort in leading our communications.

A handwritten signature in black ink, appearing to read 'A. Glanznig', written in a cursive style.

Andreas Glanznig

Chief Executive Officer

Centre for Invasive Species Solutions

Image by Stefan Daniljchenko from Photographer at Large.



CENTRE FOR
INVASIVE SPECIES SOLUTIONS

4 YEARS OF RESEARCH,
DEVELOPMENT AND
COMMUNITY ENGAGEMENT

THE 20/21 SNAPSHOT

The problem

Invasive species decrease agricultural productivity

- The cost and damage from vertebrate animals is about \$600 million/year¹
- The cost and damage from weeds is about \$5 billion/year²

Invasive species are the #1 pressure on Australia's threatened species.³

- Have high or medium impact on 42% of nationally listed threatened species⁴

The solution

The Centre for Invasive Species Solutions is a national collaborative research, development and engagement organisation, formed to tackle the ongoing threat from invasive species through achieving adoption of new innovation and transformational technologies.



member and partner organisations:

9 governments

1 CSIRO

5 universities

62 institutions

involved as third parties to our research

2 research and development corporations

5 industry, NRM and conservation NGOs

RESEARCH

48 PROJECTS



2 Projects completed



48 Projects are underway

125 PROJECT MILESTONES

115 Achieved

10 Advanced progress

29 PUBLICATIONS PRODUCED

7 technical reports

22+ Scientific publications

DEVELOPMENT

PRODUCTS IN DEVELOPMENT

Passive acoustic surveillance detection kit prototype for Starlings

Feral deer specific aggregator

2 web scrapers to monitor e-commerce sites



Computer vision ID app and WeedScan management platform

New real time eDNA techniques (Red-eared slider turtle, Asian black spined toad, Kaphra beetle, Myrtle rust and invasive ants)

1 'Proof of absence' eradication tool software package

1 Audio lure trap for Asian Black Spined Toads

1 Line of genetically modified Zebra Fish

1 Artificial Intelligence trained thermal imaging analysis for feral pigs and deer

2 AVPMA REGISTRATION PACKAGES IN DEVELOPMENT

GonaCon™ fertility control vaccine for kangaroos and wallabies (urban use)

RHDV2 rabbit biocontrol agent

EXTENSION

FACE TO FACE

264 Stakeholder workshops conducted



27 Conference papers presented

1 Certificate III Course in Pest animal management - redeveloped

DIGITAL

PestSmart
FeralScan
WeedsAustralia
CommunityInvasivesAction

4 National digital platforms in use

255,019 PestSmart website views

23,400+ FeralScan Users

258,000 FeralScan records

299,291 WeedsAustralia page views

Community adoption

550 pest management groups

Strategic pest management outcomes enhanced by the data collection undertaken by 550 pest management groups using FeralScan, and by connecting these groups with government land managers.



3 national pest animal coordinator positions



The Wild Dog, Feral Deer, and new Feral Cat and Fox National Coordinators are hosted by the Centre, with a National Feral Pig Coordinator hosted by Australian Pork Limited.



465 rabbit tissue samples analysed through the National Rabbit Biocontrol Monitoring Program from samples collected by the community and land managers

1 McLeod, R. (2016). Cost of Pest Animals in NSW and Australia, 2013-14. eSYS Development Pty Ltd. Report prepared for the NSW Natural Resources Commission.

2 McLeod, R. (2018). Annual Costs of Weeds in Australia. eSYS Development Pty Ltd. Published by the Centre for Invasive Species Solutions, Canberra, Australia.

3 Keamney, S. G., Canwardine, J., Reside, A. E., Fisher, D. O., Maron, M., Doherty, T. S., ... & Wintle, B. A. (2019). The threats to Australia's imperilled species and implications for a national conservation response. *Pacific Conservation Biology*, 25(3), 328-328.

4 Ward M, Canwardine J, Yong C, Watson JE, Silcock J, Taylor GS, et al. A national scale dataset for threats impacting Australia's imperilled flora and fauna. *Ecol Evol*. 2021.

* Within the 2020/21 financial year.

INVASIVE SPECIES SOLUTIONS (ISS) TRUST

Throughout the existence of the organisation (previously known by other names), the Centre for Invasive Species Solutions (CISS) has a proud history of collaboration. Typically, the partnerships have been with all levels of government, research based organisations (including universities) and membership-based associations. This meant that the concept of seeking partnerships with private individuals, foundations and businesses is a natural progression. As mentioned in the Chair’s Report in the 2019/20 Annual Report, the Board established the Invasive Species Solutions Trust and gained tax deductibility and were fortunate to enlist the support of Dr Glen Saunders AM as the Trust Founder and Her Excellency, Mrs Linda Hurley as the inaugural Patron.

Establishment Phase

Task	Timing
Trust established by Founder Dr Glen Saunders	September 2020
Patron appointed	September 2020
Public Fund and Trust Registered	December 2020
Tax deductibility confirmed	December 2020
Fund Management Committee established	December 2020
Strategic Fundraising Plan adopted	February 2021
Fundraising Manager commenced	April 2021

The Invasive Species Solutions Trust has now progressed to the implementation phase. It has been registered as a charity with the Australian Charity and Not-for-profit Commission (ACNC) and is now in the process of registering in all Australian states and territories to enable fundraising throughout Australia. We intend to launch the Invasive Species Solutions Trust in December 2021, this was delayed by the COVID19 pandemic.

The Trust will provide supporters with opportunities to partner with CISS on nominated projects, which are promoted from time to time, or to simply support the work of CISS. Trevor Capps (Fundraising Manager) would welcome contact from individuals or businesses who have a passion project that they would like to fund to decrease the impact of invasive species.

In the coming year, opportunities to support the work of the Centre for Invasive Species Solutions through the Trust will become more visible with the publication of projects needing your support, a crowdfunding campaign, and opportunities for sponsorship. We would also welcome discussions with people who want to create a lasting effect in protecting the Australian environment, its threatened species and/or our agriculture through leaving a gift in their will. If you would like to know more about how to do this or get the sample wording to take to your solicitor, please contact us or visit our website for more information.

We invite you to partner with us to deliver lasting improvements for our native species, our agricultural systems, and our natural environment.

For more information contact: **Trevor Capps** | Fundraising Manager

Phone | (02) 6201 5509 **Email** | trevor.capps@invasives.com.au



Trust Patron Her Excellency Mrs Linda Hurley



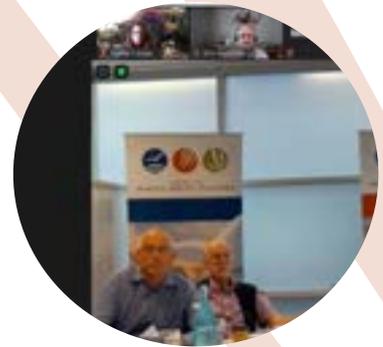
EVENTS

Australian Biosecurity Workshop — virtual 4-5 November 2020



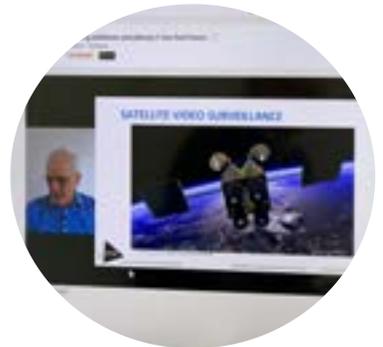
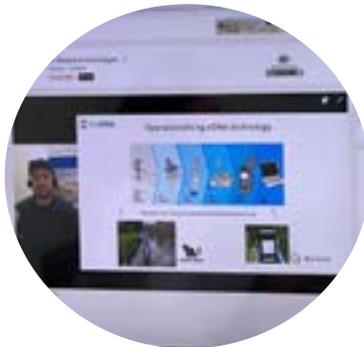
More than 250 people attended this virtual workshop to explore ways to transform Australia's biosecurity systems to better protect our economy, environment and way of life. The workshop was hosted by the Centre, Animal Health Australia, Invasive Species Council and Plant Health Australia.

CISS Forum 2020 — virtual 12-13 November 2020



Over 50 people attended the virtual forum which provided a snapshot of the Centre's achievements and gave opportunities for our members, partners and key stakeholders to provide strategic input into the Centre's strategic direction and activities into the future.

18th Australian Vertebrate Pest Conference — virtual 25-27 May, 2021



More than 400 people attended this virtual conference hosted by the Centre in partnership with Agriculture Victoria and opened by the Hon Mary-Thomas MP, the Victorian Minister for Agriculture and Regional Development. The conference theme, Feral Futures 2051, was explored through a series of keynote, panel discussions and parallel sessions involving more than 100 speakers.

CISS Innovation Showcase — Adelaide 8 June, 2021



Over 50 people attended the Centre's Innovation Showcase at Prospect Town Hall in Adelaide. The event showcased several local and national pest animal and weeds innovation programs and was attended by representatives from the Government of South Australia, several South Australian Landscape Boards, the University of Adelaide and several not-for-profit environmental organisations.

CISS Innovation Showcase — Parliament House, Canberra 10 February, 2021

Over 100 people attended the Centre’s Innovation Showcase held at Parliament House Canberra. The event was hosted by co-chairs for the Parliamentary Friends of Primary Producers — the Hon Nola Marino MP and the Hon Joel Fitzgibbon MP — and attended by Federal MPs, Senators, political advisers, and representatives from the agricultural, environmental and R&D sectors.

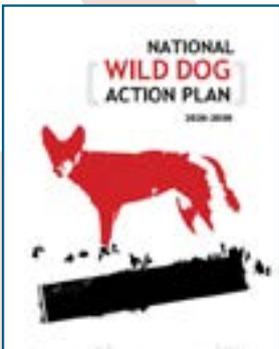




Image: Greg Mifsud, National Wild Dog Management Coordinator. Heather Channon, National Feral Pig Management Coordinator, and Annelise Wiebken, National Deer Management Coordinator, at the CISS Innovation Showcase, Parliament House, 10 February, 2021.

YEAR IN REVIEW

National Wild Dog Action Plan 2020–30 launched



Submission made to the **Federal Senate inquiry into The problem of feral and domestic cats in Australia**

Major upgrade to the PestSmart best practice management website completed

PAPPPutty, PAPP Putty, toxic PAPP based paste, applied to traps to quickly and humanely kill caught wild dogs, registered for use by the APVMA

Australian Government announces \$2.75 million in funding for six CISS Stage 2 vertebrate pest and weed innovation projects worth \$5.74m



Dr Annelise Wiebkin appointed as the Centre's new **National Deer Management Coordinator**

July 2020

August 2020

September 2020

October 2020

February 2021

March 2021

April 2021

May 2021

CISS Innovation Showcase hosted by the Parliamentary Friends of Primary Producers held at Australian Parliament House

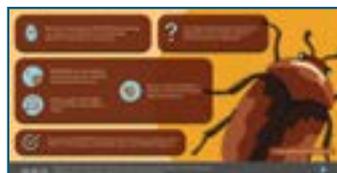
New **Feral Cat Glovebox Guide** launched by the Hon Sussan Ley MP, Minister for the Environment

Release of Centre's **Invasive Species Solutions 2030: Overview of Technology Opportunities** report

The **2021 Feral Photos and Video Competition**



Breakthrough **Environmental DNA technique** developed to quickly and accurately help detect the Khapra Beetle, a major cropping pest



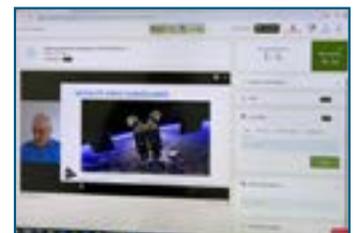
Invasive Grasses program commenced

NRM Regions Australia, Invasive Species Council, WoolProducers Australia, and Rabbit Free Australia join the Centre as Associate Members

Trevor Capps appointed as the Centre's new **Fundraising Manager**



The **18th Australasian Vertebrate Pest Conference — Feral Futures 2051**, hosted by the Centre in partnership with Agriculture Victoria. Attracted a virtual audience of more than 400 people



Centre IP provided to support emergency permit for double strength zinc phosphide baits

Virtual **Australian Biosecurity 2030 Workshop** attracted an audience of more than 250 delegates from Australia and New Zealand.

Virtual **CISS Forum 2020** attended by more than 50 participants

Release of CSIRO report **Australia's Biosecurity Future: Unlocking the next decade of resilience (2020-2030)** with the Centre, Animal Health Australia, and Plant Health Australia



FeralScan celebrates it's 10-year anniversary



New **HOGGONE** feral pig bait launched by Animal Control Technologies Australia after more than a decade of R&D. Developed through a former Invasive Animals CRC collaboration with USA and NZ scientists and support from MLA and AusIndustry

November 2020

December 2020

January 2021

June 2021

July 2021

August 2021

Australian Government commences consultation on the draft **National Environment and Community Biosecurity Research, Development and Extension Strategy, 2021-2026.**

National coordination provided through the Centre.

CISS Innovation Showcase held at Prospect Town Hall, South Australia attracted more the 50 people

Centre's Feral Futures: Overview of Technology Opportunities for Vertebrate Pest Management report released



National Feral Cat and Fox Coordinator, Gillian Basnett, appointed

OUR STRATEGY

Our Vision

An invasive species free Australia

Purpose

Together, create and deliver valued invasive species solutions for primary industries, the environment and communities

Our Values

As a service and member-oriented company, the Centre for Invasive Species Solutions (CISS) strives to be:

- a trusted authority for delivering effective, independent and science based solutions
- a catalyst for inspiring solutions through collaboration and thought leadership
- a promoter of ethical solutions that respect the welfare of all species
- audacious in pursuing new ideas to disrupt established thinking and identify solutions

Our Four Strategic Pillars

1. **Strategic collaborations** — Focusing on... partnerships and collaborations to leverage, lead and amplify outcomes
2. **Integrated solutions** — Focusing on... research, innovation and engagement (R,I&E) to advance large-scale coordination and breakthroughs
3. **Capability and adoption** — Focusing on... acceleration of best practice management adoption to build communities of impact
4. **Efficient and effective Centre** — Focusing on... internal governance and operations, financial management, effective communication and skilled staff

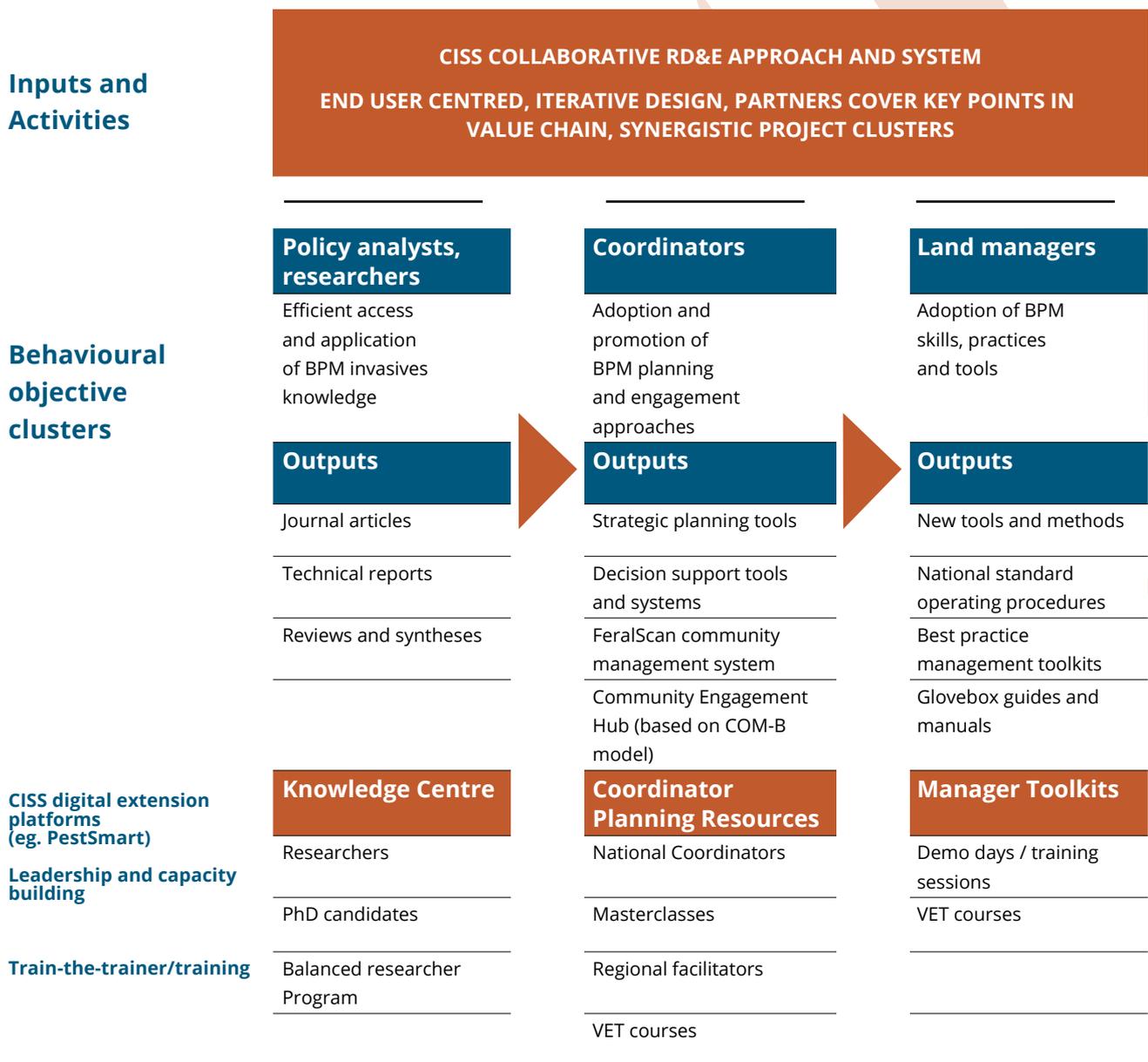
Our Innovation Domains

1. **Incursions**
2. **Integrated Landscape Management**
3. **Biocontrol**
4. **Community Engagement and Education**

THE CISS APPROACH

The CISS Research, Innovation and Engagement Model and System

The CISS research, innovation and engagement model has been developed and refined over the 12-year Invasive Animals CRC, and has been instrumental in the design of our programs. It aims to cover all key points in the value chain from need identification through to engagement and adoption via a managed distributed network of Member, partner and other organisations. A schematic representation of the generic CISS research, innovation and engagement model is below.



THE CISS APPROACH

OUR RESEARCH AND DEVELOPMENT

The Centre's R&D effort is focused on both prevention and early response to new and emerging invasive species, and strategic landscape scale management of established vertebrate and weed pests. Our 39 RD&E project portfolio addresses national biosecurity and invasive species RD&E priorities. The projects' outputs aim to strengthen strategic responses to vertebrate pests and weeds challenges in the following areas:

- Incursion prevention and response, through:
 - development of response tools and systems, and
 - development of detection tools;
- Integrated landscape management and empowering action, through
 - a coordinated feral deer program,
 - a coordinated wild dog program, and
 - other pest products and tools;
- Biocontrol technologies and systems, through
 - a rabbit biocontrol program, and
 - advancement of a nationally coordinated approach to gene drive technology

The research and development section is divided to highlight achievements against the three areas above, supplemented by achievements in cross sectoral capacity building and RD&E planning.

Collaboration

Collaboration is the key to developing and scaling solutions that arise from, and must be implemented in, complex operating environments. For this reason, around 85% of the Centre's Portfolio No.1 projects involve between two and ten collaborating organisations. Collaboration is an important part of ensuring research outputs translate into innovation, positive outcomes and impact by: i) designing solutions that take into account multiple perspectives, ii) building different pathways to adoption tailored to the different operating environments in which decisions are made, and iii) coordinating and clearly communicating about new solutions from the sources considered most credible to different stakeholders.

Working to and facilitating national priorities

All Centre RD&E projects are designed to address national biosecurity priorities, such as those agreed to by the National Biosecurity Committee (NBC) and its Environment and Invasives Committee (EIC). In some cases, however, documented priorities are dated, or new ones are yet to be agreed. In these cases, the Centre can play a role in facilitating and setting future priorities, such as through the preparation of a 10 Year National Investment Plan for Weeds RD&E, which involved considerable national consultation, and through assisting the Office of the Chief Environmental Biosecurity Officer prepare a National Environment and Community Biosecurity RD&E Strategy.

Monitoring, evaluation and reporting

Since early 2018 the Centre has had a Research Excellence and Impact Framework to guide its monitoring, evaluation, and impact assessment activities. The primary elements of the Framework implemented to date cover detailed monitoring of project progress against a range of inception to impact criteria, prospective impact assessments (e.g. for our rabbit and wild dog programs, and coordination of a mid-term review of overall Portfolio No.1 progress).

The projects outlined in this section use the following status bar to indicate which stage a project has reached:

Initial planning	Underway	Final stages	Complete
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The COVID challenge continues

Last year drought, bushfires, storms, hail damage and COVID-19 converged as the prevalent risks to our research teams throughout the country. This reporting year COVID-19, and in particular its Delta variant, continued the most significant Centre-wide risk.

The Centre is humbled and enormously proud to say that the feedback from our project teams is unchanged; that our projects have remained resilient and on track to deliver to specification by June 2022. Again, this is in large part due to the quick risk management responses of the Centre's members and partners, and the amazing effort of CISS researchers to quickly adapt to new research schedules, methods and routines.

The Centre applauds the efforts of our researchers, including those who also played important roles when seconded to the Australian Government's various COVID-19 response initiatives.



The Centre's international collaborations

Along with our numerous national collaborative RD&E programs, our Centre has engaged in a number of key international collaborations



The Centre is collaborating with SpayFirst USA to use its data to facilitate the registration of GonaCon™ for management of overabundant species

In collaboration with research labs in Italy, CSIRO is sourcing assays to test for the presence of RHDV2

In collaboration with researchers in the USDA, CISS is embarking on the first steps towards evaluation of a new toxin as a rodenticide in both Australia and the United States

CISS is an affiliate member of the Genetic Biocontrol of Invasive Rodents (GBIRD) Program an international partnership between CSIRO, NZ Landcare, US Department of Agriculture, University of Adelaide, North Carolina University, Texas A&M University and Island Conservation.



QDAF is working with IPB University in Indonesia to assess surveillance of Asian black-spined toads

In collaboration with research laboratories in India, CISS is testing the toxicity of a potential rodenticide

WA's DPIRD is working with Singapore National Parks which has provided suitable recording locations for Asian black-spined toads. The recordings will help test it's acoustic detection technology

The University of Canberra ecoDNA research team partnered with an international aquarium trade facility in Bangkok, Thailand to test their environmental DNA extraction methods for use in an Australian biosecurity context

The Arthur Rylah Institute is working with NZ Manaaki Whenua Landcare Research to co-develop proof-of-absence software tools for eradication management

INCURSIONS PREVENTION AND RESPONSE



CENTRE FOR SPECIES SOLUTIONS



imal and weed management
and strategies through
laborative research,
development and
extension

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Dr Alejandro Trujillo-González (University of Canberra) showing a sample as part of his work on the 'Real-time eDNA tools to improve early detection and response approaches for high risk pest animals' project, at the CISS Innovation Showcase, Parliament House, 10 February, 2021.

Incursions Prevention and Response

The challenge

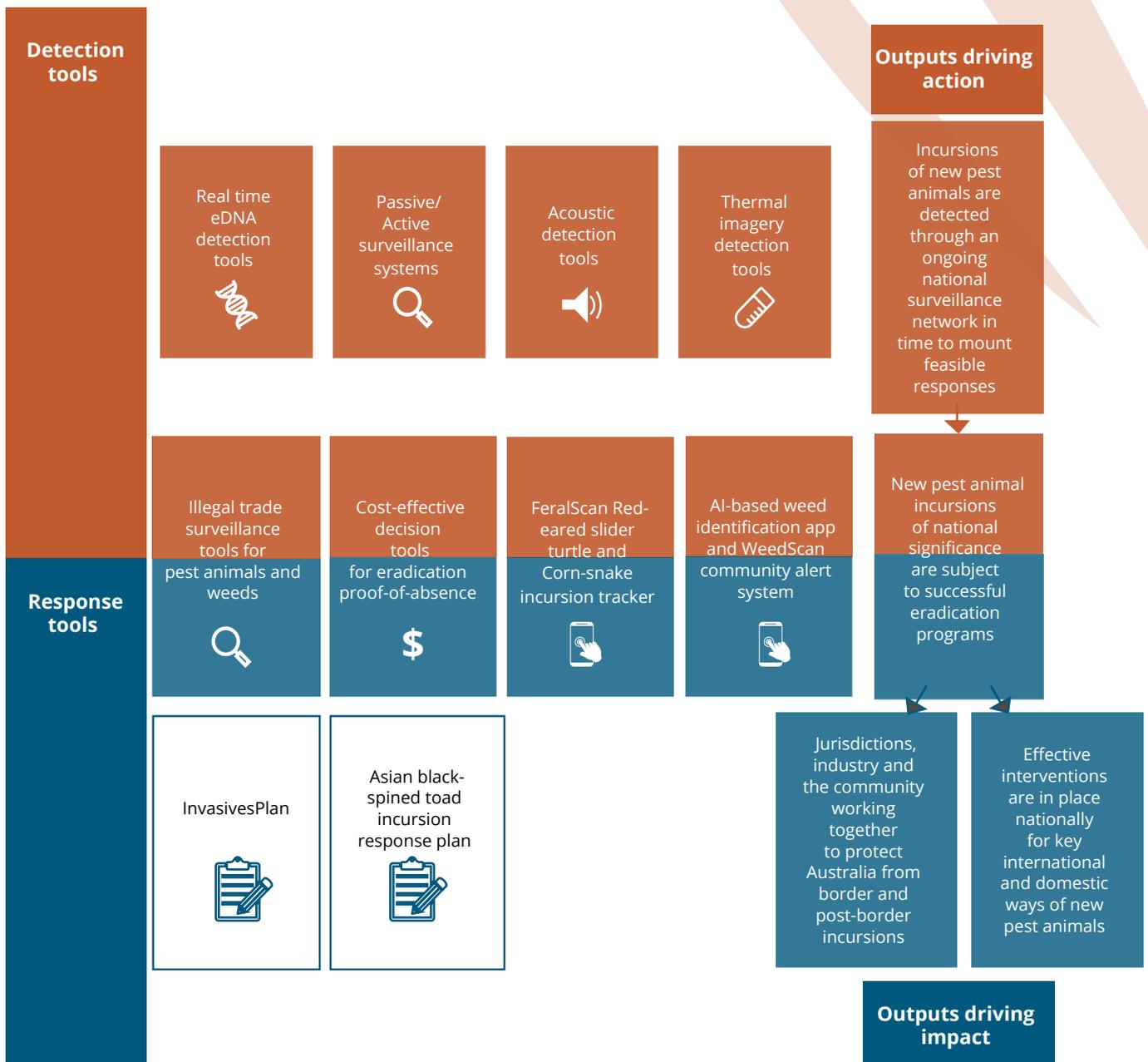
Global trade and illegal imports (including e-commerce) will rise markedly over the next decade causing a major increase in incursion risks. These risks are already significant, with 1,551 biosecurity incidents covering 138 vertebrate species between 2010-2015. The most commonly intercepted vertebrate hitch hiker is the Asian black-spined toad.

The incursion risk is further amplified by non-native plants and ornamental birds, reptiles and fish which are already in Australia, but are yet to naturalise in the Australian landscape: this includes over 5,900 non-native plant species already in Australia that have weed histories overseas. This large reservoir of potential future weeds is the driver for about 20 new weeds naturalising in the environment each year or 1 every 18 days.

The solution

Our incursions prevention and response investments aim to protect Australia's economy, environment and social amenity from the impacts of new pest animals and invasive plants through the following proposed outputs due to be delivered by 2022.

Expected Outputs



2020/21 progress highlights



1. Web based decision-making tool for cost effective pest management and proof of eradication tool in final development phases.



2. Automated monitoring of Australian e-commerce sites for alien wildlife and weed trade through the use of web scrapers is ongoing. Machine learning has been successfully trialed and utilized to automatically process the collected data.



3. Preparedness and capability assessments have begun planning to better respond to biosecurity threats to agriculture and waterways.



4. A library of Asian Black Spined Toad (ABST) calls has been collected for use as audio lures in toad traps.



5. Environmental DNA (eDNA) assays have been developed for detection of ABST, Red Eared Slider Turtles and Khapra Beetles.



6. Mock up field stations and prototypes of Passive Audio Surveillance kits for the detection of starlings have been deployed and are being refined.



7. Machine learning trained AI has been developed to identify list of priority of weeds for mobile app WeedScan.

Engagement with end-users

Several Incursions projects are at the stage where they will be seeking end-user feedback on the functionality and efficacy of their emerging tools. Online showcases with Commonwealth government representatives and other end user groups to garner feed-back and elicit interest in the project outputs have taken place. Many Incursions projects are currently planning end user workshops to allow hands on testing of their emerging tools from end-users. The ongoing COVID pandemic has impaired the ability to hold face-to-face engagement events, virtual workshops and training sessions are being held and continue to be planned in their stead.



A/Prof. Phill Cassey (University of Adelaide) presenting his work on 'Understanding and intervening in illegal trade' in non-native species at the CISS Innovation Showcase, Parliament House, 10 February, 2021.

Incursion Prevention and Response Achievements

Response Tools

Development of a national incursion management framework for invasive species

Initial planning	Underway	Final stages	Complete
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2020/2021 update

While this project has completed, the final draft of the National Vertebrate Incursion Prevention and Response Plan (InvasivesPlan) 2019–2024 is being progressed towards National Biosecurity Committee (NBC) endorsement. Its accompanying Framework and Compendium are being further developed under the NEBRA custodianship of the Chief Environmental Biosecurity Office.

Leader: Dr Malcolm Kennedy* and Dr Michelle Christy | Western Australian Department of Primary Industries and Regional Development

Partners: Western Australian Department of Primary Industries and Regions, South Australian Department of Primary Industries and Regions, Victorian Department of Economic Development, Jobs, Transport and Resources, Tasmanian Department of Primary Industries, Parks, Water and Environment, New South Wales Department of Primary Industries, Australian Government Department of Agriculture, Water and the Environment.

Aim: To understand roles and responsibilities with respect to the prevention and detection of invasive animal and plant incursions. It also aimed to improve recognition of what is required to increase the efficiency and effectiveness of responses to new animal and plant incursions of national significance.

* Dr Kennedy started a new role with QDAF in early 2020

Development of a national incursion response plan for Asian black-spined toads

Initial planning	Underway	Final stages	Complete
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2020/2021 update

As a complementary project to the preparation of InvasivesPlan, this project prepared a draft National Response Plan for the Asian black-spined toad (ABST) as an example of a hitchhiker invasive species. The plan outlined what is needed to respond to an ABST detection, and currently sits with the Office of the Chief Environmental Biosecurity Officer.

Leader: Dr Michelle Christy | Western Australian Department of Primary Industries and Regional Development

Partner: Western Australian Department of Primary Industries and Regions and Australian Government Department of Agriculture, Water and the Environment.

Aim: To develop a national incursion response plan for the Asian black-spined toad as a model for other invasive amphibian response plans.

Top image: American corn snake. Bottom image: Asian black-spined toad, Cloverdale. Image supplied by DPIRD WA.

Response Tools

Illegal trade surveillance tools for pests and weeds

Biosecurity surveillance of e-commerce and other online platforms for illegal trade in plants



Initial planning	Underway	Final stages	Complete
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2020/2021 progress

A national list of declared weeds in each jurisdiction has been consolidated, this list has been verified by relevant biosecurity policy officers in each state and territory. Currently the project is utilising web scrapers to monitor sixteen websites for listed weeds. Hundreds of detections have been made across Australia and over a hundred species of declared species have been found to be in trade.

Leader: Associate Professor Phill Cassey | University of Adelaide

Partners: University of Adelaide and Australian Government Department of Agriculture, Water and the Environment.

Aim: To ensure that effective interventions are in place nationally for monitoring key international and domestic online sources of illegal plants and e-commerce trade pathways.

Understanding and intervening in illegal trade in non-native species

Initial planning	Underway	Final stages	Complete
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2020/2021 progress

Web scrapers continue to be used across a broad range of internet marketplaces and automated data processing has been successfully trialed. The project is utilising machine learning tools to better process the wildlife trade data and has developed a database of the species involved in the illegal wildlife trade which will be used to guide searches on the internet for illegal wildlife trading.



Leader: Associate Professor Phill Cassey | University of Adelaide

Partners: University of Adelaide, CSIRO, Victorian Arthur Rylah Institute for Environmental Research, South Australian Department of Primary Industries and Regions, Australian Museum and Australian Government Department of Agriculture, Water and the Environment.

Aim: To develop a comprehensive understanding of the nature of exotic pet keeping and illegal vertebrate species trade in Australia, which will lead to preventing the incursion of new alien species.

Top image: Velvet Tree Pear (*Opuntia tomentosa*) on grazing land in Central Queensland. Image by Andrew Mitchell. RBottom image: Oliver Stringham (University of Adelaide) working on the 'Understanding and intervening in illegal trade in non-native species' project. Image supplied by A/Prof. Phill Cassey (University of Adelaide).

Response Tools

Tools for developing cost-effective decisions for managing invasive pest eradications

Initial planning	Underway	Final stages	Complete
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2020/2021 progress

Development of the web-based decision-making tool has entered a consolidation phase, remaining work has now moved into testing, refining and error trapping. Work has also been completed on developing new methods for quantifying the contribution of 'Judas' animals to eradication programs. The Proof-of-Eradication tool was trialed by the Queensland Department of Agriculture and Fisheries in their effort to eradicate fire ants, and the Hawkes Bay Regional Council, New Zealand in the eradication of brushtail possums.

Leader: Dr Dave Ramsey | Victorian Arthur Rylah Institute for Environmental Research

Partners: Victorian Arthur Rylah Institute for Environmental Research, CSIRO, University of Adelaide, Victorian Department of Economic Development, Jobs, Transport and Resources, Manaaki Whenua Landcare Research, New Zealand, and Australian Government Department of Agriculture, Water and the Environment.

Marine Pest Preparedness and Capability

Initial planning	Underway	Final stages	Complete
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2020/2021 update

This project has recently commenced and is currently in early planning.

Leader: Melissa Walker | NSW Department of Primary Industries

Partner: NSW Department of Primary Industries, Port Stephens Fisheries Centre.

Aim: To create a clear plan that increases the preparedness and capability to respond to marine pest risk to the NSW environment.

Freshwater Invasive Fish Preparedness and Capability

Initial planning	Underway	Final stages	Complete
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2020/2021 update

This project has recently commenced and is currently in early planning.

Leader: Melissa Walker | NSW Department of Primary Industries

Partner: NSW Department of Primary Industries, Port Stephens Fisheries Centre.

Aim: To produce a clear plan to manage the biosecurity risks posed by the ornamental fish industry and freshwater invasive fish species



Top image: Red imported fire ants. Biofouling Solutions (Creative Commons). Biofouling on a commercial vessel being assessed to identify any marine pest species. Middle image: Biofouling Solutions (Creative Commons). Biofouling on a commercial vessel being assessed to identify any marine pest species. Biofouling Solutions (Creative Commons). Biofouling, including marine pest species *Perna viridis* (Asian green mussel). Bottom image: A Platyfish investigation on the North Coast of NSW earlier this year. Images by NSWDPPI.



NSW Fisheries Officer Paul Blade doing some sampling for the 'Freshwater Invasive Fish Preparedness and Capability' project. Image by NSW DPI.

Detection Tools

Development of integrated passive and active surveillance tools and networks

Initial planning	Underway	Final stages	Complete
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2020/2021 progress

Progress: Collaboration with James Cook University and IBP University, Indonesia has resulted in a library of Asian Black-Spined Toad calls, an analysis of these calls to determine the audio characteristics of an “average” toad call to be used in the “Toadinator” Cane Toad trap. Results from citizen science data streams confirm a surveillance gap in areas considered at an elevated risk for incursion by known pests.

Leader: Dr Peter Caley | CSIRO

Partner: CSIRO, Western Australian Department of Primary Industries and Regional Development, University of Adelaide, Queensland Department of Agriculture and Fisheries, University of Canberra, Victorian Arthur Rylah Institute for Environmental Research and Australian Government Department of Agriculture, Water and the Environment.

Aim: To develop a coherent, complementary approach for combining community surveillance and targeted surveillance using passive (e.g. community sighting) and active sensing (e.g. eDNA) technologies to detect and manage pest incursions in a timely manner.



Top image: Citizen surveillance in action—bird watchers on the Birdsville Track. Image by Nick Gascoigne. Bottom image: Biosecurity Queensland researchers, who are working on the CISS funded project ‘Development of integrated passive and active surveillance tools and networks’ are working with volunteers in the Rocklea area of Brisbane to help monitor acoustic traps to detect any Asian black spined toad invasions. Image supplied by Steve Csurhes.

Case study: Detection of Khapra Beetle using environmental DNA

The infographic is set against a yellow background with a large illustration of a Khapra Beetle (*Trogoderma granarium* Everts) on the right. It contains several text boxes with icons:

- Top Left:** A beetle icon with an exclamation mark. Text: "Sensitive environmental DNA/RNA-based testing can improve the detection of invasive pest species of importance to biosecurity."
- Top Right:** A question mark icon. Text: "Can khapra beetle genetic material be detected in dust samples collected during biosecurity inspection?"
- Middle Left:** A vacuum cleaner icon. Text: "eDNA/RNA was successfully extracted from dust collected using handheld vacuums."
- Middle Right:** A hand icon. Text: "Proper sampling needed to prevent cross-contamination and false positives."
- Bottom Left:** A magnifying glass icon. Text: "Khapra beetle eDNA/RNA was detected using TaqMan assays."
- Bottom Center:** A checkmark icon. Text: "Environmental DNA/RNA testing of dust samples can aid biosecurity officers in identifying contaminated cargo for prioritised inspection."

At the bottom left, there are Creative Commons icons (CC, BY, NC) and a citation: "Detection of exotic khapra beetle environmental DNA using portable technologies in Australian biosecurity. Trujillo-González A, Thuo DN, Devi U, Sparks K, Wainman T & Gleason D. Journal of Economic Entomology - 2021". At the bottom right, there is a logo for "AIRMADE FOUR SCIENCE".

Ground breaking genetic surveillance technology has been developed to detect infestations of Khapra Beetle in imported shipping containers. Khapra Beetle is highly invasive and poses a major threat to seed and grain production that could cost the nation \$15.5 billion over 20 years. The beetles hitchhike in shipping containers and can survive for several years in dark, hard to reach and difficult to spot corners. Real-time PCR (Polymerase Chain Reaction) technology has been developed to detect the beetle's DNA and RNA enabling rapid screening of shipping containers for infestations. This Centre innovation is poised to reduce the time needed to verify samples from days to less than an hour.



Image: Dr Alejandro Trujillo-González (University of Canberra) collecting dust samples from shipping containers using portable vacuum cleaners during operational testing trials to detect khapra beetle environmental DNA.

Detection Tools

Real-time eDNA tools to improve early detection and response approaches for high risk pest animals

Initial planning	Underway	Final stages	Complete
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2020/2021 progress

Assays have been developed and validated for both Red Eared Slider Turtles and Asian Black Spined Toads, both National Priority Exotic Environmental Pests. In collaboration with Queensland DAF, the researchers determined that enhancing eDNA collection using haul-out pontoons greatly improves the detection rate of turtles and a pilot study was able to detect an early incursion into a location in Brisbane using this method.

Leaders: Associate Professor Dianne Gleeson and Dr Elise Furlan | University of Canberra

Partners: University of Canberra, New South Wales Department of Primary Industries, and Australian Government Department of Agriculture, Water and the Environment.

Aim: To develop an enhanced detection method for aquatic invasive species, both those that are identified as high-risk and those that could potentially pose a biosecurity risk, using real-time environmental DNA sampling techniques.



Biosecurity Molecular Screening

Initial planning	Underway	Final stages	Complete
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2020/2021 progress

Successfully developed and validated real-time PCR (polymerase chain reaction) assays for the detection of Khapra beetles. Field testing procedures will be refined to inform a longer-term rollout of technology in biosecurity operations. The project has been extended to the detection of Red Imported Fire Ants, Yellow Crazy Ants and myrtle rust.

Leaders: Associate Professor Dianne Gleeson and Dr Alejandro Trujillo-González | University of Canberra

Partners: University of Canberra, University of Sydney, Cawthron Institute and Australian Government Department of Agriculture, Water and the Environment.

Aim: To develop a real time eDNA protocol to quickly and easily detect biosecurity threats through the international ornamental fish trade.



Detection Tools

Automated detection: triggering smarter, faster, better responses to incursions

Initial planning	Underway	Final stages	Complete
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2020/2021 progress

Several aspects of a Passive Acoustic Surveillance prototype are in the process of being refined. The user interface is being updated based on end user feedback, a mock-up field station with preferred hardware is being constructed and a single machine learning algorithm is being trained on a prototype listening and detection system. A call library of Asian Black-Spined Toad field recordings is in the process of being collated so that the existing algorithm can be retrained for ABST detection.

Leader: Dr Susan Campbell | WA Department of Primary Industries and Regional Development

Partners: WA Department of Primary Industries and Regional Development, DKB Solutions and Specialised Zoological and Australian Government Department of Agriculture, Water and the Environment.

Aim: To demonstrate the benefits of using Passive Acoustic Surveillance (PAS) technology by deploying multiple units in key locations, building on the development of an automated remote detection system for starlings and Asian Black-Spined Toad in the CSIRO sister-project.

Development of an artificial intelligence-based weed identification App and reporting program

Initial planning	Underway	Final stages	Complete
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2020/2021 progress

A national list of priority weeds in consultation with States has been created and photographic assets to enable their identification using computer vision have been collected and organised. Preliminary computer vision models have been built and can identify most weeds with reasonable confidence. The weed reporting system and weed information systems are currently in development. In the coming year, emphasis will be on integration of these individual part to create a mobile app and supporting IT infrastructure to deliver the project's technical objectives.

Leader: Dr Hanwen Wu, NSW Department of Primary Industries

Partners: CSIRO, Atlas of Living Australia, NSW Department of Primary Industries, SA Dept of Primary Industries and Regions, VIC Department of Jobs, Precincts and Regions, VIC Department of Environment, Land, Water and Planning.

Aim: To develop, trial and implement Australia's first real-time, artificial intelligence-based, automated identification of national, state and regional priority weeds, alongside a fit for purpose community weed management, alert, reporting and communication system — WeedScan.

Top image: Starling. Image by Peter Tremain. Middle image: Alexander Schmidt-Lebuhn (CSIRO) talks about the 'Artificial intelligence-based weed identification App and reporting program' at the CISS Innovation Showcase, Parliament House, 10 February, 2021.

Detection Tools

Enhanced preparedness to diagnose 200+ priority pests and diseases of NSW and Australian Agriculture

Initial planning	Underway	Final stages	Complete
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2020/2021 progress

This project has recently commenced and is in the process of compiling a priority list of pests and diseases that threaten biosecurity, this list will be used at a later date to identify gaps in laboratory capability to diagnose and respond to these pests.

Leaders: Dr Brendon O'Rourke | NSW Department of Primary Industries

Partners: NSW Department of Primary Industries

Aim: To improve capability to screen and diagnose pests and diseases using a combination of targeted and multiplexed testing and to strengthen response and tracing capability by building analysis pipelines for whole genome sequencing.



Top image: Feral cat seen roaming the wilds just outside of Tennant Creek, being harassed by a Willie Wagtail. Image by: Simon Ferguson.
Bottom image: Alexander Schmidt-Lebuhn (CSIRO) talks about the 'Artificial intelligence-based weed identification App and reporting program' at the CISS Innovation Showcase, Parliament House, 10 February, 2021.

INTEGRATED LANDSCAPE MANAGEMENT AND EMPOWERING ACTION



The Murchison Regional Vermin Cell Fence, is one of four dog proof fences currently under construction in the Southern Rangelands of Western Australia. The fence encloses 52 pastoral properties and 9 Department of Biodiversity, Conservation and Attractions properties in an area larger than Tasmania. Image supplied by Tracey Kreplin (DPIRD WA).

Integrated Landscape Management and Empowering Action

The challenge

Feral deer

The six deer species established in Australia are expanding in abundance and range. While agricultural, environment and social impacts are increasing rapidly in many regions, there is currently little knowledge on the most cost-effective management strategies, and no best-practice guidelines for managing deer anywhere in Australia.

Wild dogs

Wild dogs are the single biggest threat holding back sheep production in Australia and are a major cause for the contraction of the rangeland sheep grazing industry. They also cause major impacts to other livestock industries and peri-urban communities. Large-scale cooperative management strategies are critical to reversing this trend.

Other pests

Foxes, cats, pigs, and other vertebrate pests continue to wreak environmental havoc and damage to agricultural assets across the country. In many cases these pests are experienced in tandem with each other as well as with deer and wild dogs. This reinforces the need for landscape scale solutions, as well as strategies that ensure the solution to managing one pest species does not create a void for other pest species to fill.

The solution

Our integrated landscape management program aims to see a reduction in the economic, environmental and social costs associated with invasive species through development and demonstration of large-scale integrated management strategies. The program has a specific target towards developing new and improved tools for wild dog and feral deer management and empowering communities to take collective action. Projects such as Prep-for-Reset also consider the challenge of managing multiple pest species. National coordination is an important element of our activities as a means of applying consistent and practices proven through both diverse and collective experience, and in galvanising the critical mass in community responses needed at the landscape scale. We have National Coordinators for wild dogs, feral deer, and most recently, feral cats and foxes.

Expected Outputs (Deer)

	Outputs driving action		
Understanding impact	Economic impact of deer in Australia	Role of deer in hosting exotic livestock disease	Quantification and evidence supporting a call-to-action for landscape scale management of deer
New tools	Feral deer aggregator	Drone automated thermal detection	Availability of tools fit for purpose specific to deer
Optimising management	Developing best management strategies for deer in rural environments	Developing management strategies for deer in peri-urban environments	New codes of practice and standard operating procedures for deer management
Community management	National Deer Management Coordinator	Wild DeerScan monitoring and reporting alerts	Best management practice guides and management toolkits
	Outputs driving impact		

2020/21 progress highlights



1. The cost effectiveness of aerial culling deer has been assessed and the outcomes are being published in a peer review journal. Once populations are reduced through aerial culling, ground shooting is likely to be able to keep deer populations to lower level. The welfare implications of aerial culling of deer have also been assessed and the techniques for the best welfare outcomes have been established.



2. Molecular testing of diseases found in both deer and domestic cattle show that there is little to no transmission between species.



3. Genetics testing of deer in the Illawarra region has shown that there are 4 genetically distinct population clusters which, while connected, can allow the definition of geographic management units to increase management effectiveness.



4. The feral deer aggregator continues to progress. Additional modifications have been made to further minimise potential non-target access to the feeders and these are currently being tested.

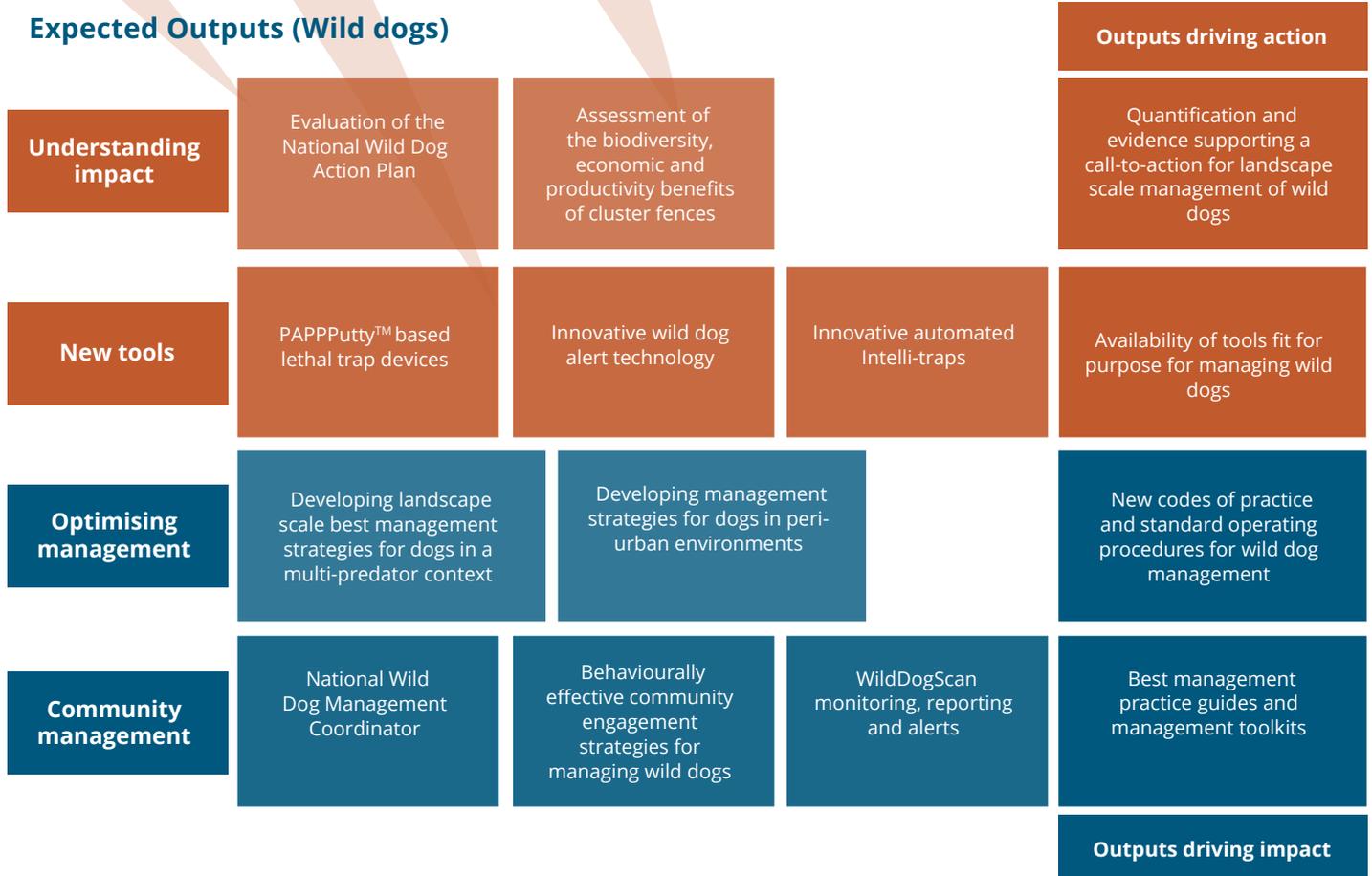


5. The draft National Feral Deer Action Plan has been written and will be available for public comment in October 2021. The National Deer Management Coordinator has been working actively with community groups and has been successful in raising awareness of the agricultural and environmental impacts of deer.

Engagement with end-users

A steering committee of end-users overseeing these projects is acting to provide practical feedback to the researchers and help extend the lessons and tools beyond the immediate sites of research activity. Community and stakeholder engagement continues to be important for monitoring deer in peri-urban environments, with additional monitoring sites identified through management effort and known impact areas from residents.

Expected Outputs (Wild dogs)



2020/21 progress highlights

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1. Data from camera trap and Canid Pest Ejector (CPE) trials shows that most wild dogs will encounter a CPE when deployed at current levels and little to no benefit would be obtained if that density was increased, however, wild dog — CPE interaction and activation rates could be increased through using different lures and attractants.
- 

2. The effectiveness of cluster fencing in WA is being assessed as fencing progresses towards completion in the Murchison Hub Cell. The smaller cluster fence is nearly completed and very few wild dogs are being detected inside the fence.
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3. Control programs have significantly reduced wild dogs within cluster fences in Qld with dog numbers remaining low. The benefits of reduced predation should be more rapid than those from reduced grazing pressure from native herbivores, however it is difficult to detect due to drought conditions.
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4. Data from the Australian Bureau of Statistics and remote sensing of vegetation both inside and outside of the Qld cluster fences is being analysed to give insight into changes in ground cover and can provide analysis of total grazing pressure by species.
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5. Prep4Reset continues to control invasive predators at multiple sites in NSW. Additional monitoring sites have been established, and negotiations are underway to establish research sites in Qld.
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6. The FeralScan community mapping program involves over 34,000 users and is supporting 550 community-based user groups. These record figures were no doubt helped by an incredible 82 training workshops held across the country, both face-to-face and virtually. The WildDogScan component reached nearly 130,000 records. Additionally, over 10,000 alerts were sent to biosecurity staff, landholders and pest management staff during the past year.
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7. The National Wild Dog Management Coordinator continues to play an important role in implementing the National Wild Dog Action Plan (NWDAP) 2020-2030 as well as expanding the ability of communities to effectively manage wild dogs. Despite COVID restrictions, there were 63 community and government-based training sessions on wild dog management.

Other tools and services

2020/2021 progress highlights

1. The efficacy and environment modules for the national registration of Eradicat® have been prepared and submitted to the APVMA for a technical assessment. Once the APVMA response is received, the full application for national registration of Eradicat® will be prepared and lodged.
2. The new Glovebox Guide for the management of feral cats was prepared and released to assist in the best practice management of feral cats.
3. Preparation of the APVMA registration package for GonaCon™ is ongoing.

Engagement with end-users

Invasive animal management in both rural and peri-urban areas relies on successful community engagement. Engagement through workshops allows community members to become informed of, and involved in the research being undertaken in their areas, e.g. helping to develop Community Led Plans for invasive animal management. Communication with key stakeholders and land managers such as NSW Local Land Services and wild dog coordinators ensures that consistent messages are being conveyed to landholders and the community.

Integrated Landscape Management Achievements

Feral Deer Program

Cost-effective management of wild deer



Initial planning	Underway	Final stages	Complete
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2020/2021 progress

A cost benefit analysis of aerial culling of deer was undertaken. Aerial culling is more effective than ground shooting with some deer population being reduced by 75–88%. Subsequent ground shooting was able to maintain deer abundance at a low level in some populations however in others there was a rapid recovery of abundance following the cessation of aerial culling. The welfare implications of aerial culling of deer were also examined in depth and best practice culling techniques to maximise welfare outcomes are being developed.

Leader: Dr Dave Forsyth | New South Wales Department of Primary Industries

Partners: New South Wales Department of Primary Industries, Queensland Department of Agriculture and Fisheries, University of Canberra, Tasmanian Land Conservancy, Charters Towers Regional Council (Qld) and Australian Government Department of Agriculture, Water and the Environment.

Aim: To investigate cost-effective methods for reducing the impacts of feral deer in Australia and to disseminate this knowledge widely to the deer management community.

The role of wild deer in the transmission of diseases of livestock

Initial planning	Underway	Final stages	Complete
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2020/2021 progress

The molecular analysis of diseases found in both domestic cattle and feral deer has revealed that there is little to no spread between the two species. The project team are analysing scat and camera trap data to determine if this lack of transmission between species is as a result of low contact rates.



Leader: Dr Carlo Pacioni | Victorian Arthur Rylah Institute for Environmental Research

Partners: Victorian Arthur Rylah Institute for Environmental Research, New South Wales Department of Primary Industries, Victorian Department of Economic Development, Jobs, Transport and Resources, La Trobe University and Australian Government Department of Agriculture, Water and the Environment.

Aim: To investigate the risk posed by deer to the livestock industry as hosts for exotic disease and to evaluate the effectiveness of possible mitigation strategies should an outbreak occur.



Top image: Volunteer shooter participating in sambar deer management operations in Alpine National Park, Victoria. Image by Parks Victoria. Middle image: Deer in Bass Coast, Victoria. Image by Antonietta Gentile. Bottom image: Dr Andrew Bengsen (NSW DPI) discussing findings from this project with attendees at the Deer Masterclass, Tamworth, 4 May 2021. Image by Sebastien Comte (NSW DPI).

Feral Deer Program

Feral deer aggregator

Initial planning	Underway	Final stages	Complete
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2020/2021 progress

Extensive field testing of the prototype deer aggregator has shown that there is still a potential for some species of non-target animals to access the feeder box. Modifications to the design have been undertaken and are now being field tested. This project has also been extended to June 2022.

Leader: Dr Brad Page | South Australian Department of Primary Industries and Regions

Partners: South Australian Department of Primary Industries and Regions, South Australian Department for Environment and Water and Department of Agriculture Water and the Environment.

Aim: To develop a deer aggregating device for testing in areas with high densities of native fauna (e.g. kangaroos, possums and feral deer). It builds on foundational R&D by the NSW Office of Environment and Heritage primarily aimed at goats.

National Deer Management Coordinator

Initial planning	Underway	Final stages	Complete
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2020/2021 progress

The project builds on the successful national coordination models deployed for wild dogs and pigs. Dr Annelise Wiebkin, National deer Management Coordinator, started on October 1, 2020. The draft National Deer Action Plan has been prepared and is currently being reviewed by the Environment and Invasives Committee prior to being released for public comment in October 2021.



Leader: Dr Annelise Wiebkin | South Australian Department of Primary Industries and Regions

Partners: South Australian Department of Primary Industries and Regions and Australian Government Department of Agriculture, Water and the Environment.

Aim: To support community-led deer control in all states and territories, compile national deer distribution data, current state and national laws, policies and practices, and facilitate the development of a National Action Plan for feral deer.



Top image: Red Deer feeding from deer aggregator. Image by Matt Korcz. Middle image: Feet component of deer aggregators being prepared for next part. Image by Matt Korcz. Second image: Dr Annelise Wiebkin, National Deer Management Coordinator presents the deer aggregator with Ted Rowley Jindabyne, NSW, beef farmer, at the CISS Innovation Showcase, Parliament House, 10 February, 2021. Bottom images: (L-R) Fallow deer on a game trail New England NSW. Image by Peter Bradford. Rusa deer, Forster, NSW. Image by Ashley Carlson.

Feral Deer and Wild Dog Program

Management of wild dogs and deer in peri-urban landscapes: strategies for safe communities



Initial planning	Underway	Final stages	Complete
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2020/2021 progress

Feral deer: Genetic analyses of deer populations in the Illawarra region have shown that there are four main populations. Three of these are linked while the fourth is separate. While there is some interchange between the three linked populations, the geographical definition of management units around these populations will enhance the effectiveness of management actions. The fourth population appears to be a distinct and separate release of deer compared with the other populations.

Wild dogs: Trials with Canid Pest Ejectors (CPE) and camera traps have demonstrated that most wild dogs will have the opportunity to encounter with a CPE when placed at the prescribed density (≤ 4 per linear km or ≤ 16 per 100 ha). While encounter rates for CPEs are high, the rate of interaction is lower indicating that new or improved lure heads may be needed to increase interaction rates between wild dogs and CPEs. Work is currently being undertaken to determine the longevity of PAPP in CPE capsules to ensure maximum efficacy in triggered CPE units.

Leader: Dr Matthew Gentle | Queensland Department of Agriculture and Fisheries

Partners: Queensland Department of Agriculture and Fisheries, New South Wales Department of Primary Industries, ACT Parks and Conservation, New South Wales Local Land Services, Griffith University, Sunshine Coast Council, Brisbane City Council and Australian Government Department of Agriculture, Water and the Environment.

Aim: To provide pest managers, through collaborations and community-led actions, with alternative strategies for managing wild dogs and deer in peri-urban areas of Australia.



Top image: WaterNSW Catchment Officers learning the faecal pellet count protocol for wild deer monitoring in the Illawarra region, NSW. Image by: Sebastien Comte (NSW DPI). Bottom image: Aerial shooting of chital deer in north Queensland, as part of the Cost-effective management of wild deer project. Image by J. Hampton.

Case study: Feral Deer Aggregator



In just 30 years, land managers in both rural and urban areas have seen feral deer go from being a novel intrusion in the landscape to become a widespread established pest animal across many regions of Australia. The costs associated with impact of deer are substantial, including on agriculture (in Tasmania alone deer are estimated to cost farmers up to \$80m per year)¹, biodiversity, public and private land (such as post fire control) and forestry.

Control tools for feral deer include excluding them with fences or culling by shooting from the ground or air. The efficiency of culling is limited, but can be increased through the use of thermal imaging equipment, traps and attractants. This is where the CISS Deer Aggregator project plays an important role. The project builds on foundational research and development by NSW Office of Environment and Heritage to manage goats by refining the feed structure suitable for attracting, concentrating and managing feral deer.

The Aggregator is currently being trialled on properties and National Parks across several States and will open new opportunities for improved pest deer management.

The National Feral Deer Coordinator plays an important role in bringing this tool to the attention of producers and other land managers across Australia in what is one of Australia's fastest growing pest problems.

Images (L-R, T-B) Deer Aggregators are easily disassembled for transport. Image by A/Prof. Ian McDonald (CISS). Deer Aggregator set up in large deer trap in Jindabyne, NSW. Image by Ted Rowley (MAIA, CPAg). Red deer visiting Deer Aggregator in South Australia's south east. Red deer visiting Deer Aggregator in South Australia's south east. Red deer visiting Deer Aggregator in South Australia's south east. Fallow deer visiting Deer Aggregator in peri-urban site in the Adelaide Hills. Fallow deer visiting Deer Aggregator in peri-urban site in the Adelaide Hills. Western Grey Kangaroo triggers the Deer Aggregator's feed hopper door to close, South east, SA. Base extensions and fencing installed to exclude Emus, pictured Sahra McFetridge (Invasive Species Unit, PIRSA) South east, SA. Base extensions and fencing installed to exclude Emus, South east, SA. Possum deterrents installed on Deer Aggregators, South east, SA. Field inspections of Deer Aggregators, pictured Jane McKenzie (Invasive Species Unit, PIRSA), South east, SA. Images by Matt Korcz.

¹ Donaghy, K. (2020) Transcript of evidence by Ms Kylie Donaghy, Tasmanian Farmers and Graziers Association, to the Senate Inquiry into the Impact of feral deer, pigs and goats in Australia, 14 October 2020.

Wild Dog Program

Assessment of the biodiversity, economic and productivity gains from exclusion fencing in Queensland

Initial planning	Underway	Final stages	Complete
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2020/2021 progress

The region has remained in drought over the past year and has done so since the projects inception. The low rates of rainfall are likely masking the impacts of the fence on vegetation both inside and outside the fenced cells. Wild dog activity within the fences remains low with no detectable activity in the Morven cluster since 2017 and similar in the Tambo cluster since April 2021. There has been no commensurate increase in detections of mesopredators inside the clusters following the decline of wild dog activity.

Leader: Dr Malcolm Kennedy | Queensland Department of Agriculture and Fisheries

Partners: Queensland Government Department of Agriculture and Fisheries, Queensland Government Department of Environment and Science, New South Wales Department of Primary Industries, Western Australia Department of Primary Industries and Regional Development, Meat and Livestock Australia and Central Queensland University and Australian Government Department of Agriculture, Water and the Environment.

Aim: To determine the cost-effectiveness of cluster fencing in the short and long term through the reduction in predation by wild dogs and reduced competition from kangaroos. This requires an assessment of the effectiveness of pest control by landholders, improvements in pasture production and, ultimately, improvements to livestock production, relative to unfenced areas. It will also assess biodiversity benefits through vegetation cover and increases in wildlife abundance and biodiversity.

Assessment of the biodiversity, economic and productivity gains from exclusion fencing in Western Australia

Initial planning	Underway	Final stages	Complete
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2020/2021 progress

COVID restrictions and wet weather have hindered the progress of this project however the project team is making good progress. Data collection within the cluster fence cells is continuing and is showing that even though the fences are not yet complete, the number of wild dogs being detected is declining. The lack of livestock in the cells (currently agisted away) has resulted in substantial understory and herbage regrowth due to the rain. Ongoing monitoring of the livestock, wild dog, and macropods within the Murchison Hub Cell is already showing some increase in productivity.



Leader: Dr Tracey Kreplins | Western Australian Department of Primary Industries and Regional Development

Partners: Western Australian Department of Primary Industries and Regional Development, Western Australian Department of Biodiversity, Conservation and Attractions, Murdoch University, Meat and Livestock Australia and Australian Government Department of Agriculture, Water and the Environment.

Aim: To understand the relationships between active predator management, cell-fencing and water availability on native herbivores, introduced herbivores and introduced predators. It will ultimately identify how changes in predator and herbivore density can be practically utilised by landholders to improve small stock production and native biodiversity.

Top image: Landholders take a tour of the cluster fences in Western QLD, as part of the National Wild Dog Action Plan stakeholder meeting. Image supplied by NWDAP. Bottom image: In this image Stuart Dawson (CISS post-doc) is setting up cameras and bait removal detection devices. Image supplied by Tracey Kreplins (DPIRD WA).



In this image John Stuart, Moses Omogbeme (CISS PhD student) and Jim Miller, Biosecurity Officer (DPIRD WA), are working on Canid Pest Ejectors and camera trap deployment, as part of the Assessment of the biodiversity, economic and productivity gains from exclusion fencing (WA). Image supplied by Tracey Kreplins (DPIRD WA).

Wild Dog Program

Preparing for RESET landscape-scale predator management [Prep4Reset]



Initial planning	Underway	Final stages	Complete
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2020/2021 progress

Significant investment has been made over the past year in the design of camera posts in an attempt to alleviate the problem of theft and vandalism of camera traps. Camera trap monitoring has continued over the year. Three new sites have been set up with a fourth under consideration. Across most sites, wild dogs were the most detected predator species however feral cats and foxes detected at high levels in several sites. The camera traps also made the first detection of a quoll in the Richmond range in 33 years.

Leader: Dr Paul Meek | New South Wales Department of Primary Industries

Partners: New South Wales Department of Primary Industries, New South Wales Local Land Services, Meat and Livestock Australia, Australian Wool Innovation and Australian Government Department of Agriculture, Water and the Environment.

Aim: To synthesise research and collect before-control predator, wildlife and livestock impact data to enable the planning, implementation and evaluation of the Full Reset project. Prep4Reset also supports crucial networking to generate financial and time co-investment from multiple stakeholders in the Full Reset project.

PAPPPutty™ registration - lethal paste for leg hold trap devices



Initial planning	Underway	Final stages	Complete
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2020/2021 progress

The registration application for PAPPPutty™ was granted by the APVMA on the 28th September 2020. Licencing arrangements are currently underway to enable the distribution of PAPPPutty as and when allowed by the appropriate state Pesticide Control Orders. The BiteMe™ product was not taken to full commercialisation stage as our commercialisation partner advised that it was not likely that the product would be commercially viable.

Leader: Dr Paul Meek | New South Wales Department of Primary Industries

Partners: New South Wales Department of Primary Industries, Connovation Ltd and Australian Government Department of Agriculture, Water and the Environment.

Aim: To register and commercialise a wild dog and fox lethal trap device with the PAPPPutty™ para-aminopropiophenone (PAPP) based product that could be applied on cloth put on trap jaws, which takes advantage of the wild canids tenacity to bite at the trap when captured.

Bottom image: The PAPPPutty gel is within a silicon lethal trap device which is placed onto the leg hold trap as seen in this image, supplied by Dr Paul Meek (NSW DPI).

Wild Dog Program

Wild Dog Alert

Initial planning	Underway	Final stages	Complete
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2020/2021 progress

The project has entered the commercialisation phase with the with the NSW Department of Primary Industries being nominated being nominated as the Designated Partner to take the product forward for commercialisation. CISS and the project's Commercialisation Governance Committee will monitor the progress of the commercialisation process.

Leader: Dr Paul Meek | New South Wales Department of Primary Industries

Partners: New South Wales Department of Primary Industries, Meat and Livestock Australia, Australian Wool Innovation and Australian Government Department of Agriculture, Water and the Environment.

Aim: To develop and test several automated detection system to provide land managers with real time evidence that wild dogs are on their land.

e-Technology Hub — Intelli-traps

Initial planning	Underway	Final stages	Complete
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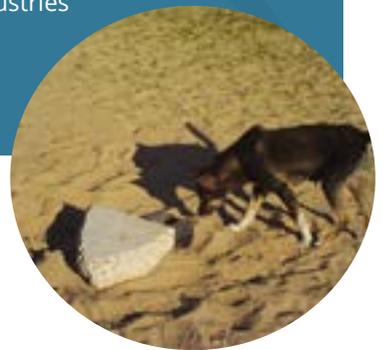
2020/2021 progress

The development and testing phases of this project are complete, and it has entered the commercialisation phase with the State of New South Wales, acting through the Department of Primary Industries within the Department of Regional NSW, as the nominated Designated Party to take the outputs from this project through the commercialisation process. CISS will monitor the commercialisation process as it progresses.

Leader: Dr Paul Meek | New South Wales Department of Primary Industries

Partners: New South Wales Department of Primary Industries, University of New England, Department of Primary Industries and Regional Development and Australian Government Department of Agriculture, Water and the Environment.

Aim: To develop and test remote systems for the management of livestock and biodiversity, a system for targeted delivery of baits for wild dogs and an autonomous gate closure system for trapping feral pigs.



OUR RESEARCH AND DEVELOPMENT

Top image: Wild dog. Image by K Foster. Middle images: Wild Dog Alert can transmit alerts using the BuckEye camera trap system, allowing messages to be transmitted over areas with no telecommunication network. A dingo approaches the sentinel bait station which recognises the animal as a dog and presents a bait and then reloads ready for the next



Pastoralists from Marree having a go at setting a Canid Pest Ejector during a 'managing wild dogs on organic properties' field day. This project is supported by The Far West Dog Fence Boards' Association through funding from the Australian Government's National Landcare Program. Image supplied by National Wild Dog Coordinator Greg Mifsud.

Wild Dog Program

Behaviourally effective communication and engagement in management of wild dogs

Initial planning	Underway	Final stages	Complete
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2020/2021 progress

This project has been completed with all milestones met. The research demonstrated that there was no one-size fits-all approach to connect with and engage landholders in wild dog management activities and that messaging needs to be targeted according to socio-economic and psychological profiles of the recipients to be effective. It also found that messaging alone will be insufficient to engage landholders if there are other potential barriers to engaging in wild dog management. Similarly, research showed that multifaceted approaches are needed to educate, train and support landholders with managing wild dogs.

Leader: Dr Lynette McLeod | University of New England

Partners: University of New England, Western Australian Department of Primary Industries and Regional Development, Meat and Livestock Australia, Australian Wool Innovation and Australian Government Department of Agriculture, Water and the Environment.

Aim: To use behavioural science principles to assist wild dog facilitators to understand and engage more effectively with non-participating landholders.

National Wild Dog Management Coordinator

Initial planning	Underway	Final stages	Complete
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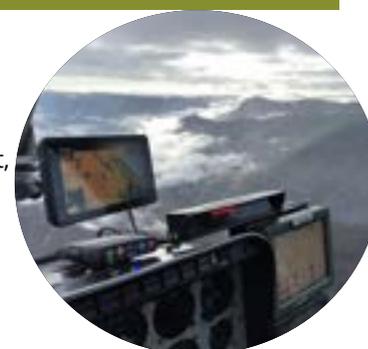
2020/2021 progress

The National Wild Dog Action Plan (NWDAP) 2020-2030 was formally announced and launched, and a website was launched on the official start of the NWDAP on July 1, 2020. Funding announced by Hon Minister David Littleproud will ensure that NWDAP support staff and a range of key projects are funded until June 2022. The Wild Dog Coordinator has held extensive face-to-face and virtual meetings over the past year and has increased the profile of, and involvement in wild dog management. Many new groups are now becoming actively involved in wild dog management including, with some working with a number of peak cattle production bodies to increase cattle productivity through effective predator management.

Leader: Greg Mifsud | Centre for Invasive Species Solutions

Partners: Australian Wool Innovation, Meat and Livestock Australia, Queensland Department of Agriculture and Fisheries, Victorian Department of Economic Development, Jobs, Transport and Resources, Victorian Department of Environment, Land, Water and Parks, Western Australia Department of Primary Industries and Regional Development, New South Wales Department of Primary Industries, Animal Health Australia, Sheep Producers Australia, Wool Producers Australia and Australian Government Department of Agriculture, Water and the Environment.

Aim: To build on the platform for strategic management of wild dogs that has been developed over the past ten years.



Top image: Brian Dowley, Industry funded Community baiting program coordinator with DELWP talking about the importance of participation in community wild dog baiting programs at a joint NSW/Victorian Government workshop on cross border feral pig and wild dog management. Middle image: Pastoralists from the William Creek area came to Anna Creek Station to a demonstration site to learn about how to bait wild dogs on organically certified properties based on the guidelines developed by the National Wild Dog Action Plan. Developed by National Wild Dog Management Coordinator, Greg Mifsud, in consultation with the Organic Certifiers the guidelines provide a process that allows for the use of 1080 bait products within livestock proof exclusion fences. By preventing access to the baited area using fences and limiting bait movement by tethering or canid pest ejectors, pastoralists can control wild dogs and feral animals using best practice control without jeopardising their organic certification. Bottom image: Aerial baiting on the Northern Tablelands May 2021 at Niangala, NSW. Images supplied by National Wild Dog Coordinator Greg Mifsud.

Wild dog research, development and extension pipeline

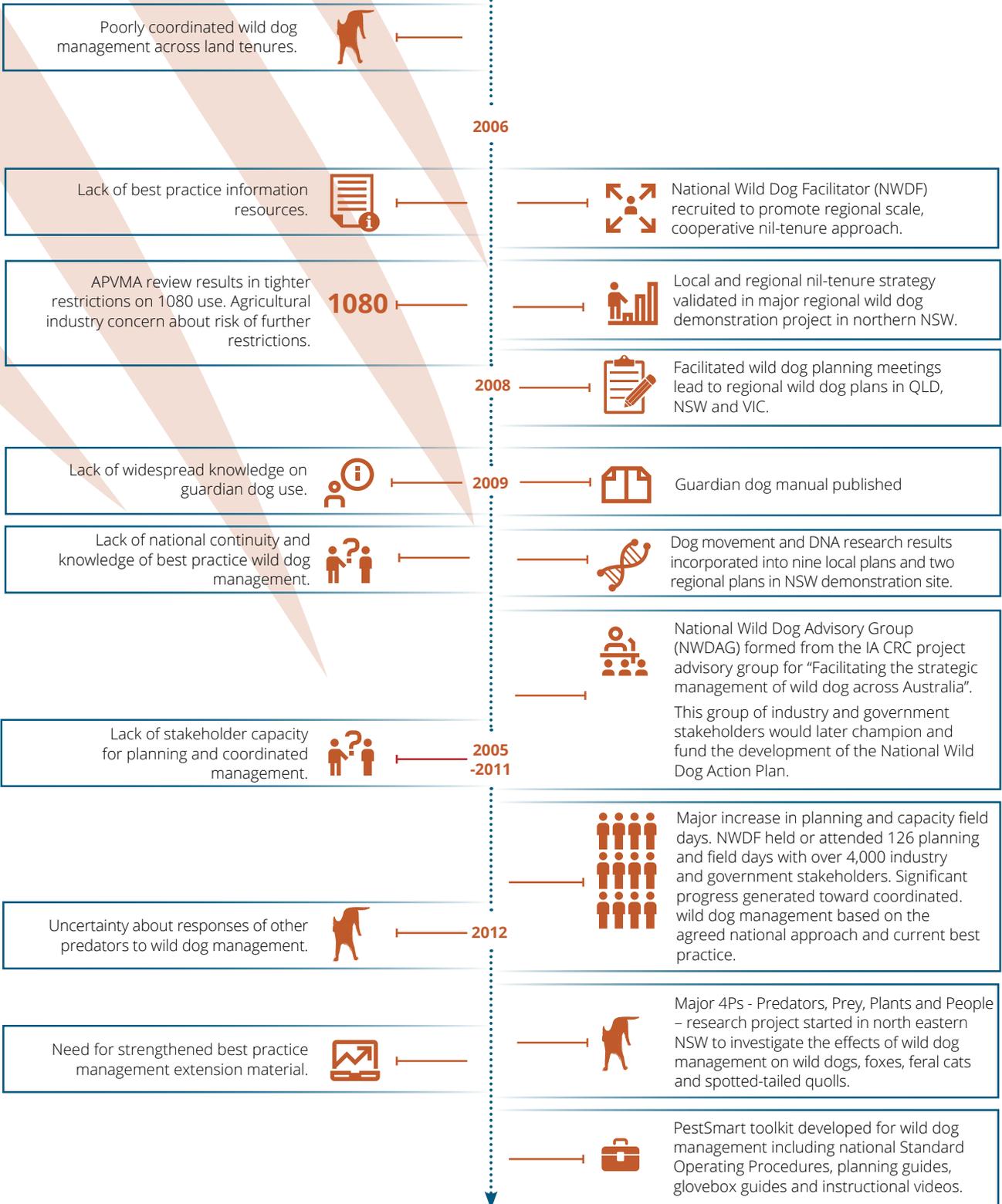
Achieving smarter, more effective and more engaged management through innovation

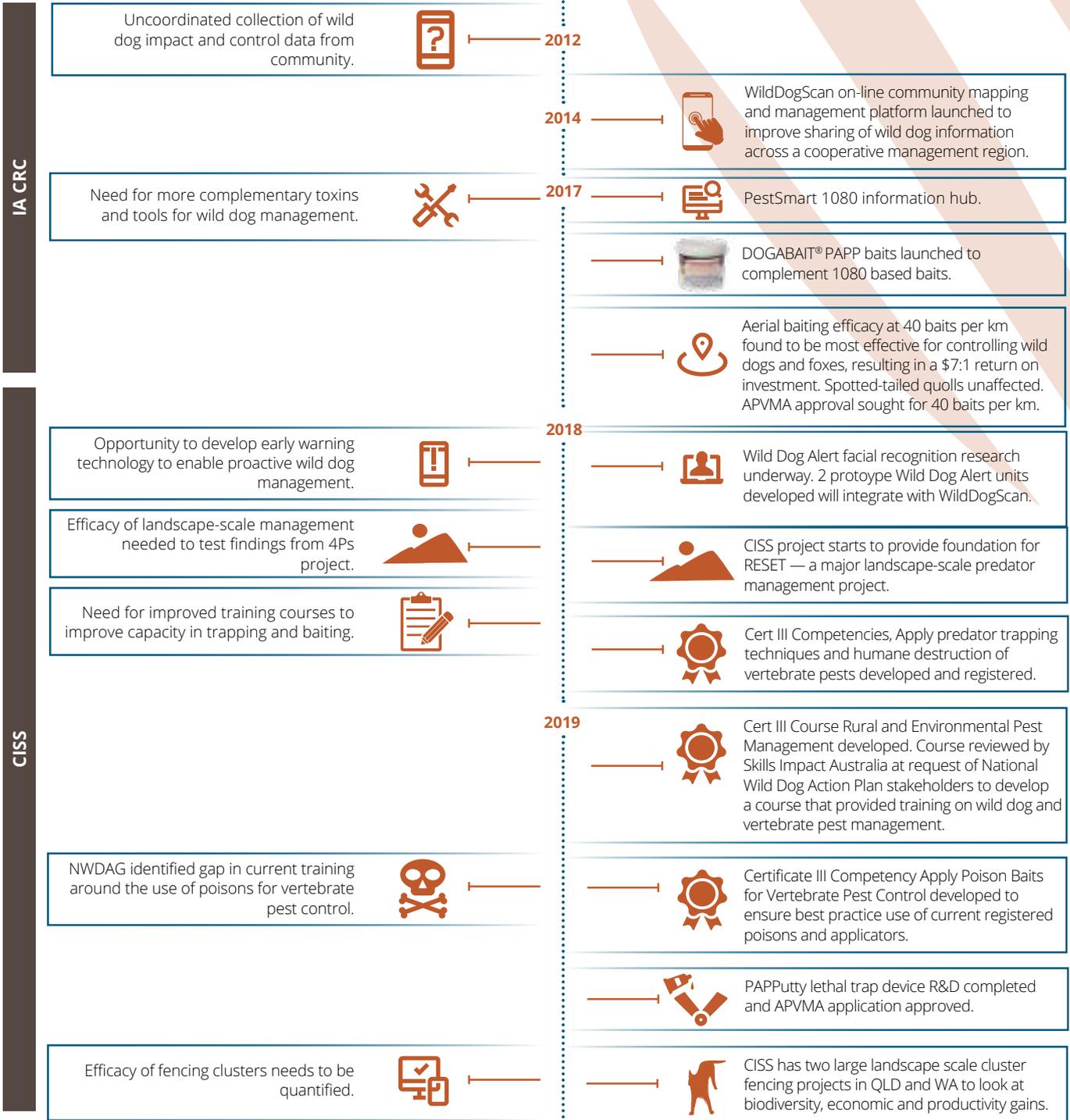


OUR RESEARCH AND DEVELOPMENT

PRE-IA CRC

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OUR RESEARCH AND DEVELOPMENT

Wild Dog Program

North-East NSW Wild Dog Coordinator



Initial planning	Underway	Final stages	Complete
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2020/2021 progress

The coordinator commenced in March 2021 and has been active in the NSW Northern Tablelands and Hunter LLS regions promoting, and being actively engaged in, wild dog management programs through working with local and regional wild dog management groups.

Leader: Dave Worsley | Centre for Invasive Species Solutions

Partners: Australian Wool Innovation, Northern Tablelands Local Land Service, Hunter Local Land Service.

Aim: To mitigate the impacts by wild dogs and vertebrate pest species through the deliver of best practice wild dog and vertebrate pest management programs.

Other tools and services

National Feral Cat and Fox Coordinator

Initial planning	Underway	Final stages	Complete
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2020/2021 progress

Gillian Basnett was appointed to the position of National Feral Cat and Fox Coordinator in August 2021. She has actively engaged with a range of government, NGO and community groups and is actively raising the profile of, and need or, best practice feral cat and fox management programs.



Leader: Gillian Basnett | Centre for Invasive Species Solutions

Partners: Australian Government Department of Agriculture, Water and the Environment.

Aim: With a focus on the seven priority bushfire affected areas and a focus on the EPBC Act priority species, the coordinator will promote the adoption of best practice management for foxes and cats, raise awareness of fox and cat management techniques, engage local and regional organisations and government to facilitate regional scale fox and cat management linked with community based monitoring.

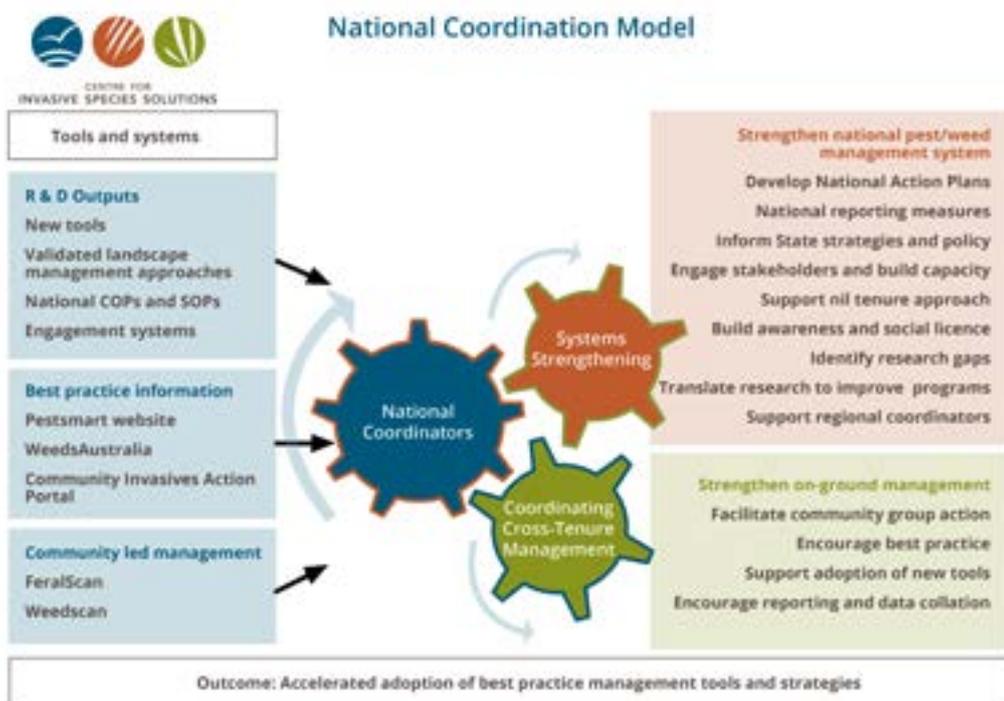


Top image: Dave Worsley, North-East NSW Wild Dog Coordinator, at the CISS Innovation Showcase, 10 February, 2021. Middle image: Gillian Basnett, National Feral Cat and Fox Coordinator, holds a northern quoll. Image supplied by Gillian Basnett, Bottom images (L-R) : Deer control research as part of the 'North-East NSW Wild Dog Coordinator' project, in northern tablelands, NSW. Lara David and Hugh Worsley Aerial baiting at Koreelah, NSW, May 2021. Lara, David and Hugh Worsley. Aerial baiting at Koreelah, NSW, May 2021. Images by Dave Worsley.

Case study: National Coordination model

The **National Coordinator model** began with the Centre's predecessor, the Invasive Animals Cooperative Research Centre through the appointment of the National Wild Dog Coordinator. Since then the model has branched out to include both Wild Deer and, Feral Cat and Fox Coordinators. The coordinator model has been designed to drive and accelerate best practice tools and strategies through landscape scale, nil tenure community led management at all scales form local, regional and up to state government.

The national coordination model brings evidence based best practice information to communities, focusing on engagement rather than traditional extension. It has proven under the Wild Dog Coordinator to have remarkable value. Independent economic impact analysis showed that the model generated estimated total benefits of \$11.9 million.



A juvenile fox sets out to hunt and forage for food in the forest's depths during the early morning. As it cautiously searches for prey, it moves quietly above the dense foliage and maintains a low profile to avoid being spotted. However, spotting an opportunity, it quickly hides behind a bush to observe the target and plan an attack. Young and inexperienced, the hesitant fox slowly abandons the idea of chasing its prey and finds comfort in observing it while its longing eyes slowly watch the animal leave the surrounding area. Image by Lucca Amorim.

Case study: Welcome to our new National Feral Cat and Fox Coordinator!



This year saw the appointment of Gillian Basnett as Australia's first National Feral Cat and Fox Management Coordinator, a position funded by the Australian Government Department of Agriculture, Water and the Environment. This new role will communicate best practice methods, drive adoption of humane cat and fox control methods, support community led management programs and champion responsible domestic cat ownership. The scope of the Coordinator's activities will be focused on seven priority bushfire affected regions.

OUR RESEARCH AND DEVELOPMENT



Image: Joe Donaldson (Kangaroo Island Landscapes Board) demonstrating setting a leg hold trap as part of their Dunnart Bushfire Recovery Program on Kangaroo Island. They caught their 700th cat since the 2020 bushfires while Gillian Basnett was visiting. Cat management is being undertaken in the east and the west of the island by KI Landscapes Board, National Parks and Wildlife South Australia, Kangaroo Island Land for Wildlife and Australian Wildlife Conservancy. Image by Paul Jennings.

Top images (L-R): Checking motion sensor cameras for cat activity on Kangaroo Island with Chantelle Geissler (KI Landscapes Board). Image by Paul Jennings. Gillian radio tracks Banded Hare-wallabies on Faure Island, which were introduced onto the island, along with other threatened species, after cats were eradicated. Feral cats and foxes pose a significant threat to Southern Brown Bandicoots (*Isodon obesulus*), sub-species' of which are listed as threatened in a number of states. Images by Simon Cherriman. Cage traps are a common tool for feral cat management. A variety of visual aids, like these feathers, scents and sounds are used to lure feral cats and foxes in padded jaw traps. Feral cat control is vital in recently burnt landscapes where ground and understorey vegetation has been removed making native wildlife extra vulnerable to predation by introduced predators. Images supplied by Gillian Basnett.



Image: A large feral cat wandering around a national park in the middle of the day, TAS. Image by Ryan Francis.

Other Pest Products and Tools

National registration of a poison cat bait containing 1080 in liquid form



Initial planning	Underway	Final stages	Complete
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2020/2021 progress

A data gap analysis indicated that no additional testing sites were required to facilitate the national registration process for Eradicat®. The efficacy and environment APVMA modules be prepared and submitted to the APVMA for a pre-registration technical assessment for the APVMA to determine if sufficient data is available for the registration. Once the APVMA responds to the technical assessment, additional data will be collected if needed and the full application for registration will be prepared for lodging.

Leader: Dr Brad Page | South Australian Department of Primary Industries and Regions (SADPIR)

Partners: South Australian Department of Primary Industries and Regions, South Australian Department of Environment and Water and Western Australian Department of Biodiversity, Conservation and Attractions and Australian Government Department of Agriculture, Water and the Environment.

Aim: To collate available data, and collect new priority data, on bait efficacy and non-target risks to significantly progress the national registration of the bait with APVMA.

GonaCon™ fertility control vaccine registration



Initial planning	Underway	Final stages	Complete
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2020/2021 progress

A data gap analysis was commissioned which has identified the additional data that is needed for the registration of GonaCon™ in Australia. Collecting and collating these data into the required APVMA application modules is ongoing in collaboration with the US Department of Agriculture and the licenced manufacturer, SpayFirst.

Leader: Dr Tony Buckmaster | Centre for Invasive Species Solutions

Partners: ACT Government.

Aim: To register GonaCon in Australia as an injectable fertility control agent for macropods.

Top image: Class is in. This feral cat left her kitten in the clearing while she went hunting. Returned with a native bush rat (*Rattus fuscipes*) and gave to kitten to practice hunting behaviours, VIC. Image by Johnston. Bottom image: A kangaroo is injected with GonaCon™ as part of a research trial being conducted by the ACT Government. Image supplied by Claire Wimpenny.

New rodenticide toxin assessment

Initial planning	Underway	Final stages	Complete
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2020/2021 progress

In collaboration with researchers in the USDA, India and France, CISS is embarking on the first steps towards assessment of a new toxin for potential use as a rodenticide in both Australia and the United States. Initial testing of the compound shows that it would be a suitable additional tool for the management of mice alongside currently available rodenticides. (See map pg 13-14)

Leader: Dr Tony Buckmaster | Centre for Invasive Species Solutions

Partners: GRDC, USDA.

Aim: To progress the R&D and subsequential registration of a new rodenticide for use in Australia.

Mount Hope Malleefowl Recovery

Initial planning	Underway	Final stages	Complete
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2020/2021 progress

This project has been completed. The Mount Hope Malleefowl Recovery project was funded externally by the NSW Department of Planning, Industry and Environment (NSW DPIE). It re-commenced in January 2019 and continued through until the end of June 2020. Predator densities, monitored using an extensive array of camera traps, declined over the period of the project as a result of the sustained management actions (CPEs and baiting). There was uncertainty around the remaining population of malleefowl in the region, which can only be assessed by counting the number of active nests during the breeding season. Monitoring in 2019 found only two active nests however there was eggshell on most non-active mounds surveyed. As eggshell has a limited lifespan in the environment, it is likely there was an extensive breeding season in approximately 2016. With the rainfall events recorded in 2020, it is hoped that another significant breeding event has occurred.

Leader: Dr Tony Buckmaster | Centre for Invasive Species Solutions

Partners: New South Wales Office of Environment and Heritage, New South Wales National Parks and Wildlife Service, Mt Hope Pest Management Group.

Aim: To assess the impacts of feral predator control on the Malleefowl population in western NSW.



Other Pest Products and Tools

Wild pigs, deer and other pests

Initial planning	Underway	Final stages	Complete
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2020/2021 progress

This project is in the early stages of commencing with the contract being executed in May 2021. Project parties are preparing detailed activity workplans to define the project activities over the coming years.

Leader: Dr Dave Forsyth | NSW Department of Primary Industries

Partners: NSW Department of Primary Industries.

Aim: To optimise the effectiveness of vertebrate pest management techniques and provide greater understanding of best practices.

NSW predators and prey — landscapes

Initial planning	Underway	Final stages	Complete
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2020/2021 progress

This project is in the early stages of commencing with the contract being executed in May 2021. Project parties are preparing detailed activity workplans to define the project activities over the coming years.

Leader: Dr Guy Ballard | NSW Department of Primary Industries

Partners: NSW Department of Primary Industries.

Aim: To deliver management solutions (tools and practices) into the hands of land managers to minimise the negative economic and social impacts of invasive predators.

Automated thermal imagery analysis platform for multiple pest species

Initial planning	Underway	Final stages	Complete
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2020/2021 progress

A stakeholder engagement process was undertaken to allow the development of the software to be guided by user requirement. Development and refinement of the AI software model shows great promise for detecting multiple species to the point where seven species (pigs, rabbits, kangaroos, sheep, cattle, deer and goats) are detected and identified. Further development has focused on 'benchmarking' the model, allowing the accuracy of detection and identification to be measured.

Leader: Stuart Dawson and Peter Adams, WA Department of Primary Industries and Regional Development

Partners: WA Department of Primary Industries and Regional Development, NSW Department of Primary Industries, Qld Department of Agriculture and Fisheries, Charles Sturt University and Thomas John Low.

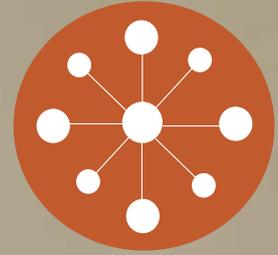
Aim: To develop automated thermal imagery analysis models that incorporate artificial intelligence to provide a central analysis platform equally accessible to all stakeholders and end-users.

Top image: A feral pig clearing a section of broken fencing outside of Quilpie, QLD. Image by Sam Oostrom. Bottom image: A magpie tries to drive off a vixen. Halbury, South Australia. Image supplied by Sandy Horne.



Six Wedge-Tailed eagles were eating from a sheep carcass, but one by one, the fox drove them away to get to the food, Victoria. Image by Bernie McRitchie

BIOCONTROL TECHNOLOGIES AND SYSTEMS



Egi Kardia (Postdoctoral Fellow with CSIRO), testing rabbit tissue samples in the lab in Canberra. Image by Yvette Cazabon.

Biocontrol Technologies And Systems

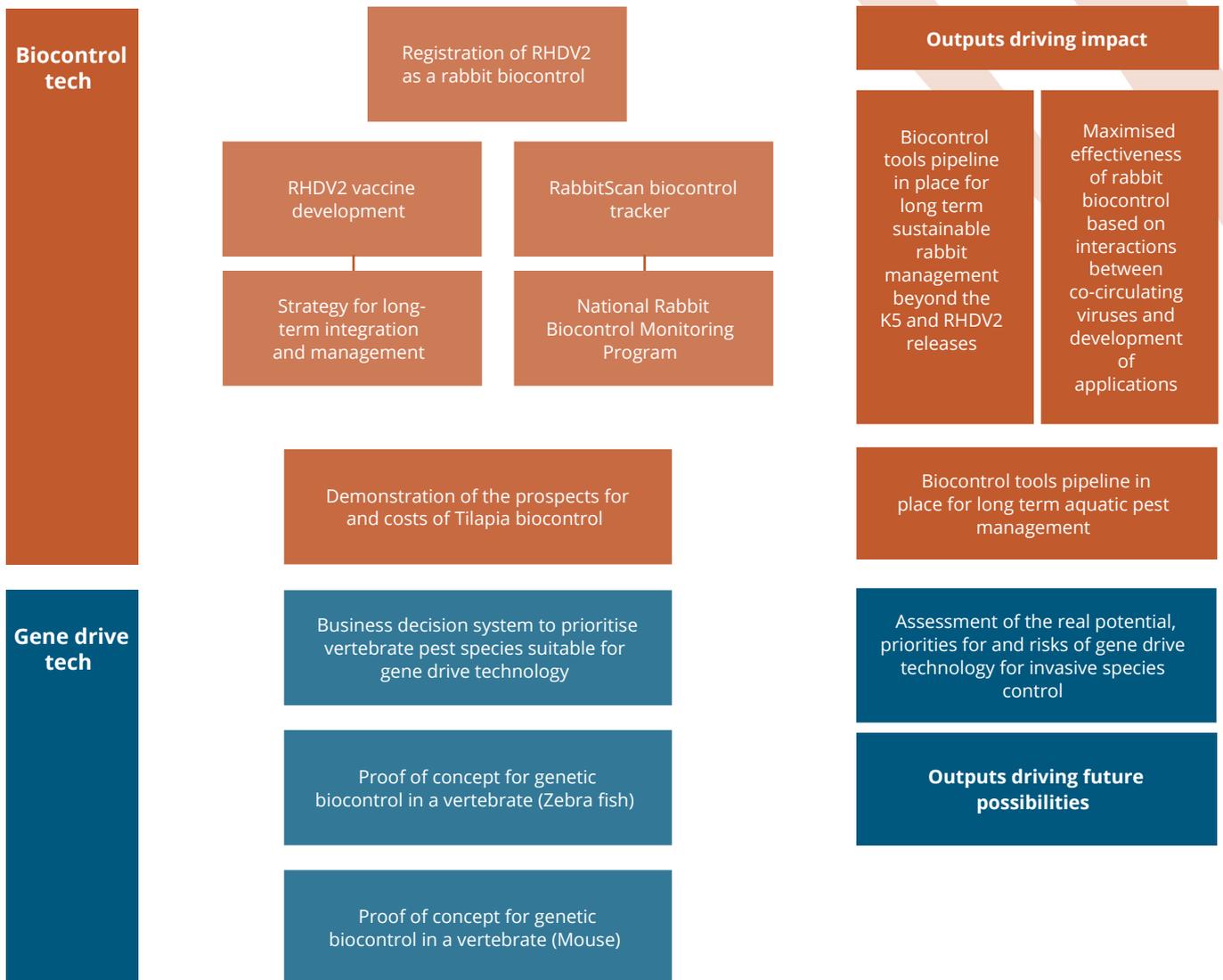
The challenge

Rabbits have invaded two-thirds of Australia and are our most costly vertebrate pest: they cause a \$216m/yr loss in agricultural productivity and impact 322 nationally listed threatened species. From a rabbit population high of between 1 and 10 billion rabbits, rabbit biocontrol has led to over \$70 Billion in increased agricultural productivity between 1950 and 2010, but on-going genetic resistance to any viral biocontrol agent means that a new agent needs to be released every 8–10 years to secure the benefits of past biocontrol. Additionally, existing biocontrol agents ebb and flow across landscapes over time and thus to maintain effectiveness, on-going releases are needed.

The solution

Our biocontrol program aims to roll out new and improved biocontrol agents every 8–10 years as part of our rabbit biocontrol pipeline, and as a result hopes to see a sustainable reduction of impacts of established pest rabbit populations. The program is also looking at biocontrol and genetic technologies for other species such as pest fish (tilapia) and gene drives.

Expected Outputs



OUR RESEARCH AND DEVELOPMENT

2020/21 progress highlights



1. Researchers are continuing to gather efficacy data required to register RHDV2 as an additional biocide product for use in Australia – this includes virulence assessments of the virus in rabbits of different ages and the completion of a humaneness assessment of RHDV2.



2. Monitoring of national rabbit calicivirus activity continues, determining which virus is active where and when, providing critical information for the development of tailored application strategies. A fly sampling network monitoring 20 sites across Australia is being assessed as a potential additional monitoring tool.



3. Progress has also been made towards a multivalent vaccine to protect pet and farmed rabbits.



4. A new project to assess tilapia lake virus as a potential biocontrol agent for Tilapia in Australia is well advanced, and a business case for Tilapia biocontrol has been drafted.



5. A genetic biocontrol R&D prioritisation framework and business case is nearly complete, with a draft report due for release in late 2021.



6. Two new gene drive projects have commenced. The first, funded by the Australian Government, will deliver an assessment (proof-of-concept) for a genetic biocontrol strategy for vertebrate invasive species with a particular focus on fish. The second, funded by the NSW State Government, will do likewise with a particular focus on mice.

Engagement with end-users

The Centre's biocontrol and genetic innovation streams have two very different end-user profiles. In the case of biocontrol, our research is shaped by an innovation pipeline strategy where end users, many of whom have been facing and managing the plight of rabbits for decades, actively seek to adopt new and complementary tools including the latest biocontrol releases for on-ground application. As such, land managers have played an important role in intensive release programs (e.g. the K5 release) and continue to play an important role in the Centre's ongoing rabbit monitoring program. Further, some help guide our research through participation alongside industry and government officials on our multi-project Rabbit Steering Committee. In the case of our gene drive research, which delves into prospective over-the-horizon technologies, the risks, regulatory frameworks and associated ethical issues are such that direct engagement is largely at the policy, regulatory and scientific level. That said, community survey work plays a crucially important role in our research, informing a high level steering committee of policy, regulatory, NGO, scientific and industry officials who oversee all our gene drive research.



Gerry Leach, a farmer from VIC and Chair of the Victorian Rabbit Action Network with Rabbit Biocontrol research leaders Dr Patrick Taggart (NSW DPI) and Dr Tanja Strive (CSIRO), at the CISS Innovation Showcase, Parliament House, 10 February, 2021.

Rabbit Biocontrol Program

Understanding RHDV2 interaction with other RHDVs and its potential as an additional rabbit biocontrol agent



Initial planning	Underway	Final stages	Complete
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2020/2021 progress

The project's box trials are now complete, with the data analysed. Analyses possibly suggest that the release of RHDV2 may have some benefit if released into seronegative wild rabbit populations. However, given 1) that accurately identifying the serological history of wild rabbit populations is difficult; 2) land managers do not routinely identify wild rabbit serological history prior to virus release; 3) that RHDV2 is currently the dominant naturally circulating virus in wild rabbit populations; and 4) K5 can overcome RHDV2 immunity but RHDV2 cannot overcome RHDV immunity; it would seem that K5 may currently be the best universal strain to be used in intentional virus releases.

Project staff are beginning to write up the results of our completed experimental infection trials in laboratory rabbits. This includes the RHDV2 virulence assessment in adult and young laboratory rabbits which has now been published. The maternal antibody trials are complete and the results have been written up and are at an advanced manuscript stage.

A series of experiments have been undertaken that contribute data to understanding the interactions between the different genotypes of RHDV. These investigations have involved studying the 'protection' afforded by both natural infection and maternal antibodies. These data confirm that:

1. each of the challenge viruses (RHDV1, RHDV1a & RHDV2) cause extremely high mortality rates (approaching 100%) in naïve laboratory rabbits.
2. that RHDV2 has a very variable capacity to overcome immunity (active or maternally derived) to other genotypes.
3. that the K5 strain of RHDV1a has the capacity to overcome immunity to RHDV2 strains in a moderate proportion of rabbits.
4. that immunity to an "homologous" strain of RHDV (any genotype) cannot be overcome, even with a massive virus challenge (approximately 150,000 RID50).

The application for registration of a RHDV2-specific vaccine by APVMA continues to encounter difficulties and will be withdrawn. Instead, we will apply for registration of a multivalent RHDV vaccine which gives good protection against viruses from genotypes 1, 1A and 2 in experimental challenge studies.

Leader: Dr Pat Taggart | New South Wales Department of Primary Industries

Partners: New South Wales Department of Primary Industries, CSIRO, Primary Industries and Regions South Australia, Meat and Livestock Australia, Australian Wool Innovation and Australian Government Department of Agriculture, Water and the Environment.

Aim: To explore the potential of RHDV2 (an exotic RHD virus first reported as a biosecurity outbreak in wild rabbits in May 2015) to complement existing biocontrol agents through a series of experimental studies. This project plays a vital role in the Centre's 20-year rabbit biocontrol pipeline and aims to understand the potential use of this virus as a future rabbit biocontrol agent. This project will also support the development of a multivalent vaccine to protect pet and commercially bred rabbits.

Image: Emma Sawyer (NSW DPI) setting rabbit traps to capture and collect data for rabbit virus analysis. Image supplied by Tarnya Cox (NSW DPI).

Rabbit Biocontrol Program

National rabbit biocontrol optimisation

Initial planning	Underway	Final stages	Complete
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2020/2021 progress

Samples of the livers from dead rabbits and strain identification submitted by farmers suggest RHDV2 and its recombinants continue to be epidemiologically dominant in the Australian landscape, with the RCV-A1/RHDV2 recombinant variant detected most frequently and present in all jurisdictions apart from WA and the RHDVa-Aus / RHDV2 recombinant variant was detected in the ACT, NSW, and QLD. RHDV2 (the original strain) was only detected in SA and WA during this reporting period but has been completely replaced by recombinant strains in VIC, TAS, ACT, NSW, and now also QLD. K5 was detected in 6 samples in WA and 1 sample in SA. RHDV1 was detected in 1 sample in Victoria.

The research team assessed temporal patterns in the supply and release of the RHDV virus for rabbit management. Data strongly recommended that RHDV is not released when young rabbits are present in the population as infection in this cohort is sub-lethal and induced life-long virus immunity. The recruitment of these rabbits into the breeding population may make the population harder to control in future and leading to population increases rather than decreases. Approximately half of all RHDV supply and release occurred in winter or spring, the major breeding seasons for rabbits in Australia. This raises concerns regarding land managers being able to readily acquire RHDV for release and whether this is useful for the ongoing management of rabbits in Australia. RHDV supply was correlated with below average rainfall, suggesting that land managers notice and want to control rabbits and their impacts more following drier years and when both rabbits and their impacts are potentially more damaging.

Regular rabbit capture/recapture sampling including blood sampling continues at Turretfield. Turretfield capture and re-capture data currently being analysed to assess the effect of RHDV outbreaks on rabbit abundance over time and the ability of RHDV2 to lethally infect RHDV survivors. This analysis will commence once the next batch of serological reagents arrives from Italy.

Leader: Dr Tanja Strive | CSIRO

Partners: CSIRO, New South Wales Department of Primary Industries, Primary Industries and Regions South Australia, Meat and Livestock Australia, Australian Wool Innovation and Australian Government Department of Agriculture, Water and the Environment.

Aim: To improve strategic knowledge about how to apply biocontrol agents to maximise rabbit biocontrol effectiveness, through monitoring and evaluation of current rabbit viruses in the Australian landscape.



Top image: CSIRO rabbit biocontrol lab. Bottom image: Rabbit tissue sample sent in by a member of the public, through the RabbitScan portal. Images by Yvette Cazabon.

Spotlight on: Rabbit biocontrol

Biocontrol has proven a monumental pillar for rabbit management. In the 60 years to 2011 the myxoma and calicivirus have produced \$70 Billion in agricultural benefits and limited the wild rabbit populations to about 15% of their potential numbers. As rabbit populations build up resistance to existing biological controls it is critical that an ongoing pipeline of regular release of new and existing agents.

In 2017, the Centre's 20-year rabbit biocontrol pipeline strategy resulted in the release of the first new biocontrol agent in 20 years — RHDV1 K5. In conjunction with the Centre's new freeze-dried delivery system that enables the virus to be mailed out to farmers and land managers at room temperature, and despite the 2015 outbreak of a new rabbit disease — RHDV2, RHDV1 K5 is still expected to result in \$54.3 million in benefits over the next 30 years.



Image: European rabbit eating plants in a garden, VIC. Image by Eva Kowal.

Rabbit biocontrol innovation pipeline.

Achieving sustainable landscape scale rabbit management.

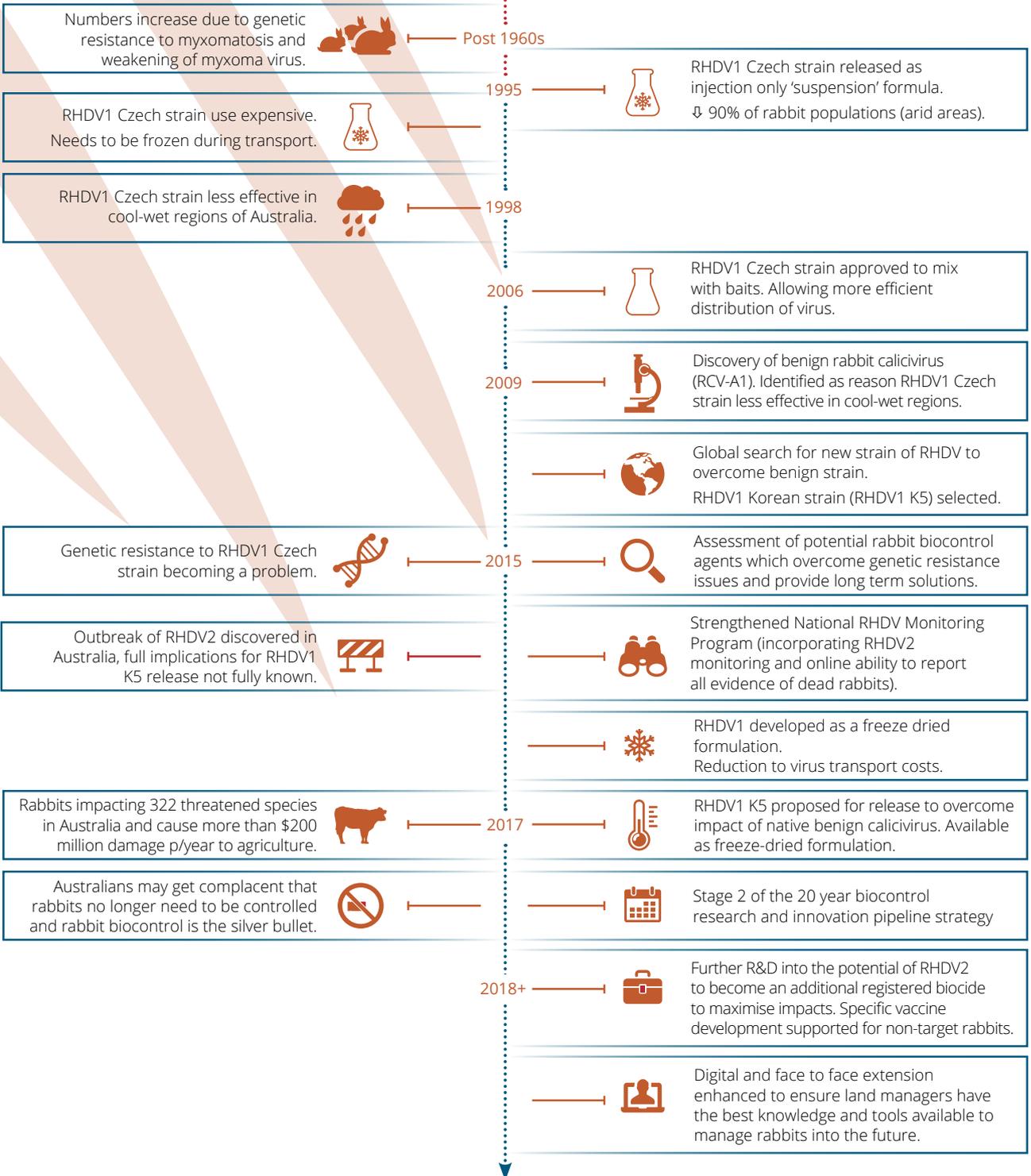


OUR RESEARCH AND DEVELOPMENT

PRE-IA CRC

IA CRC

CISS



Tilapia biocontrol: prospecting and evaluation

Initial planning	Underway	Final stages	Complete
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2020/2021 progress

The review of Tilapia pathogens has been completed. 22 pathogens were reviewed with three showing promise as potential biocontrol agents. The review identified Tilapia Lake Virus (TiLV) as the most suitable pathogen suitable for further investigation but also noted that a newly emerged pathogen, Tilapia Parvovirus (TiPV) is also worth keeping a watching brief over as a potential future biocontrol agent. The Tilapia biocontrol report has been drafted and is in a review process.

The capability to work with TiLV has been developed at CSIRO-ACDP and a tilapia breeding facility has been established in James Cook University. This breeding facility is set up in compliance with permit requirements for invasive fish and will be used to establish a breeding colony to supply fish for future susceptibility trials.

A business case for investment into Tilapia biocontrols was drafted and will be published during the next reporting period.

Leader: Dr Agus Sunarto | CSIRO

Partners: CSIRO, Qld Department of Agriculture and Fisheries, James Cook University and University of Sunshine Coast and Australian Government Department of Agriculture, Water and the Environment.

Aim: To evaluate Tilapia diseases in the context of biocontrol more broadly and conduct a desktop review of Tilapia diseases and assess their potential as biocontrol agents. If one or more candidate agents are identified, then susceptibility of tilapia in Australian waterways will need to be determined followed by target specificity trials.



Top image: Tilapia. Image by Samantha Courtney. Bottom image: European Rabbit. Image by Anne Young. Bottom image: A facilitated stakeholder Workshop was held in February 2020 at CSIRO Black Mountain Science and Innovation Park. Thirty-four external participants representing NGOs, industry organisations, state and federal government departments, universities, and research units attended. A range of policy and regulatory staff, wildlife managers, geneticists, ecologists, and social scientists were involved. Image by Dr Wendy Ruscoe (CSIRO).

Spotlight on: Advancing Gene Drive Technology

Genetic biocontrol — solutions for the 21st Century

Gene drives – a non-lethal fertility control technology — emerged in 2015 with the potential to transform invertebrate pest control forever! Research is now underway to apply this technology to vertebrate pests. Gene drives are a mechanism that manipulate reproductive processes to pass on a specific genetic trait to the target's offspring. This can be used to introduce population controlling traits, like female or male infertility, in the target species. Managing the impacts of mammalian invasive species, especially at a landscape scale, are very time, money, and resource intensive. Genetic biocontrol holds great potential as a tool for vertebrate pest species specific suppression or even eradication for the 21st Century.

The Future of Gene Drive technology in Australia for Vertebrate Pest Control

Australia has an enviable environment for development of **genetic biocontrol technologies** that provide a clear advantage for significant progress in coordinated and integrated advancement in the major factors applicable to development of this technology. We have excellent scientific technical capability, an established risk assessment community, a sophisticated society able to be engaged, and strong demand for applications given the scale of vertebrate pest impacts. Establishment of a decision and implementation framework with agreed approaches to further development and strong investment in a science roadmap, will realise these current advantages



Image: European Rabbit, QLD. Image by Laurence Sanders.

Advancing Gene Drive Technology

Business decision system to prioritise vertebrate pest species for development of gene drive for population control



Initial planning	Underway	Final stages	Complete
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2020/2021 progress

A draft final report was prepared by the end of the reporting period. This was supplemented by a decision framework for prioritising vertebrate pest species for which the development of a gene drive management option would be most beneficial.

The project suggests the successful development of genetic biocontrol technology will inevitably lead to the animals being classified as genetically modified organisms (or living modified organisms). As such, appropriate regulation, licencing and risk assessment will be brought to bear and must be addressed before any release of modified animals into the wild. Importantly, post-deployment monitoring, of the modified animals and any associated genetic biocontrol technology contaminants, will be necessary to assure Australia's trade security.

Targeted engagement with key stakeholders throughout the project highlighted important factors that influenced their level of support for genetic biocontrol technologies. Demonstrating the safety and efficacy of genetic biocontrol technologies (e.g. ability to contain a release, species-specificity etc), will require extrapolation and modelling of data from laboratory studies of model vertebrate species. Learning from and incorporating international research findings, will further help to build both stakeholder and public confidence in the safety and efficacy of the technologies within Australia.

The project recommends public engagement and the communication of genetic biocontrol technology science should commence immediately and continue throughout the duration of all phases of genetic biocontrol research, development, and implementation.

The business case component of the project suggests that whilst the case for vastly improving vertebrate pest management in Australia is strong, new advances including genetic biocontrol technology, must have clear advantages over existing technologies. Currently, the level of interest and support for genetic biocontrol research and development favours the pursuit of ongoing collaborations across a variety of disciplines (e.g. genetics, ecology, social science, communication, policy and regulation). Co-ordination of this multi-disciplinary work would benefit from the formation of a centralised system. Such a system, a 'Community of Practice', could provide an independent source of governance and knowledge.

Leader: Dr Wendy Ruscoe | CSIRO

Partners: CSIRO, Department of Biodiversity Conservation and Attractions WA, Department of Primary Industries and Regional Development WA and Australian Government Department of Agriculture, Water and the Environment.

Aim: To explore the use of gene drive modification in vertebrate pest species in Australia. There are many knowledge gaps and technical hurdles to overcome the jump from invertebrate to vertebrate gene drive manipulation. Risk analysis and social license for gene drives will be necessary to establish a framework and prioritisation system. This information is necessary for development of appropriate investment strategies in gene drive research as a pest control tool. By developing framework to assess the potential, the priorities and risk scenarios for key target pests (e.g. mice, rabbit, carp) it will give CISS a leading national and international role in this innovative field.

Image: European Rabbit. Image by: Brian Cooke.

Advancing Gene Drive Technology

Proof of Concept for Genetic Biocontrol in Vertebrates through a Fish Model Species



Initial planning	Underway	Final stages	Complete
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2020/2021 progress

The project is seeking to create gene expressions in zebra fish models that will aid in population control of invasive fish species. Two different types of zebra fish have been generated each with a different expression system (from four different systems that were tested — two did not prove viable). This is an important outcome since the level and distribution of expression of dCas9-VPR is known to be deleterious in and of itself. Generating two lines out of four constructs tested is valuable and a critical first step in the path to generating the final “synthetic species”.

Thus far one of the two has been successfully bred and offspring show inheritance of the dCas9-VPR construct which demonstrates successful genomic integration. The second is presently in breeding now and will be assessed for transmission to the next generation very soon. The appropriate and functional inheritance of the dCas9-VPR is clearly an essential feature of the trait and necessary for implementation of the incompatibility system.

These two lines will form the basis for establishment of the “synthetic species”. Genes that can be targeted for lethality during embryo development have been identified via literature review and bioinformatics. From a number of gene targets identified, at least one line of zebrafish has now been developed with a modified promoter region that will protect it from the lethal induction by the dCas9-VPR.

This promoter-modified line has been cross-bred with the two dCas9-VPR carrying zebrafish. Offspring will soon be characterised and will deliver the second essential step the in creating the “synthetic species”.

Leader: Dr Mark Tizzard | CSIRO

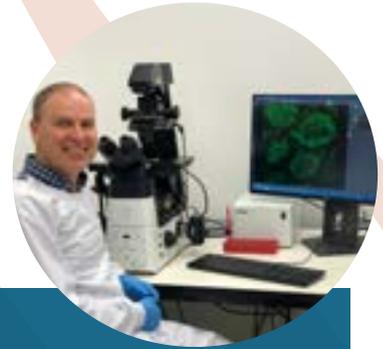
Partners: CSIRO, Macquarie University and Australian Government Department of Agriculture, Water and the Environment.

Aim: To deliver assessment (proof-of-concept) for a genetic biocontrol strategy for vertebrate invasive species with a particular focus on fish. The outcome will either prove or disprove the genetic biocontrol strategy and thereby help to understand the opportunity or limitations to this approach to pest animal biocontrol.

Advancing Gene Drive Technology

Genetic Biocontrol Technology for Mouse Management

Initial planning	Underway	Final stages	Complete
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2020/2021 progress

This project commenced during the reporting period and is funded by NSW DPI. In a world-first, this project will assess three innovative gene drive strategies based on selective advantage of sperm that carry a population modification trait. These meiotic or non-homing gene drives leverage recent advances in CRISPR/Cas9 gene editing and offer a much more feasible alternative to the current focus on homing gene drives but have not yet been developed in vertebrates. Importantly, the genetic components for each strategy have already been validated in cultured cells. Meiotic gene drives work by biasing the inheritance of a deleterious trait which is spread through natural sexual reproduction leading to species specific suppression or eradication of target mammal populations.

Meiotic gene drives are both a lower risk and faster genetic biocontrol approach for mammal pests. None of the project's 3 strategies requires gene drive "homing" and all have demonstrated potential for eradication using our latest published in silico individual based modelling platform. As a further innovation, during development experimental data for each drive will be applied to a new Australian Research Council funded bespoke species-specific spatial modelling platform. This multidisciplinary approach will ensure that the technology developed in mice has maximum efficiency and will facilitate rapid translation into other vertebrates. In addition, all gene drive strategies exploit fundamental reproductive processes that are common amongst mammals and can therefore potentially be translated into other significant mammal pests.

Leader: Dr Paul Thomas | University of Adelaide

Partners: University of Adelaide, CSIRO, NSW Department of Primary Industries.

Aim: To generate and deliver breakthrough genetic biocontrol technology to transform mammal pest management in Australia. It aims to demonstrate proof of concept for genetic biocontrol in a mammal model (and potential target) - the mouse.



Top image: Paul Thomas in the lab. Bottom images: House mouse. Images by Jessamy Frost

Support For National Capacity And Planning

CISS Balanced Researcher Program



Initial planning	Underway	Final stages	Complete
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2020/2021 progress

The Balanced Researcher Project continues to enhance the training of doctoral student associated with the Centre and has been expanded to include postdoctoral student involved in some of the projects. The regular virtual meetings of the participants have continued to allow them to maintain connection in the absence of the ability to meet in person. The second annual camp, run as a virtual event, was completed with the students undertaking actional leadership and team building training as well as undertaking training in grant writing applications.

A longitudinal study of the Program due to commence during the reporting period was delayed, but came back on track immediately after, with the contracting of Dr Saan Ecker (former head of ABARES Social Science Research Unit) to undertake this research.

Leader: Dr Tony Buckmaster | CISS

Partners: Australian Government Department of Agriculture, Water and the Environment.

Aim: To prepare PhD candidates for entry into the biosecurity-related workforce and allow them to be active contributors to that workforce from day one. Students are trained in business acumen, leadership, team building skills as well as specific training to enable them to complete their research thesis and fulfil future career goals.

Towards a New Weeds RD&E Portfolio

While the Centre has a number of weeds specific projects running concurrently, we continued to work on developing a specific CISS-led weeds RD&E Portfolio. The operating and funding environment for weeds RD&E is complex with many actors involved. A CISS 10-year Investment Plan for Weed RD&E developed in 2018-19 aimed to put in place an enduring model (at least ten-years) of co-investment to enhance the impact of current and future weed management efforts, particularly where they address the priorities of the Australian Weed Strategy 2017-27.



During 2020-21, the Plan was used as the basis for implementing a national network of research and community adaptation sites to manage invasive grasses, with NSW being the first partner to collaborate in the Invasive Grasses Program. Commencing in April 2021, NSW DPI established the first of three state-based experimental and demonstration sites, and was successful in receiving a Commonwealth grant to support the implementation of farmer-led adaptation sites based around each demonstration site.

2020-21 also saw the launch of the Weeds Australia weed information portal, the review and update of over 300 weed information profiles, the continued development of a weed identification app using artificial intelligence to alert whether a plant is weed or not, and the agreement to create a weed biocontrol hub for the ongoing development of weed biocontrol management options.

With over \$8 million committed in cash and in-kind resources being directed through CISS for weed RD&E projects, the Centre commenced a process to develop a full-blown Weed RD&E Portfolio to sit alongside its Invasive Animals RD&E Portfolio. A planning process in 2021-22, alongside the appointment of a full-time Weeds RD&E Program Manager, should see the final steps put in place to commence the weeds Portfolio from around July 2022.

Top image: CISS Balanced Researcher participants attempting to launch an object as part of the team building challenge at the first Balanced Researcher camp held in Canberra in February 2020. Balanced Researcher participants Moses Omogbeme (Murdoch University) (on left) and Maria Jenckel (CSIRO) (on the right) are being assisted by Ash Dowden (Centre). Bottom image: *Nassella-trichotoma*. Image by Andrew Mitchell.

Spotlight on: Invasive grasses are a particularly difficult class of weed to manage, but if done so well the production and biodiversity benefits are significant.

The CISS National Invasive Grasses Research, Development & Engagement Business Plan commenced its national rollout in April 2021. The National Invasive Grasses Program will establish up to a dozen large scale demonstration sites across Australia. All large-scale sites will have at least seven on-farm producer-led adaptation satellite sites, which in turn will be accessible to the wider communities surrounding them.

NSW DPI kick-started implementation of the Program with the establishment of three national sites to test and highlight best practice management of serrated tussock, Chilean needle grass and African lovegrass. The Australian Government quickly followed with an announcement that it would provide funding to establish 21 adaptation sites associated with the NSW national sites.

The aim of the Program is to have at least 4,000 land holders engaged in Program activities, with at least half of them adapting the recommended practices to their properties within the life of the Program.

Support For National Capacity And Planning

National Environmental Biosecurity RD&E Strategy Coordination

Initial planning	Underway	Final stages	Complete
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2020/2021 progress

During 2018–19, CISS was appointed by the National Biosecurity Committee (NBC) to assess implementation progress made against the National Environment and Community Biosecurity Research, Development & Extension (NECBRD&E) Strategy 2016–2019, and to assist the Environment and Invasives Committee (EIC) prepare a new strategy for 2020 and beyond.

This project entered into its final phase during this reporting period. A draft NECBRDE Strategy was prepared and, just following the reporting period, presented to the Environment & Invasive Committee. The Strategy reflects a gap analysis undertaken of the previous 2016-19 Strategy, which identified the absence of a custodian and lack of coordination for the original Strategy as key reasons for a lack of its implementation. The project also found: a) each of the four national biosecurity RD&E strategies acknowledge the need for better cross-strategy linkages to reduce duplication and eliminate silos, yet they lack a mechanism to achieve this; and b) it is opportune that the release of the new Strategy coincides with a time when there is increased recognition of the importance of environmental and community biosecurity.

The revised Strategy explicitly identifies coordination as the primary mechanism for implementation of the Strategy. This approach is strongly supported by stakeholders. Committee oversight of the Strategy is recommended to strengthen the likelihood of broad and appropriate implementation. It also recommends that an implementation national coordinator work closely with stakeholders through the establishment of working groups to ensure coordination of the delivery of key strategic actions identified by the Strategy.

Leader: A/Prof Richard Price | CISS

Partners: Australian Government Department of Agriculture, Water and the Environment and state government members of the Environment and Invasives Committee (EIC).

Aim: The National Coordinator position supported by this project aims to: i) assess what has been undertaken against the current strategy and identify the critical gaps, ii) develop a communication strategy and action plan to assist with the promotion and implementation of the strategy, iii) network and collaborate with key stakeholders in environmental biosecurity RD&E to prepare a new NECBRD&E strategy for implementation from 2020, and work with CISS and the EIC on the transition to implementation of the new strategy.

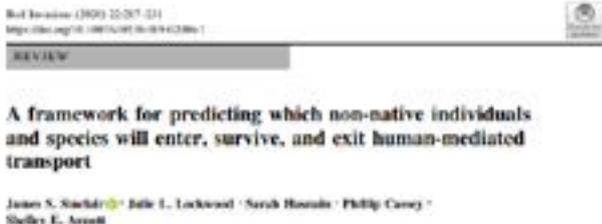


OUR PRODUCTS AND EXTENSION

OUR PRODUCTS AND EXTENSION

22

Registered products and trademarks

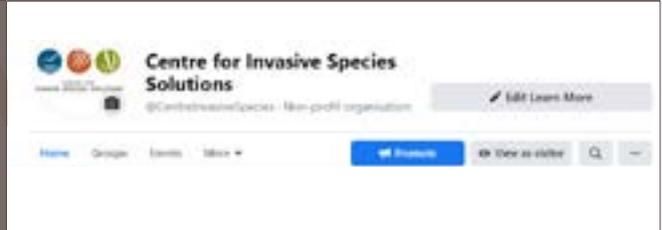


22

Peer reviewed research publications

2,629

Followers of CISS social media

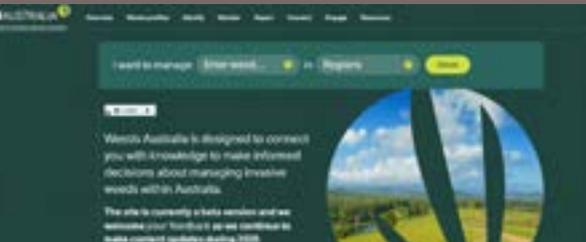
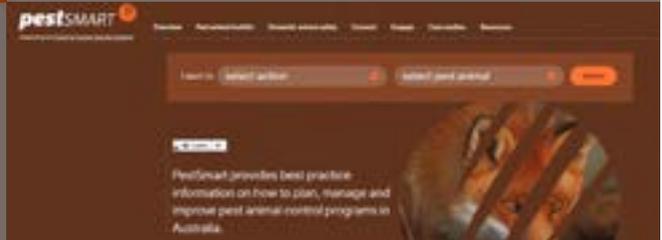


23,400+

FeralScan users

255,019

PestSmart webpage views



299,291

WeedsAustralia webpage views

4,721

CISS e-news subscribers



CISS
CHRONICLE

New products and commercialisation

Over the past year, several new commercial products have been registered or progressed. These include legacy products from the Centre's predecessor — the Invasive Animals Cooperative Research Centre (IA CRC) — as well as new products started by the Centre.

IA CRC legacy products include:

- HOGGONE® sodium nitrite feral pig bait. The culmination of more than 10 years work through a strategic partnership between Animal Control Technologies (ACTA), Meat and Livestock Australia, US Department of Agriculture, and Invasive Animals Ltd, ACTA obtained Australian Pesticides and Veterinary Medicines Authority (APVMA) registration in September 2019 and the product is now commercially available. (<https://animalcontrol.com.au/>)
- PAPPPutty™ Lethal Paste for Wild Canids for use on leg-hold traps. This extensive collaboration between Invasive Animals Ltd, NSW DPI and Connovation Ltd resulted in PAPPPutty being registered by the APVMA in September 2020.
- Gonacon Immunocontraceptive Vaccine for the non-surgical serialisation of kangaroos and wallabies is an international collaboration between Invasive Animal Ltd, the US Department of Agriculture, Spayfirst, CSIRO and the ACT Government. Initial difficulties with manufacturing processes have been overcome. Differences in registration processes between the US and Australia have resulted in added impediments to the Australian registration process. These are gradually being resolved.
- Wild Dog Alert and E-Tech Hub are collaborative AI/machine learning based technology projects between Invasive Animals Ltd, Australia Wool Innovation, Meat and Livestock Australia, NSW DPI, WA DPIRD and the University of New England. They are now cooperating through a Commercialisation Governance Committee to oversee the commercialisation process. Commercialisation of outputs is being managed through the NSW DPI Global Ag-Tech Ecosystem (GATE) program.

New product development or registration started under CISS that will follow a commercialisation pathway to market include:

- Feral Deer Aggregator which currently has several prototype devices under trial and suitable device/s will be carried through to commercialisation.
- 1080 based feral cat bait, ERADICAT® which is already registered and available in WA, however Invasive Animals Ltd is progressing national APVMA registration of the bait to enable its Australia wide use.
- RHDV2 vaccine, whose development is well progressed.

SEE THE RESEARCH AND INNOVATION SECTION FOR PROJECT PROGRESS SUMMARIES

Intellectual property management

Licensed IAL IP that generates modest royalties from the sale of products developed through the IA CRC (2005–17) is reinvested into the Centre. Licensed intellectual property (IP) that generates royalties from the sale of products from the Pest Animal Control CRC (pre-2012) is disbursed to IP owners from that CRC.

IP that is novated and/or managed by IAL is related to the commercialisation of:

- PIGOUT®, 2020-21 financial year royalty of \$1,370.20, distributed to Pest Animal Control CRC Participants
- HOGHOPPER, 2020-21 financial year royalty of \$539.70, retained by IAL
- RODEMISE®, 2020-21 financial year royalty of \$12,804.51, retained by IAL
- Wild dog and fox PAPP, 2020-21 financial year royalty of \$92.74, retained by IAL
- HOGGONE®, 2020-21 financial year royalty of \$11,276.95, retained by IAL

Intellectual property strategy

IP as defined in the Portfolio Agreement No. 1 encompasses all assets resulting from intellectual endeavour excluding Moral Rights. Public Good IP will continue to be managed in the same way as previous years and by the IA CRC — that is, all IP is 100% vested in IAL (called Centre and/or Portfolio IP) and available to all Portfolio Agreement parties for their own use in research, training and adoption.

IP with commercial potential is managed distinctly from public good IP:

- Co-investors (Investor Partners) in a commercially orientated project (Specified Project) may legally and beneficially co-own project IP.
- Specified Project IP is distinguished from Centre IP.
- Specified Project IP ownership is determined by a process that is agreed to by Specified Project participants directly involved in the project.
- All investors in a Specified Project have a say in developing the terms under which project IP will be commercialised.

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

Patents

IAL has maintained and managed patents and patent applications for the use of nitrite salts as poisons in baits for omnivores. The development work in nitrite salts is focused on feral pig control. Patented IP managed during the reporting period includes:

- Australian granted patent AU 2008221237 — Nitrite Salts as Poisons in Baits for Omnivores
- New Zealand granted patent 579357 — Nitrite Salts as Poisons in Baits for Omnivores
- United States of America granted patent US 9750242 — Nitrite Salts as Poisons in Baits for Omnivores
- Canadian patent application 2677935 — Nitrite Salts as Poisons in Baits for Omnivores.

Digital assets

The Centre for Invasive Species Solutions is maintaining and upgrading a number of our leading pest management digital resources, including:

- PestSmart (knowledge hub) — www.pestsmart.org.au
- WeedsAustralia (knowledge hub) — www.weeds.org.au
- Community engagement tool (e-training course) — www.community.invasives.com.au
- FeralScan (community surveillance digital platform) — www.feralscan.org.au
- Rabbit management planning decision support tools — <https://landcare.shinyapps.io/SimRab>
- Field Guide to Pest Animals of Australia (app) — iTunes Apple store

Digital technology embraced by the Centre is seen as a core enabler of present and future best-practice pest animal management. All our digital tools have been enhanced and integrated to provide end users with improved community features and better ways to connect.

Intellectual property protected (non-patent)

Table 1: Intellectual Property currently held for commercial purposes

IP DESCRIPTION AND PRODUCT NAME	IP CREATION DATE BY YEAR	LICENCE NATURE
Blue Healer trademark	2005	Not applicable
HOGGHOPPER design and manufacturing specifications	2010	Exclusive (worldwide)
Rodenticide pen/field efficacy studies	2005–2008	Exclusive (in Australia)
Nitrite-based pesticide products: Commercialisation of granted patents (Aus, NZ, USA and Canada)	2007	Exclusive (worldwide)
PIGOUT pen/field efficacy studies	2003–2005	Exclusive
PAPP wild dog and fox bait and toxin	2005–2014	Exclusive (worldwide)
PAPP wild dog and fox bait and toxin	2012	Not applicable
PestSmart trademark	2015	Not applicable
LandSmart trademark	2016	Not applicable
FarmSmart trademark	2016	Not applicable
AntSmart trademark	2015	Not applicable
AVPC trademark	2015	Not applicable
Centre for Invasive Species Solutions trademark	2017	Not applicable
PlantSmart	2018	Not applicable
FeralScan trademark	2018	Not applicable
BiteMe trademark	2018	Not applicable
PAPPutty trademark	2019	Not applicable
Wild Dog Alert trademark	2019	Not applicable
WeedScan trademark	2019	Not applicable
BiosecuritySmart trademark	2020	Not applicable

Patents

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PATENT NAME

Australian granted patent AU 2008221237 — Nitrite Salts as Poisons in Baits for Omnivores

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United States of America granted patent US 9750242 — Nitrite Salts as Poisons in Baits for Omnivores

Canadian patent application 2677935 — Nitrite Salts as Poisons in Baits for Omnivores. Exclusive (worldwide)

Option agreements to commercialise intellectual property

Table 2: Option agreements to commercialise intellectual property

IP DESCRIPTION AND PRODUCT NAME	CONTRACT	IP CREATION DATE	LICENCE NATURE
Rodenticide (CRADA) with USDA	USDA	2013–2017	Exclusive (worldwide)
HOGGONE® USA (CRADA) with USDA	USDA	2013–2017	Exclusive (worldwide)
Microencapsulated sodium nitrite formulations (CRLA) with Texas Parks and Wildlife	Texas Parks and Wildlife Department USDA	May 2015	Exclusive (worldwide)
Rodenticide (CRADA)	USDA	2017–2022	Exclusive (worldwide)

Research excellence

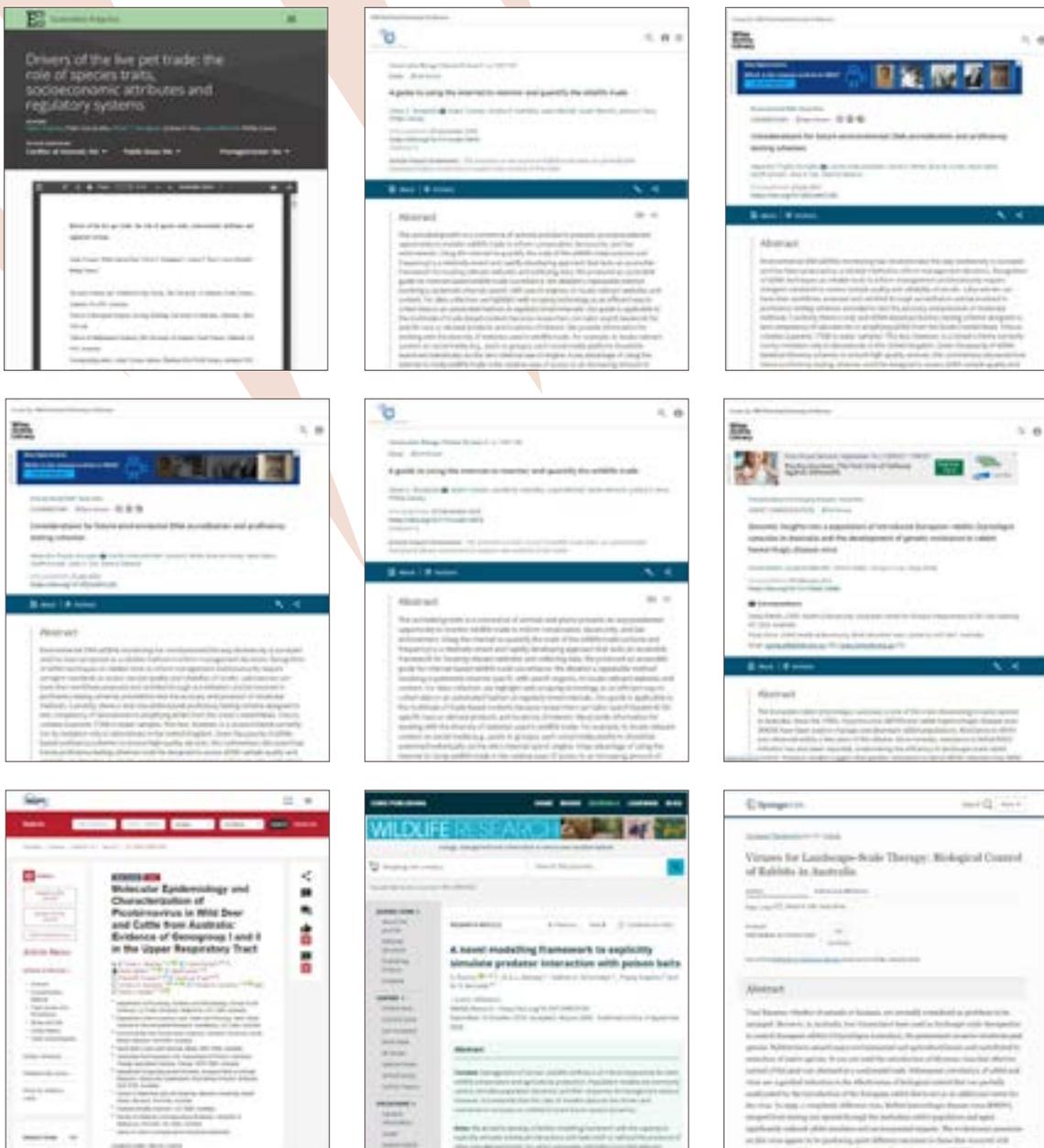
The Centre for Invasive Species Solutions continues to pride itself on research excellence that informs best practice management, and the development and subsequent adoption of new tools, technologies and systems that increase the ability of land managers to effectively deal with invasive species.

During the financial year, **22** peer reviewed scientific publications and **7** technical reports were published through our extensive RD&E collaboration.

The majority of these publications are as a direct result of research undertaken as part of the Centre for Invasive Species collaborative research projects while a small number are the result of flow on work from projects of the Invasive Animals CRC that are now coming to fruition. A full list of publications is presented on the next page.

In addition to published material from research outputs, the past 12 months has seen CISS projects take part in **264** stakeholder workshops and **29** (27 full and 2 speed talks) presentations at the Australasian Vertebrate Pest Conference. These conferences and workshops have been an effective method for showcasing best practice pest management techniques and for working with, and increasing the capacity of stakeholders and end users to use best practice invasive species management techniques.

OUR PRODUCTS AND EXTENSION



List of Publications

Incursions

1. Stringham, O. C., and Lockwood, J. L. (2021). Managing propagule pressure to prevent invasive species establishments: propagule size, number, and risk-release curve. *Ecological Applications* 31(4):e02314.
2. Sinclair, J. S., Stringham, O. C., Udell, B., Mandrak, N. E., Leung, B., Romagosa, C. M., & Lockwood, J. L. (2021). The International Vertebrate Pet Trade Network and Insights from US Imports of Exotic Pets. *BioScience*. 71 (9) 977-990.
3. Stringham, O. C., Moncayo, S., Thomas, E., Heinrich, S., Toomes, A., Maher, J., Hill, K.G.W., Mitchell, L, Ross, J.V., Shepherd, C.R., & Cassey, P. (2021, July 7). Dataset of seized wildlife and their intended uses. <https://doi.org/10.32942/osf.io/uyqd3>.
4. Stringham OC, Moncayo S, Hill KGW, Toomes A, Mitchell L, et al. (2021). Text classification to streamline online wildlife trade analyses. *PLOS ONE* 16(7): e0254007.
5. Stringham, Oliver C., García-Díaz, Pablo, Toomes, Adam, Mitchell, Lewis, Ross, Joshua V., Cassey, Phillip. Live reptile smuggling is predicted by trends in the legal exotic pet trade. *Conservation Letters*. 2021;e12833.
6. Toomes, A., Stringham, O. C., Mitchell, L., Ross, J. V., & Cassey, P. (2020). Australia's wish list of exotic pets: biosecurity and conservation implications of desired alien and illegal pet species. *NeoBiota*, 60, 43.
7. Mynott JH, Shackleton M, Furlan E, Rees G, Gleeson D, Bond. (2021). eDNA: review of applicability for monitoring and detecting biotic populations of the Murray-Darling Basin. Technical Report.
8. Trujillo-González, A., Villacorta-Rath, C., White, N. E., Furlan, E. M., Sykes, M., Grossel, G., Divi, U., & Gleeson, D. (2021). Considerations for future environmental DNA accreditation and proficiency testing schemes. *Environmental DNA*, 00, 1– 10. <https://doi.org/10.1002/edn3.243>.
9. Rourke, ML, Fowler, AM, Hughes, JM, et al. Environmental DNA (eDNA) as a tool for assessing fish biomass: A review of approaches and future considerations for resource surveys. *Environmental DNA*. 2021; 00: 1– 25. <https://doi.org/10.1002/edn3.185>.
10. Rojahn, J, Gleeson, DM, Furlan, E, Haeusler, T, Bylemans, J. (2021). Improving the detection of rare native fish species in environmental DNA metabarcoding surveys. *Aquatic Conservation: Marine and Freshwater Ecosystems*. 2021; 31: 990– 997. <https://doi.org/10.1002/aqc.3514>.
11. Gormley, A.M., Anderson D.P., Lustig, A., Latham C.M., Howard, S., Scroggie, M., and Ramsey D.S.L. (2021). Quantitative Decision Support for Eradication: A Primer. Manaaki Whenua – Landcare Research and Arthur Rylah Environmental Research Institute. Published by the Centre for Invasive Species Solutions, Canberra, Australia.
12. Barnes, B., Giannini, F., Parsa, M., & Ramsey, D. (2021). Inferring species absence from zero-sighting records using analytical Bayesian models with population growth. *Methods in Ecology and Evolution*, 00, 1– 13. <https://doi.org/10.1111/2041-210X.13697>.
13. Barnes, B., Giannini, F., Parsa, M., & Ramsey, D. (2021). Inferring species absence from zero-sighting records using analytical Bayesian models with population growth. *Methods in Ecology and Evolution*, 00, 1– 13. <https://doi.org/10.1111/2041-210X.13697>.

Community engagement

1. Stringham, O.C., Toomes, A., Kanishka, A.M., Mitchell, L., Heinrich, S., Ross, J.V. and Cassey, P. (2021). A guide to using the Internet to monitor and quantify the wildlife trade. *Conservation Biology*. Accepted Author Manuscript. <https://doi.org/10.1111/cobi.13675>.

Biocontrol

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Digital Extension

The Centre supports the adoption of best practice invasive species management by making practical resources for land managers available through three dedicated extension websites: PestSmart, FeralScan, Weeds Australia and Community Invasives Action.



PestSmart® — www.pestsmart.org.au — provides best practice information on how to plan, manage and improve pest animal control programs in Australia.

FeralScan® — www.feralscan.org.au — provides a pest animal recording and management tool for Australian land managers.

Weeds Australia — www.weeds.org.au — connects Australian land managers with the information they need to make informed decisions about managing invasive weeds.

Community Invasives Action — www.community.invasives.com.au — provides tailored resources for people coordinating community-led action on invasive species.

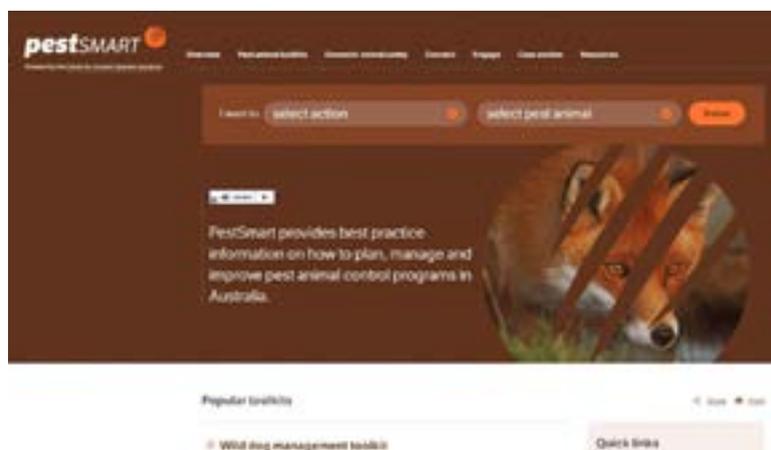
The Centre also supports national communication campaigns focused on invasives species and Australian biosecurity in partnership with our members, associate members, partners, and other key stakeholders.

PestSmart: providing Australian land managers with digital resources to manage pest animals

The PestSmart website provides land managers with information toolkits to manage pest animals and the knowledge to plan, implement and improve their control programs.

A significant upgrade of the PestSmart website was undertaken in 2019/20. This drew on two years of consultation and co-design work with key user groups. The new site went live on 21 August 2020 and attracted 134,519 users and 219,827 unique page views during the financial year.

The most popular pages were Domestic animal safety: the facts of 1080 baiting (12,639 unique page views), the Economic and environmental impacts of rabbits in Australia (7,609 unique page views), and the Resources page (6,351 unique page views).



Glovebox Guides

Visitors to the PestSmart website can order copies of the Centre's Glovebox Guide Series which cover best practice management of wild dogs, foxes, feral cats, rabbits, and feral pigs, as well as tailored poison baiting guides for wild dogs and foxes, and feral pigs.

Over 9,200 orders for hard copies of the Glovebox Guides were received in 2020/21 from councils, government agencies, pest management groups, schools, contractors, and other individuals. The Glovebox Guide for Managing Foxes, the Glovebox Guide for Managing Rabbits, and Glovebox Guide for Managing Feral Pigs were the most popular.



Feral Photos and Video Competition

The Centre's popular Feral Photos and Video competition was reprised in 2021 with close to \$5000 worth of prizes on offer, thanks to our competition partners: Animal Trap Solutions, CSIRO Publishing and Outdoor Cameras Australia. The winners were chosen by members of the public with entrants voting for their favourite entries and included:

- 1st place — Lucca Amorim from NSW with 'The Hidden Observer'. (Photo)
- 2nd place — David Eastham from Victoria with 'Always Watching'. (Photo)
- 3rd place — Lara Winsor from SA with 'Urban Fox Scavenger'. (Video)
- 4th place — Simon Ferguson from NT with 'Feral Cat Tennant Creek'. (Photo)
- 5th place — Darryn Mundt from QLD with 'Mmmm berries'. (Photo)



Image 6: Our winner for the 2021 Feral Photos and Video Competition, Lucca Amorim, opens his prize from Outdoor Cameras Australia.

Case study: FeralScan community pest animal management platform

feralSCAN 

The Centre's FeralScan community monitoring and management program, developed by Peter West at NSW Department of Primary Industries, reached new heights in the past 12 months — as Australia's largest community pest animal monitoring resource.

The FeralScan website and app support mapping and management of pest animals by individuals, community groups and biosecurity groups across Australia.

In 2020/21 the FeralScan platform had over 34,600 individual users and 550 registered private community or biosecurity groups. Together they entered over 45,000 new pest animal records.

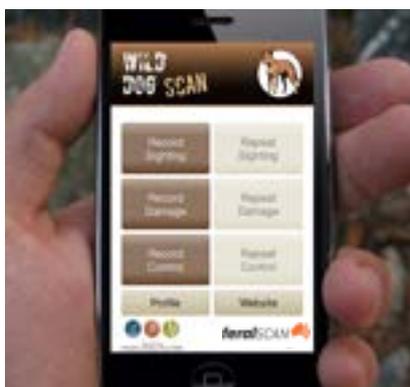
FeralScan now hosts over 258,000 geospatially located records of pest animals, the problems they cause, and the coordinated actions being undertaken to manage them by landholders and community groups.

People who use FeralScan receive practical information about monitoring and controlling pest animals, and are connected to practical PestSmart resources.

Demand for FeralScan continued to grow exponentially, with more landholders and community-groups using the free resource each year for monitoring pest animals in their local area to guide pest management.

“One of the benefits of FeralScan is that it has been developed with continuous feedback and guidance from farmers, community groups and the public. As a result, it addresses community interests and needs, and it has become a vital tool for landholder groups and biosecurity groups all over Australia” Peter West — Project Leader and Invasive Species Officer (NSW DPI) — said.

“We work tirelessly to help connect people to resources, organisations and support, to assist them with managing pest animals in their local area” Peter said.



Case Study: FeralScan now used by over 550 groups

Throughout the past year, despite challenges with Covid-19 restrictions, the project has delivered over **100** online and face-to-face community workshops across South Australia, Victoria, Queensland, NSW, Tasmania, Western Australia and the Northern Territory. Each event has helped people to use FeralScan for their local needs, apply practical PestSmart resources, learn about pest control and new technologies, and connect to local groups/ organisations.

More landholders and community-groups are using the free resource each year for monitoring pest animals in their local area to guide pest management. **FeralScan** contains an impressive **258,270** records and **31,560** photographs of pest animals and their control — which have been entered by landholders, community groups and biosecurity organisations Australia-wide.

Over **34,600** Australians have now signed up to use the program, and **550** private registered groups (including landholder groups and biosecurity groups) now use the resource to help map, monitor and manage pest animals in their local area.



Images: The FeralScan platform supports people to work together with monitoring and controlling pest species all over Australia. Images supplied by Peter West (NSW DPI).

Project highlights

FeralScan celebrated its **10th** year anniversary in January 2021

Delivered **104** community workshops and online webinars in past 12 months

23,242 alert notifications to landholder groups and biosecurity agencies

31,560 photographs of pest animals uploaded by the community

34,687 people signed up Australia-wide

128,000 wild dog records entered into WildDogScan

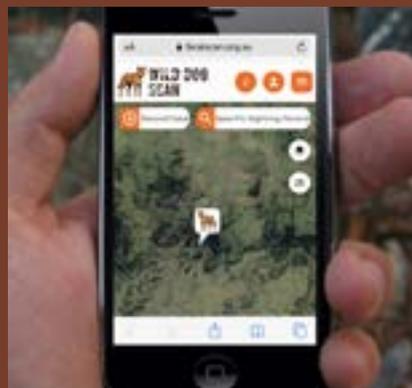
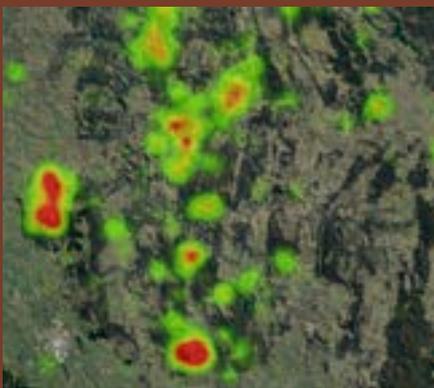
FeralScan has also recently provided heat maps to display hotspot areas for established pest animals around Australia.

<https://www.feralscan.org.au>

Next steps for FeralScan

1. Additional workshops and webinars for communities will be held around Australia
2. Landholder groups will be connected to the National Facilitators for wild dogs, pigs, deer, foxes and feral cats
3. A new interactive wild dog management map will be produced to help people get involved in wild dog programs
4. The app and website will be upgraded to meet the needs of professional pest controllers
5. Practical resources about pest control will be delivered to FeralScan users
6. Private groups will be given better dashboards to chart trends over time and evaluate the effectiveness of control programs

“We remain committed to ensuring it continues to help landholders with monitoring and managing pest animals into the future”, Peter West (FeralScan Project Leader) said.

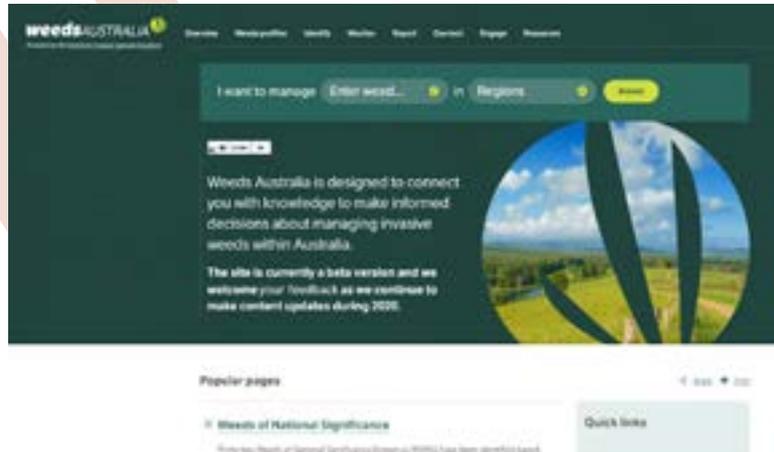


WeedsAustralia

The new WeedsAustralia website (launched as a beta version in April 2020) attracted over 87,000 users with 250,378 unique page views. The most popular pages were the Identify a weed in your region page (29,027 unique page views) and the Manage your weed problem page containing weed profiles (27,727 unique page views).

The weed profiles on the website are hosted by the Atlas of Living Australia and have been reviewed and updated during 2020/21 by the SA Herbarium.

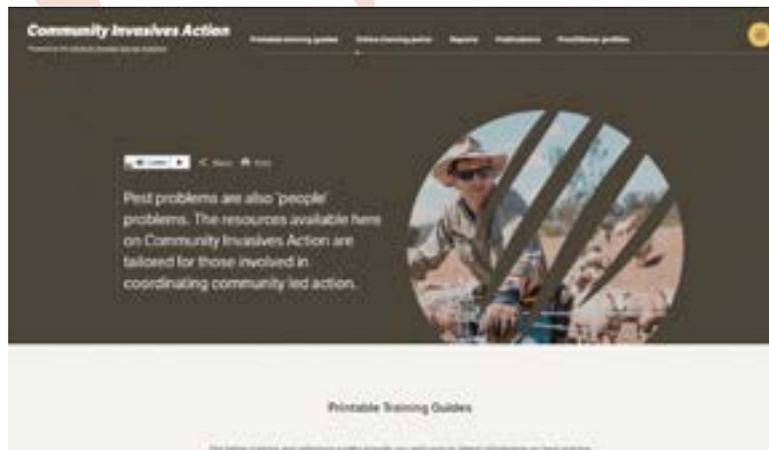
Ongoing improvements to the website will continue to be made based on user feedback.



Community Invasives Action

This microsite showcases the best practice resources for community engagement and is designed to support coordinators and extension officers working with communities across Australia.

During 2020/21 the microsite attracted 1,210 users, with 1,785 unique page views. The microsite includes a range of training guides, a training portal, reports, publications, and profiles. The most popular content was the Community Video Series.



Communication and media

Corporate website

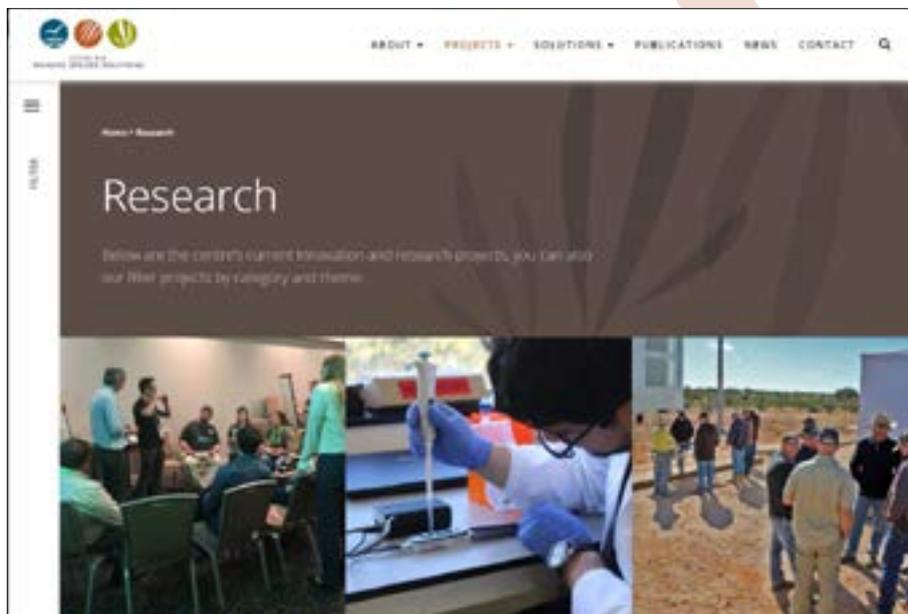
The Centre's corporate website, invasives.com.au, attracted 21,004 users (a 46% increase on 2019/20) with 53,155 unique page views (a 42% increase on 2019/20).

The number of sessions increased to 31,928 (a 59% increase on 2019/20), though the average session duration dropped to 1 minute and 20 seconds (a 31% decrease on 2019/20).

The top two three posts were:

1. "Pesky emu's proving a 'stretch' for our feral deer aggregator", published 16 May 2021
2. "Camera traps detecting the undetected", published 19 November 2020
3. "Job opportunity: National Feral Deer Coordinator", published 24 July 2020

The website is used to communicate Centre news, the ongoing impact of our research portfolio and relevant national events. Summaries of all the Centre's research projects are available on the website with progress on their delivery updated biannually.



E-newsletter

The CISS Chronicle' is published monthly with the latest Centre news, research, publications, events, and relevant news from other organisations. It is aimed at researchers, farmers, land managers, journalists, and students.

Twelve issues were published with subscriber numbers increasing over the year by 11.3% to 4,721. The newsletter open rate was 28—33%, and the click rate was 6—10%.



Media and news items

The Centre's engagement with the media resulted in 1,560 media mentions (including syndications) of the Centre and our major products — PestSmart, FeralScan and RHDV1 K5 — reaching an estimated audience of 6 million people.

Fifty news items, including media releases, were published on the Centre's website. The Centre's news page received 12,235 page views (an increase of 85% on 2019/20) and accounted for 20% of the total page views for the website.

Highlights



Australia's Biosecurity Future: Unlocking the next decade of resilience (2020-2030)

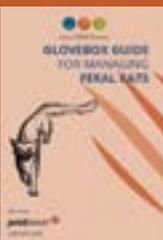
Published by the CSIRO in partnership with Animal Health Australia, Plant Health Australia, and the Centre for Invasive Species solutions.

This 2020 report generated 344 individual news items across the major metropolitan, regional and rural news outlets (online, radio, TV, and social media).



Announcement of new National Deer Management Coordinator

The announcement — made by the Hon David Littleproud MP, Minister for Agriculture and Northern Australia — was syndicated through Nine Publishing's rural press.



Launch of the new Feral Cat Glovebox Guide

The new guide was launched by the Hon Sussan Ley MP, Minister for the Environment, via Facebook.

The Department of Agriculture, Water and the Environment's media release was syndicated through the rural press.



Launch of the Feral Photos and Video Competition

The competition launch was promoted via a media release that was syndicated through the rural press.

The winning images were featured in Stock Journal, in The Sydney Morning Herald (page 3), and online.



The deer problem across Australia (featuring the Centre's deer research program)

Article by press gallery journalist Jamieson Murphy was syndicated in 124 online media articles across rural and regional press.



The Australian Senate Inquiry into Feral Deer, Goats and Pigs

Article by press gallery journalist Jamieson Murphy, noting the need for continued funding of the Centre, was syndicated through Nine Publishing's rural press.



Announcement of Mouse Genetic Biocontrol Project

The project announcement by The Hon Adam Marshall MP, Minister for Agriculture and Western New South Wales, received strong national and NSW-specific media attention.

The announcement was syndicated across more than 100 online news outlets, and Professor Paul Thomas from the University of Adelaide gave several media interviews.

Social media

The Centre's social media following increased 113% to a total audience of 2,629 across all channels (Facebook, LinkedIn and Twitter). The most popular channel was Twitter with 1,407 followers. Facebook had 970 followers and LinkedIn 252 followers.

Follow us!



<https://twitter.com/centreinvasives>



<https://www.facebook.com/CentreInvasiveSpecies>



<https://www.linkedin.com/company/centre-invasive-species-solutions>

Communication with Members, Associate Members and Partners

During the year the Centre sent members, associate members, and partners three communiques, which were followed by video conference meetings, and hosted a virtual AGM and CISS Forum.



Towards a Feral Free Future — Podcast



OUR PRODUCTS AND EXTENSION

The Centre produced an 11-part podcast series 'Towards a Feral Free Future' hosted by former ABC Landline reporter and award-winning rural journalist Prue Adams. Each episode focused on a different aspect of invasive species management.

The series was released in late 2021, with 72 downloads during the month of June. The Centre expects the series to be well received and attract a wide listening audience in 2021/22.

To listen to the podcast visit <https://podfollow.com/towards-a-feral-free-future>

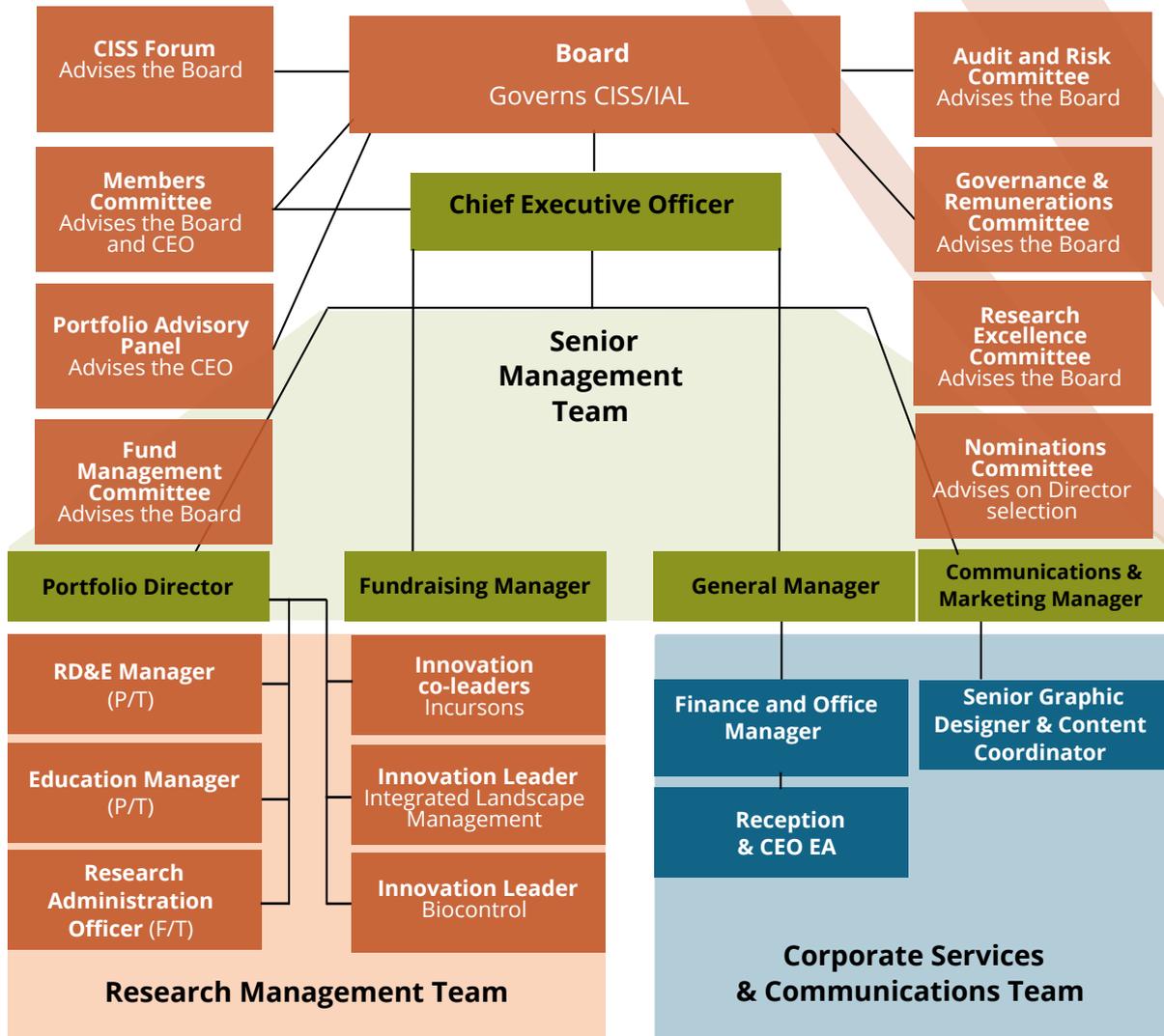
The banner features the logo of the Centre for Invasive Species Solutions, which consists of three circular icons: a blue bird, an orange circle with white lines, and a green circle with white leaves. Below the icons is the text 'CENTRE FOR INVASIVE SPECIES SOLUTIONS'. On the right side, it says 'Hosted by Prue Adams'. The background is a blurred outdoor scene with a woman smiling. At the bottom, the text reads 'SEARCH TOWARDS A FERAL FREE FUTURE IN YOUR PREFERRED PODCAST STORE'.

OUR GOVERNANCE AND MANAGEMENT

Invasive Animals Ltd (IAL) is a public company limited by guarantee incorporated and domiciled in Australia. It has been endorsed by the Australian Taxation Office, as a tax concession charity and exempt from income tax and is registered as a Charity with the Australian Charities and Not-for-Profit Commission.

From 15 September 2020, IAL was appointed as the Trustee for the Invasive Species Solutions Trust (ISST). The ISST and the related Public Fund, known as the Invasive Species Solutions Fund, were formally established by deed on 15 September 2020 (Trust Deed) and the Public Fund was entered in the Register of Environmental Organisations and Deductible Gift Recipient (DGR) status, granted 7 December 2020.

The following organisation chart excludes IAL project staff.



OUR GOVERNANCE AND MANAGEMENT

The structure and governance of the Centre provides strong support to its operations. CISS is led by a Board of skills-based Directors, who are independent from its members and partners. The Governing Board meets at least four times a year and is committed to compliance with the Australian Charities and Not-for-Profit Commission, the Australian Security & Investments Commission Corporate Governance Principles and Recommendations and the Register of Environmental Organisations.

In carrying out its governance role, the main task of the Board is to develop and monitor the CISS strategy, ensure compliance to IAL constitution, to develop policies and ensure the company complies with its contractual, statutory and other obligations.

The names and details of the Directors in office during the financial year and at time of publication of this report are as follows.



Invasive Animals Limited Board of Directors: (top row L-R) Bruce Christie, Jan Ferguson OAM, David Palmer (bottom row L-R) Murray Rankin, Robbie Davis, Peter Noble.

DIRECTORS	ROLE	KEY SKILLS	INDEPENDENT/ ORGANISATION
Bruce Christie	Chair	Director since 2020. Corporate Biosecurity expert, Research & Development, Adoption Governance	Independent
Peter Noble	Director	Director since 2015. Legal speciality, Governance & Risk Management	Independent
David Palmer	Director	Director since 2013. Governance, Management & Policy Development	Independent
Murray Rankin	Director	Director since 2013. Governance, Communication, Business & Commercial	Independent
Robbie Davis	Director	Director since 2020. Governance, Primary Industries and Regions	Independent
Jan Ferguson OAM	Director	Director since 2018. Governance, Research & Development, Communication	Independent
Dr Glen Saunders AM	Director Retired November 2020	Director since 2016. Pest Animal Management and Research	Independent
Helen Cathles	Director Retired November 2020	Director since 2005. Governance, Primary Production, Pest Animal Control	Independent
PUBLIC OFFICERS			
Lucie Hassall	Company Secretary	Appointed 14 August 2020	Centre for Invasive Species Solutions
Carolyn Campbell-Wood	Company Secretary	Appointed March 2014 Retired 21 August 2020	Centre for Invasive Species Solutions
Julie McGuiness	Company Secretary alternate	Appointed February 2018 Retired 30 September 2020	Centre for Invasive Species Solutions

DIRECTORS	BOARD MEETINGS		AUDIT AND RISK		GOVERNANCE & REMUNERATION COMMITTEE		RESEARCH EXCELLENCE COMMITTEE		TRANSITIONAL NOMINATIONS COMMITTEE	
	No. eligible to attend	2020-21	No. eligible to attend	2020-21	No. eligible to attend	2020-21	No. eligible to attend	2020-21	No. eligible to attend	2020-21
Number of meetings held for the year:	6		5		4		4		3	
Number of meetings attended:										
Directors										
Bruce Christie (Chair)	3	3	2	2	2	2	2	2		
Helen Cathles (Chair-Retired)	3	3	3	2	2	2			3	3
Jan Ferguson (Chair Research Excellence Committee)	6	6					4	4	3	3
Peter Noble (Chair Governance & Remuneration Committee)	6	6			4	4				
David Palmer	6	6	5	5						
Murray Rankin (Chair Audit & Risk Management Committee)	6	5#	5	5						
Robbie Davis	3	3			2	2				
Dr Glen Saunders AM (Retired)	3	3					2	2		
Transitional Nominations Committee Members										
Matt Koval - (Chair Transitional Nominations Comm)									3	3
John Robertson									3	3
Warwick Ragg									3	3
John Tracey									3	3

Directors were on leave at this time

Committees

Audit and Risk Committee

The Audit & Risk Committee operates under Terms of Reference as approved by the Board. The Audit & Risk Committee has responsibility for the oversight of fiscal and legal matters and ensuring appropriate procedures and internal controls are in place. The Committee is responsible for the independence of the external auditors and also manages the internal audit program. The members of the Audit and Risk Committee at any time during the year were:

- Mr Murray Rankin - Chair
- Mr David Palmer
- Mr Bruce Christie (Appointed November 2020 - optional invitee)
- Ms Helen Cathles (Retired November 2020 - optional invitee)

The Chief Executive Officer, and General Manager and external auditors are invited to Audit & Risk Committee meetings at the discretion of the committee.

Governance and Remuneration Committee

The Governance & Remuneration Committee operates under Terms of Reference as approved by the Board. The members of the Governance and Remuneration Committee at any time during the year were:

- Mr Peter Noble - Chair
- Ms Robbie Davis (Appointed November 2020)
- Ms Helen Cathles (Retired November 2020)
- Mr Bruce Christie (Appointed November 2020 - optional invitee)

The Chief Executive Officer and General Manager are invited to Governance & Remuneration Committee meetings at the discretion of the committee.

Research Excellence Committee

The Research Excellence Committee operates under Terms of Reference approved by the Board. The members of the Research Excellence Committee at any time during the year were:

- Ms Jan Ferguson OAM – (Chair from November 2020)
- Mr Bruce Christie (Appointed November 2020)
- Dr Glen Saunders AM - Chair (Retired November 2020)

The Chief Executive Officer and Portfolio Director are invited to the Research Excellence Committee meetings at the discretion of the committee.

Nominations Committee

The Nomination Committee operates under Terms of Reference approved by the Board. The Committee for the 2020–21 year included:

Name	Position
Mr Matt Koval	Chair
Ms Helen Cathles	IAL Director representative
Ms Jan Ferguson OAM	IAL Director representative
Dr John Tracey	State member (NSW)
Mr Warwick Ragg	National Farmers Federation representative
Dr John Robertson	State member (QLD)

Fund Management Committee

The Fund Management Committee was established in September 2020 in accordance with the ISST Trust Deed and Register for Environmental Organisations. The Committee meets quarterly. The Committee for the 2020–21 year included:

Mr Peter Noble Chair
Ms Jan Ferguson OAM
Ms Robbie Davis

Staff

The Centre for Invasive Species Solutions has a number of staff which coordinate and maintain its administration, communication and research management function.

NAME	POSITION/ROLE WITHIN CISS	TIME COMMITTED
Mr Andreas Glanznig	CEO	100%
Ms Lucie Hassall	General Manager	100%
Associate Professor Richard Price	Portfolio Director (Research)	100%
Associate Professor Ian McDonald	Communications Manager	100%
Dr Tony Buckmaster	RD&E Manager and Balanced Researcher Leader	100%
Mr Greg Mifsud	National Wild Dog Management Coordinator	100% *
Mr Andrew Mitchell	Research Scientist	100% **
Ms Gillian Basnett	National Feral Cat and Fox Management Coordinator	100% **
Mr Dave Worsley	NE NSW Wild Dog Control Coordinator	100%**
Mr Aaron Pobjie	Research Administration Officer	100%
Mr Trevor Capps	Fundraising Manager	100%
Ms Yvette Cazabon	Senior Graphic Designer and Content Coordinator	90%
Ms Shan Southwell	Finance and Office Manager	100%
Ms Jane Leslie	Administration Assistant and EA to the CEO	100%

* funded through Portfolio No 1 project funds

** funded through Aligned project funds

Staff changes

Ms Geena Correa (Research Administration Officer resigned March 2021, replaced by Aaron Pobjie)

A/Prof. Ian McDonald (Communications Manager resigned August 2021, replaced by Frank Exon)

Domain Leaders

NAME	ORGANISATION	DOMAIN	TIME
Dr Brad Page	Primary Industries and Regions, South Australia	Innovation co-leader, Incursions	27%
Dr Tony Pople	Queensland Department of Agriculture and Fisheries	Innovation leader, Integrated Landscape Management	30%
Dr Tanja Strive	CSIRO	Innovation leader, Biocontrol Domain	20% (pro bono)

FINANCIAL PERFORMANCE

Invasive Animals Ltd (IAL) was established to be a non-profit institution to promote a managed and co-operative approach to RD&E in the field of invasive species management so as to maximise the benefits from that RD&E. IAL was appointed as the Trustee for the Invasive Species Solutions Trust (ISST) from 15 September 2020. The ISST and the related Invasive Species Solutions Fund, was entered in the Register of Environmental Organisations and DGR status granted on 7 December 2020. The 2020–21 consolidated financial statements and notes represents those of IAL and the entity it controls, ISST, collectively referred to as the Group.

IAL’s short term objective is to continue to establish the Centre for Invasive Species Solutions, and deliver its first RD&E project portfolio — Portfolio No. 1. Portfolio No.1 is funded through a five-year agreement between the Commonwealth Department of Agriculture, Water and the Environment, all States and the ACT, two industry Research and Development Corporations, five universities and the NZ Department of Conservation. Portfolio No.1 commenced in 2017 and finishes in 2022. In addition, IAL is attracting further funding from state governments and industry bodies to further pursue its objectives.

IAL’s long-term objective is to secure the Centre for Invasive Species Solutions (CISS) as a permanent national collaborative invasive species institution that enables and drives a more coordinated and efficient approach to invasive species management across Australia’s National Biosecurity System. This will include pursuing a broader RD&E scope that covers vertebrate pests, weeds and environmental invertebrates and diseases, and diversifies revenue by attracting deductible gift receipts through the ISST and related Public Fund and additional projects aligned to the CISS strategy.

Performance of the Centre

The total contributions of resources refers to the Portfolio No.1 plus aligned and other projects. Total contributions available in 2021 were \$23,171,574, up from \$13,814,595 available in 2020. 2021 cash revenue (including IAL reserve funded projects) being \$15,400,062 and total In-kind contributions being \$7,771,512.

2021 Total Resources Available

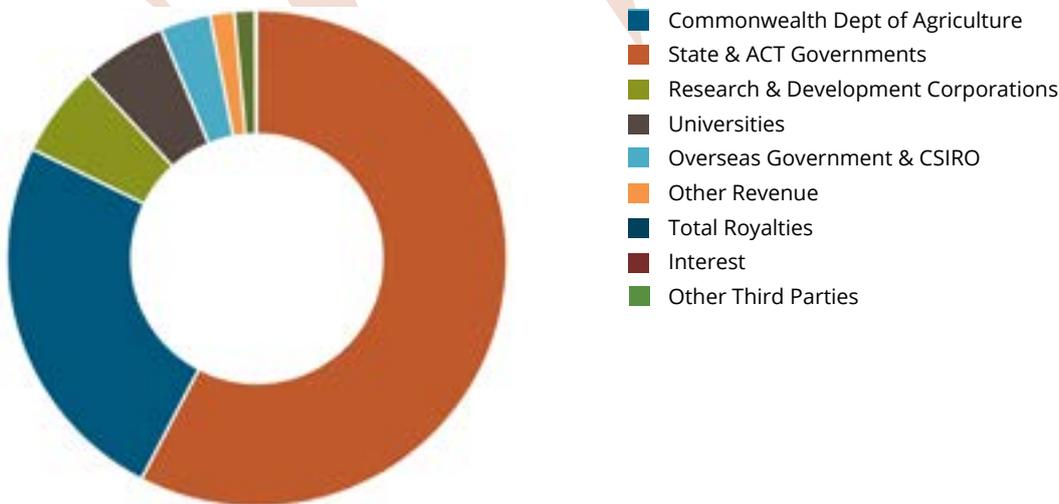


Chart 1: Financial year 2020–21 Total Contributions, both Cash and In-kind by revenue source.

The current whole of CISS leveraging ratio at 30 June 2021 was 3.86 which is tracking ahead of the benchmark of 3.6. CISS also has achieved a nominal leverage ratio of 2.33 to 1 (as defined by AgTrans Research). That is, CISS has secured \$2.33 in co-contributions (cash and in-kind, excluding any additional investment by the Department of Agriculture, Water and the Environment) for every \$1.00 (cash) of the initial Portfolio No. 1 Grant funding.

Resources applied for 2021

The following chart reflects on a percentage basis, the expenditure allocation of the cash revenue and in kind contributions received for the year. The allocation to research activity of 90% is consistent with 30 June 2020. This year a cash revenue amount of \$10,334,255 was carried forward to future years to be spent on contracted and committed projects.

Total Resources Applied for 2021

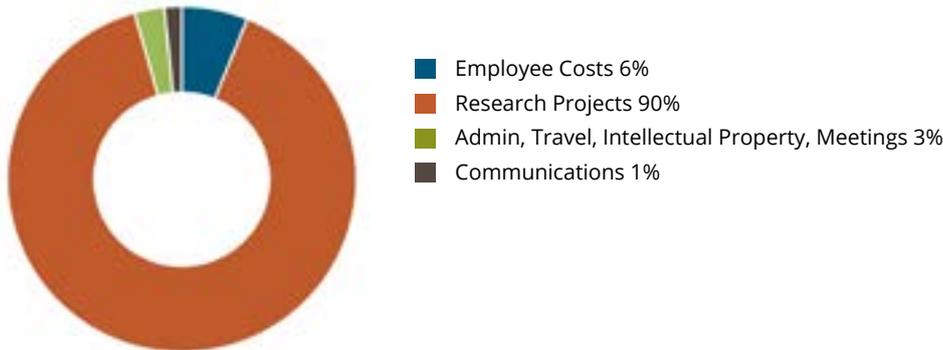


Chart 2: Financial year 2020–21— Allocation of cash and in kind resources to expenditure by percentage ratio.

Net surplus 2021

The Group achieved a net surplus of \$152,248 in 2021 (2020: \$298,163). Financial savings were achieved during the year 2020–21 in relation to travel and accommodation costs with the deferral of workshops and the use of remote, rather than in person, meeting attendance. Hosting the AVPC 18 conference also contributed to the surplus.

2021 Revenue (cash and other)

The total net revenue of \$8,704,436 (total cash \$15,400,062 including IAL reserve projects less carried forward movement of \$6,695,625) included \$5,706,550 invested by the Commonwealth Department of Agriculture, Water and the Environment, with other members and partners also providing significant revenue: \$1,292,220 by Research and Development Corporations (including universities), \$7,911,423 by the States and Territories and \$97,800 by the NZ government and others.



Chart 3: Financial year 2020–21 — Cash and other revenue received by revenue source.

2021 In-kind Contributions

The total In-kind contributions of \$7,771,512 for both Portfolio No.1 and aligned projects was invested by the States and Territories, the universities, CSIRO and other third parties.



Chart 4: Financial year 2020–21— Total In-kind Contributions received by organisation group.

The positive total asset position at June 2021 of \$13,923,622 represents sufficient cash flow to meet the liabilities of \$12,291,273. The Group's equity position at 30 June 2021 was \$1,632,349 an increase from \$1,480,091 at 30 June 2020.

Balance Sheet

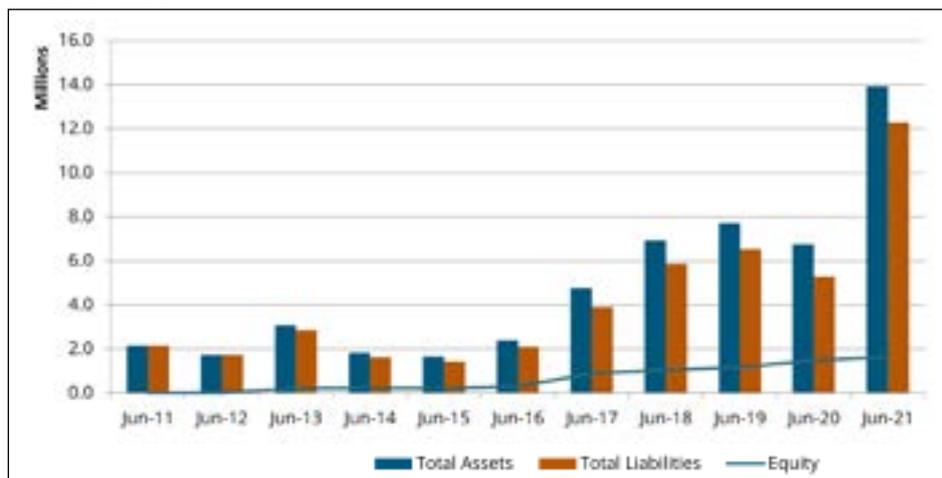


Chart 5: Financial year 2020-21 — IAL Company Balance Sheet reflecting Total Assets to Total Liabilities and resulting Equity (or Earnings).

Total Cash Reserve



Chart 6: Financial year 2020-21 — Total Cash Reserves for the Group as a quarterly trend over time.

Liquidity Ratio



Chart 7: Financial year 2020-21 — IAL's Liquidity Ratio compared to the Commercial best practice benchmark.

The current asset ratio, (a measure of liquidity), as at 30 June 2021 was 1.91.

Information used in compiling these graphs has been derived from the complete Audited Financial Statements which are available for download from www.invasives.com.au





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