cebra

Centre of Excellence for
Biosecurity Risk Analysis

Annual Report

2021 - 2022

Australian Government
Department of Agriculture, Fisheries and Forestry

THE UNIVERSITY OF MELBOURNE

Ministry for Primary Industries
Manatū Ahu Matua

CEBRA acknowledges the Wurundjeri Woi Wurrung people,
the Traditional Owners of the land on which our offices are located,
and pay respect to their Elders (past and present) and families.

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CEO's message

It is my privilege and pleasure to introduce the 2021–22 Centre of Excellence for Biosecurity Risk Analysis (CEBRA) annual report.

As CEO of the Centre of Excellence for Biosecurity Risk Analysis, I welcome readers to our annual report for the year ended 30 June 2022. This is our first year under our new grant agreement (which is in place until June 2025) with the Australian Government Department of Agriculture, Fisheries and Forestry and New Zealand's Ministry for Primary Industries.

The past twelve months have presented a multitude of challenges for biosecurity regulators, researchers and practitioners. In June, Varroa destructor (a parasitic mite of honeybees) was detected in surveillance hives near the port of Newcastle. As of writing, around 100 infected premises have been identified and thousands of hives destroyed by NSW Department of Primary Industries as part of an eradication strategy.

The foot-and-mouth disease outbreak in Indonesia and elsewhere in the region also remains of high concern, given our geographic proximity to the outbreak and the possible pathways for entry. However, no cases have as yet been identified in either Australia or New Zealand. Other recent invasive species detections include banana freckle in the Northern Territory, myrtle rust in Western Australia and Japanese encephalitis across multiple states

All of these outbreaks should be taken seriously, but it's important always to temper our concern with reason and information. Be alert, but not alarmed, is a valuable mantra. Australia and New Zealand stand well placed to tackle biosecurity threats, thanks to significant investment in research and planning.

Under our new agreement, CEBRA continues to support the department and the ministry in protecting Australia and New Zealand's people, flora, fauna and agriculture from biosecurity threats. Our work across the past year has included analysing effects of changing climate and trade on biosecurity pathways, developing frameworks relating to import and incentive-based regulation and deploying quantitative tools for better risk analysis.

To undertake these important projects, the team here at CEBRA comprises researchers with skills across ecology, statistics, economics and more. Recently, we welcomed statistician Dr David Rolls, digital librarian Les Kneebone and statistician Dr Julia Polak to the team. Dr Anca Hanea also rejoined the office after a sojourn in Spain and we farewelled Natasha (Tash) Page, with thanks for her efforts on CEBRA projects and warmest wishes for her future in consulting.

CEBRA is committed to sharing our research with other biosecurity academics and practitioners, as well as communicating the vital messages of biosecurity across the wider community. In particular, I'd like to draw attention to three initiatives that we've championed over the past year. The first is our recent collaboration with the Australian Academy of Sciences to create a series of high quality short videos. The goal of these videos is to build awareness of CEBRA's important work, as well as to increase the level of biosecurity knowledge within the general population.

Secondly, our 'CEBRAnars' provide regular, detailed updates on CEBRA research (more information about these on page 39).

Finally, I'd like to mention Biosecurity Commons, a joint initiative between the federal and Queensland governments, CEBRA and several other partners. This decision-support platform for biosecurity modelling is currently in development. CEBRA researchers Dr Sean Haythorne and Dr Aaron Dodd have been particularly involved with this project.

I'd like to end by noting that in Australia and New Zealand, we are all biosecurity stakeholders. The benefit that our biosecurity system provides every single citizen and resident – through positive impacts on food security, animal and human health and our natural environments – cannot be understated.

Professor Andrew Robinson
CEO, CEBRA

Chair's report

In the context of increased Commonwealth focus and funding on biosecurity, CEBRA commenced the 2021–2022 reporting period with a new grant agreement with the Australian Government Department of Agriculture, Fisheries and Forestry and a new agreement with New Zealand's Ministry for Primary Industries. The department agreement covers the period 1 July 2021 – 30 June 2025, with myself as the new chair and Professor Andrew Robinson appointed as the CEO. In that context, I would like to acknowledge the significant contribution made to CEBRA – and the important legacy left to continue – by the outgoing chair, Dr Colin Grant.

The new department agreement has two areas of material change identifying two principal functions, namely, governance and strategy.

Governance

With attention on governance, the CEO and the chair met with department executives to discuss their requirements as set out in the agreement and to ensure that our governance framework was most appropriate to meet their expectations. With that in mind, CEBRA took the opportunity to restructure the board with a focus on core and advisory functions. This enhanced CEBRA's overall accountability, efficiency and effectiveness, while keeping it streamlined in the process, given that it remains an entity of the University of Melbourne, with several policies and practices governed by that institution. Board members best address the range of key biosecurity discipline areas, research experience and corporate governance knowledge and experience required.

In that context, core board members have the primary accountability and decision-making role for CEBRA, while having additional advisory members enables CEBRA to draw upon a wider range of knowledge, skills and experiences to enhance its overall operation and effectiveness. The full board is supported by the very experienced and highly valued staff of CEBRA and partners.

The board introduced several governance features including the board charter, meeting protocols, a conflicts of interest policy, key performance indicators and a critical stakeholder engagement framework. The board also ensured alignment of CEBRA research priorities with the 2030 priorities of the department, reviewed the way the important Scientific Review Panel links into the board and implemented – at management level – a new project management system. Recently, CEBRA conducted a strategic vision workshop drawing on the extensive environmental scanning process undertaken by the chair and CEO. This workshop highlighted the challenge for CEBRA to manage resourcing and prioritisation of project load over the next few years to ensure sufficient agility.

Core board members across the financial year included continuing and very experienced board members: Professor Ute Roessner (University of Melbourne), who resigned in March and was succeeded by the new Head of School for BioSciences, Professor Margie Mayfield; Professor Anna Meredith, who also resigned to move overseas; Professor Jodie McVernon from the Doherty Institute and independent Mr Terry Charlton, who joined the board in May.

Advisory Board members included two department executives, Dr Robyn Martin and Dr Peter Gooday, Dr Michael Ormsby (New Zealand MPI), continuing board member Professor Peter Taylor (University of Melbourne), Professor Michael McCarthy (University of Melbourne) and independent, Dr Bruce Christie. We also have Professor Ian Robertson (Murdoch University), who kindly chairs the Scientific Review Panel and Ms Sarah Corcoran (Plant Health Australia) who has agreed to take up appointment as a core board member in July 2022. The CEO and I thank all board members for their contribution, time, and commitment to CEBRA.

Strategy

The second area of emphasis in the agreement is on strategy. The department seeks to annually – or more often – have CEBRA:

- provide strategic advice and guidance on biosecurity trends and risks
- discuss priority areas for research investment, including innovative approaches and technologies
- report on the overall progress and performance of CEBRA.

In doing that, the department has encouraged CEBRA to reach out more broadly to other jurisdictions and industry.

To help to strategically inform CEBRA's direction, aligning current and historical CEBRA work with the 2030 roadmap, CEBRA met with the Inspector-General of Biosecurity and reviewed the following four assessments completed over the past two years:

- *ACIL Allen review of CEBRA*
- *Inspector-General of Biosecurity review of the department's operational model*
- *Australian National Audit Office review of department response to biosecurity non-compliance*
- *Commonwealth Biosecurity 2030 strategy.*

Further to those reviews, and to gain an understanding of needs and opportunities consistent with the department's 2030 strategy and the National Biosecurity Strategy, the CEBRA chair and CEO reached out to ten departmental senior executives, all state and territory biosecurity executives, MPI biosecurity executive, industry leaders including Plant Health Australia, Animal Heath Australia, the Centre for Invasive Species Solutions and other organisations through a series of twenty-three meetings.

Through the CEO, we now sit on the Data, Research and Intelligence Sub-committee (DRISC) and on the Commonwealth Chief Biosecurity Officer's Science Advisory Panel. In December 2021, CEBRA hosted a successful and informative visit from department Secretary Metcalfe. With the heightened level of biosecurity risk and concern, relationships and connectedness within the biosecurity network is even more important.

At each of the board's quarterly meetings, it examined a research area in depth and took the opportunity to learn from current activity. This included Professor Jodie McVernon presenting on risk modelling to inform Covid-19 response: lessons learned, criticality of relationships, modelling to inform strategy and tactics, data challenges and opportunities and the role of experts in policy and public engagement.

With the extraordinary demand on biosecurity professionals as global changes and risks in the biosecurity environment evolve and increase, I want to finish on a note of recognition of the team behind the organisation known as CEBRA. It was clear in our environmental scanning interviews how highly valued CEBRA team members are and I know that readers will join me in acknowledging how fortunate we are to have such a skilled, professional, and highly committed team led by Andrew. I also acknowledge and thank the many capable people we interact with that enable CEBRA to so positively contribute to Australia's biosecurity system.

Lindy Hyam
Chair, CEBRA

OVERVIEW

Overview

CEBRA at a glance: 2021–22

5 DAFF research projects

AADIS extended application of the Australian animal disease model

60+ presentations, workshops and media engagements

1 combined MPI and DAFF research project

2 MPI research projects

Importer incentives in regulatory design

30+ journal articles

machine learning image analysis applications to identifying **biofouling**

Program performance

CEBRA are committed to delivering timely, on-budget research.
During the period 2021–22, we performed strongly against milestones.

Timely

On budget

Milestones met

RESEARCH

Research

Project highlights

CEBRA is committed to producing research that makes a difference. Here we shine a light on the uptake and impact of a selection of our recent projects.

PEST RISK MAPS (1606D, 170607 AND 201210011)

Surveillance of exotic pests and diseases for the purposes of early detection is a critical component of any effective and efficient biosecurity system. Under this suite of projects, CEBRA created tools for estimating post-border establishment potential of invasive species. The Victorian State Government's Department of Jobs, Precincts and Regions (DJPR) is using the outputs from James Camac's work on these projects to inform Victoria's fruit fly preliminary surveillance networks.

> 'James has been working with Tim Hurst in trying to improve their exotic fruit fly surveillance across Victoria. They are currently using surveillance models from 1606D and risk mapping from 170607 and 20121001 to provide a risk-based approximation of where they should be positioning their traps.' DJPR

Citrus Australia is also using outputs derived from 20121001 to inform sentinel plant pest surveillance networks in Brisbane (and beyond) during 2022.

> 'They [the relevant team] have been using outputs from 2012001 to help inform their 2022 spring trapping surveillance program. They also used the outputs of this project to inform a pilot survey in Brisbane during April–May 2022.' Jessica Lye, Citrus Australia

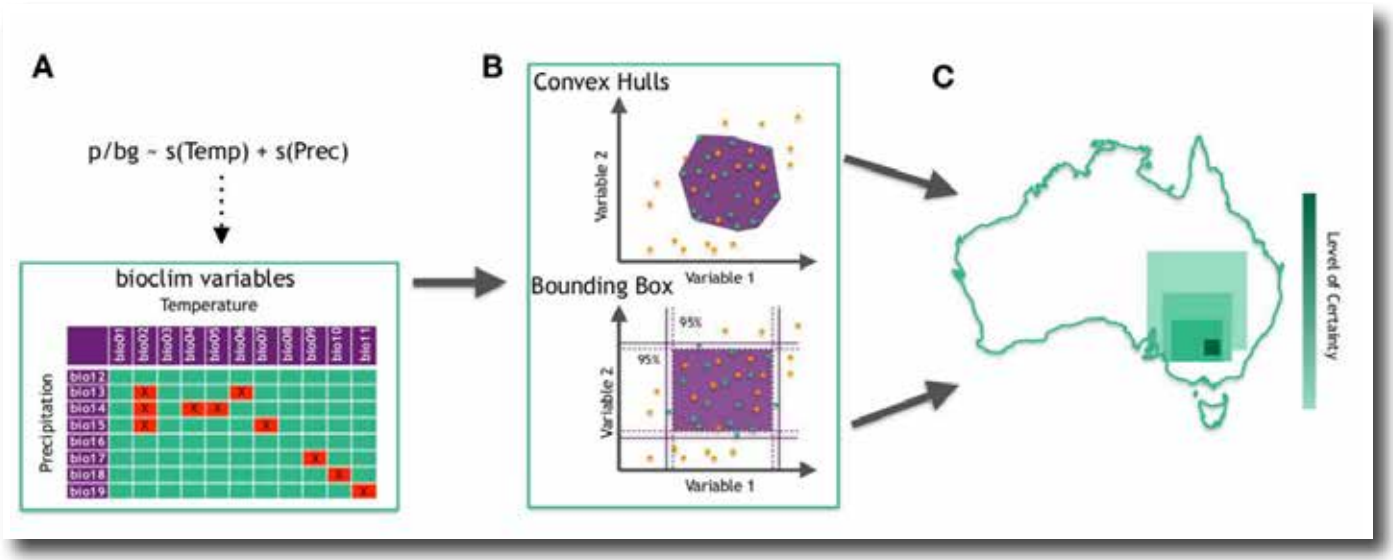


Figure 1: Camac et al. 2020

190606: ESTIMATING TRADING PARTNER EXPOSURE RISK TO NEW PESTS OR DISEASES

Work done by James Camac for CEBRA project 190606 is currently being used in New Zealand to forecast the propagule pressure hitting the country's border as a result of changing climate and trade patterns. An additional 18-month project titled '*Climate Change – trade and biosecurity*' is currently underway. This work is being conducted in partnership with Scion and focuses on analysing the potential impact of climate change on New Zealand and resulting changes in pest pathways through changes in international trade from the impacts of global warming.

1 endorsed August 2021

20121501[2] : MODELLING THE SPREAD AND CONTROL OF AFRICAN SWINE FEVER IN DOMESTIC AND FERAL PIGS

African swine fever (ASF) represents a significant threat to the Australian pork sector and the economy in general. According to ACIL Allen, estimates of the economic damages from a large multi-state outbreak of ASF in Australia could exceed A$2 billion. ASF outbreaks are widespread and increasing in number in Asia and Europe. Although ASF is not present in Australia, detections of ASF viral fragments in undeclared pork products intercepted at the Australian border and the recent spread of the disease in neighbouring Papua New Guinea demonstrate the significance of the threat.

CEBRA's Richard Bradhurst adapted his Australian animal disease (AADIS) model – originally built for modelling FMD – to ASF as part of CEBRA project 20121501. Bradhurst simulated the spread and control of ASF in domestic and feral pigs, using Queensland as a test case.

A follow-on ASF modelling project was approved by the department under the Biosecurity Innovation Program. *Modelling post-border spread and control of African swine fever on a national scale* expanded the AADIS model for ASF to a national scale. The upgraded model will help evaluate different outbreak scenarios in time and space, and trial various control measures. This will assist in the development of animal health policy and preparedness and planning for ASF outbreaks. The project started in August 2021 and was completed in July 2022[3].

MYCOPLASMA BOVIS MODELLING

Mycoplasma bovis (M. bovis) was first identified in New Zealand in 2017 as part of ongoing passive surveillance of the cattle population. Cabinet supported the phased eradication of *M. bovis* in 2018, undertaken as part of a Government Industry Agreement between Biosecurity New Zealand, Beef + Lamb New Zealand and Dairy New Zealand. As of September 2022, 275 properties have been confirmed as infected across New Zealand's dairy and beef sectors.

The eradication program has been effective in finding, containing, and controlling *M. bovis* and the number of new infected property declarations has substantially declined since 2019. Once infection is cleared from the last known case, negative data generated by *M. bovis*-specific background surveillance will be used to demonstrate that *M. bovis* has been successfully eradicated.

At the behest of New Zealand's Ministry for Primary Industries, Richard Bradhurst (and team) developed a decision-support tool for evaluating background surveillance strategies. The new tool is a national-scale simulation model of the spread of *M. bovis* in New Zealand cattle and the background surveillance program. The model is an extension of the AADIS model. The final report for this work has been submitted but not yet endorsed.

AUTOMATED IMAGE ANALYSIS FOR BIOFOULING (21K, 190801)

The department recently procured a number of underwater remotely operated vehicles (ROVs), which will be used by officers at the border to inspect the level of biofouling present on international vessels. The outputs of CEBRA project 21K: *Automated image analysis for identifying the biofouling risk of vessels: Exploring deployment strategies and analysing video footage* (work undertaken by Nathaniel Bloomfield) are planned to be used to support officers in making this assessment. Steps to put this into practice have already begun on the basis of the promising results of CEBRA project 190801: *Automated image analysis for identifying biofouling risk on vessels*.

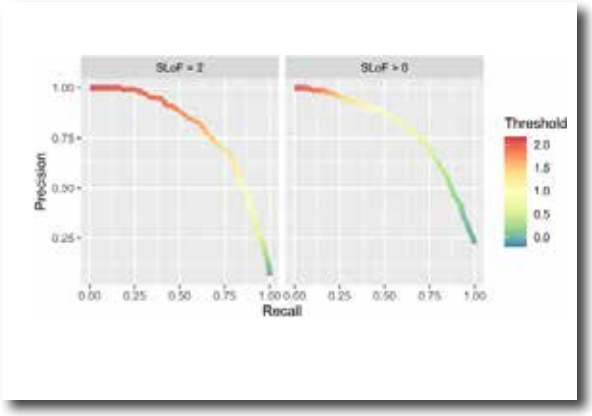


Figure 2: Bloomfield et al. 2021

The Marine Biosecurity Unit is planning to undertake their first ROV trials in Cairns in early September, and the data collected will be used to validate the models developed in CEBRA project 21K.

Steps are also being taken to facilitate the deployment of these models, such that they will be accessible to border staff, through collaboration between the department and Envir AI, which is being supported by CEBRA.

2 endorsed November 2021
3 the report has been submitted but not yet endorsed

190804: RE-EVALUATING MANAGEMENT OF ESTABLISHED PESTS INCLUDING THE EUROPEAN WASP VESPULA GERMANICA USING BIOCONTROL AGENTS

Under this project, CEBRA's Susie Hester and collaborators used a decision-analysis model to investigate whether the European wasp *(Vespula germanica)* could be a candidate for a renewed management program using *Sphecophaga vesparum vesparum*.

Whether a biological control program is worthwhile pursuing depends on the size of the benefits to industry, community and the environment from a reduction in European wasp abundance. While the project found that additional scientific research and experiments to refine key parameter values are required before a formal recommendation about a biocontrol program could be made, several insights were made as a result of this work.

For example, if European wasps continue to spread across Australia without a formal management program, total damage over a time period of 50 years could be in the order of $2.66 billion in present value terms. More than half of this is due to the damage that wasps cause to the use of public places for recreational and sporting activities.

Without a formal management program, the impacts on biodiversity, use of public places for recreation and human health were estimated to be more than one-and-a-half times the agricultural impacts over a 50-year period.

2021–22 research projects

BETTER ANTICIPATE BIOSECURITY RISK

$334,579

Project ID: 21B

Project title: Biosecurity risk from changes in climate, trade and pest and disease pathways

CEBRA project lead: Tom Kompas and James Camac

Department project lead: Shalan Schofield

Department project sponsor: Peter Gooday

2021–22: $334,579

BETTER ALLOCATE RESOURCES TO BIOSECURITY RISK

$465,000

Project ID: 21D

Project title: Value added - modelling the marginal return on investment within and across pathways

CEBRA project lead: Aaron Dodd

Department project lead: Blaine Wentworth

Department project sponsor: Peta Lane

2021–22: $249,000

Project ID: 21G

Project title: Import policy 'health-check' framework and tools

CEBRA project lead: Susie Hester

Department project lead: Peter Finnin

Department project sponsor: Robyn Martin

2021–22: $216,000

SYSTEM DESIGN AND REGULATORY INCENTIVES

$315,000

Project ID: 21C

Project title: Incentive-compatible biosecurity policies – a framework for regulatory design

CEBRA project lead: Susie Hester

Department project lead: Rachelle Clarke

Department project sponsor: Peta Lane

2021–22: $315,000

SYSTEM ENHANCEMENTS

$210,601

Project ID: 21E

Project title: A biosecurity risk research platform to inform decision-making

CEBRA project lead: : Andrew Robinson

Department project lead: Jessica May

Department project sponsor: Peta Lane

2021–22: $141,000

Project ID: 21K

Project title: Automated image analysis for identifying the biofouling risk of vessels: Exploring deployment strategies and analysing video footage

CEBRA project lead: Nathaniel Bloomfield and Andrew Robinson

Department project lead: Bart Woodham

Department project sponsor: Robyn Martin

2021–22: $69,601

Project summaries

The following summaries detail core research activities which began during the period 2021–22.

21B: BIOSECURITY RISK FROM CHANGES IN CLIMATE, TRADE AND PEST AND DISEASE PATHWAYS

CEBRA leads: James Camac, Tom Kompas

Sponsor: Peter Gooday, Assistant Secretary, ABARES

Project lead: Shalan Scholfield, Director, Established Pests and Weeds, Environmental Biosecurity Office

Theme: Better anticipate biosecurity risk

Budget 2021–22: $334,579

Project dates: 2021–23

Summary

Changing climate, potential new trade agreements between countries and increasing globalisation of human movement and trade has dramatically increased the exposure of countries to new pests and diseases that can have devastating economic, environmental and social impacts. This project proposes to enhance the trading partner pest exposure model developed in CEBRA project 190606 (Camac et al. 2021) by integrating it with global trade and climate GTAP models (Kompas and Ha, 2019). This integration will provide the department with the unique ability to estimate and forecast trading partner exposure risk to high threat pests and diseases under varying climate and trade scenarios, and as such, be able to better adapt border screening and post-border surveillance activities to mitigate threat entry and establishment risk.

Progress to date

Substantial progress has been made in this project over the past twelve months. We have developed new temperature-related damage functions (including modelling losses in labour productivity from heat stress) for major agricultural crops such as wheat, rice, maize and soy – work that is currently being prepared for scientific journal submission. These damage functions have also been integrated into the existing climate GTAP models, allowing for more realistic simulations of international import and export patterns under different climate change scenarios.

We have also made significant progress on the pest exposure model. First, the original model has been modified to work directly with annual GTAP simulated trade-flow outputs. The department has also provided CEBRA with over a decade of both border interceptions (across all taxa) and import inspection rate data for all commodity and country combinations. These data will be used to estimate country-by-commodity contamination rates, which – when combined with GTAP simulated trade flows and climate suitability modelling – can be used to derive annual and accumulative estimates of country-level threat exposure.

The integration of these two sophisticated models coupled with the significant border interception data that the department have collated will provide critical outputs that can be used in a variety of other analytical and risk assessment projects that both CEBRA and the department are perusing.

Future outlook

The project is on schedule. We are currently in the process of determining the appropriate functional groupings to use for subsequent analysis. The project teams of the department and CEBRA have also begun to discuss future extensions to the model, which may lead to subsequent projects. These extensions include:

- adding additional damage functions to the GTAP trade model (for example, water stress and drought and more substantive sea level rise)
- incorporating functional traits into the threat exposure model.

2021–22 milestones completed

Milestone 1: Project start meeting	✓
Milestone 2: Acquisition of department pilot data	✓
Milestone 3: Damage function estimation and climate suitability	✓
Milestone 4: GTAP modelling and workshop	✓
Milestone 5: GTAP model and seminar	✓

21C: INCENTIVE-COMPATIBLE BIOSECURITY POLICIES – A FRAMEWORK FOR REGULATORY DESIGN

CEBRA lead: Susie Hester
Sponsor: Peta Lane, First Assistant Secretary, Biosecurity Strategy and Reform Division
Project lead: Rachelle Clarke, Acting Director, Compliance, Strategy and Policy
Theme: System design and regulatory incentives
Budget 2021–22: $315,000
Project dates: 2021–25

Summary

Humans are largely responsible for the spread of pests and diseases across the globe, via air and sea cargo, mail, and travel. Regulators impose regulations aimed at reducing biosecurity risks by managing the behaviour of individuals and organisations involved in these activities. Each biosecurity regulation creates an inducement (incentive) for individuals to take actions that they would otherwise not consider. The effectiveness of these inducements is determined by the extent to which the behavioural changes of individuals align with the objectives of the agency responsible for mitigating biosecurity risks.

The effectiveness and efficiency of departmental biosecurity regulations will be significantly improved if incentives are explicitly considered in regulation design. The overarching objective of this project is to apply well-established economic ideas and techniques to create a novel systematic framework for incorporation of incentives into regulation design.

Progress to date

The first achievement in year 1 of the project has been to focus on the interaction between humans and the biosecurity system. In concept, our economic framing of the biosecurity system defines it as a common class of problem in which the objective and economic environment are taken as given and the task is to identify the rules and processes needed to align the actions of self-interested agents (such as importers, vessel operators and members of the public) with the objectives of the biosecurity system.

Two fundamental classes of problem must be resolved in designing the biosecurity system. Firstly, the actions of importers, vessel operators and other relevant entities must be aligned with national biosecurity objectives (efficacy). Secondly, effort should be allocated such that biosecurity objectives are achieved at the lowest overall cost (efficiency). Unfortunately, much of the information needed to resolve these problems is hidden from biosecurity authority. Furthermore, there are a vast multitude of interventions to choose from in designing the biosecurity system. Fortunately, the ideas and tools needed to understand how humans interact with institutions and to select the best set of interventions are well established.

Several important observations can be drawn from the economic framing developed in year 1:

i. The underutilisation of economics in biosecurity is a missed opportunity. Science is a necessary input – for example, understanding how invasive species establish and spread in an environment – but an application of economic frameworks relevant to how humans interact with regulations and incentives is also important.

ii. From a system design perspective, all biosecurity systems should be framed as decision trees (Figure 1) in which there are: *nodes* (decision points for some individual); *branches* (representing different choices available to the decision maker); *payoffs* (the benefit of each decision); and *probabilities* (the likelihood of a specific outcome). This framing – and the application of the economic techniques noted above – is needed to identify incentives/regulations/other interventions within the system such that independent actors such as importers and vessel operators align their actions with the outcomes set out in the *Biosecurity Act 2015* under which the biosecurity system operates.

iii. Economic techniques (experimental economics) have established a methodology that can be used to test and refine changes to the biosecurity system so that they work in the field.

iv. Biosecurity systems are complex and there are important differences in the various domains of biosecurity. Where the best interventions are not clear from economic theory, empirical techniques have been developed that allow economists to determine (statistically) what works (and doesn't) in the real world.

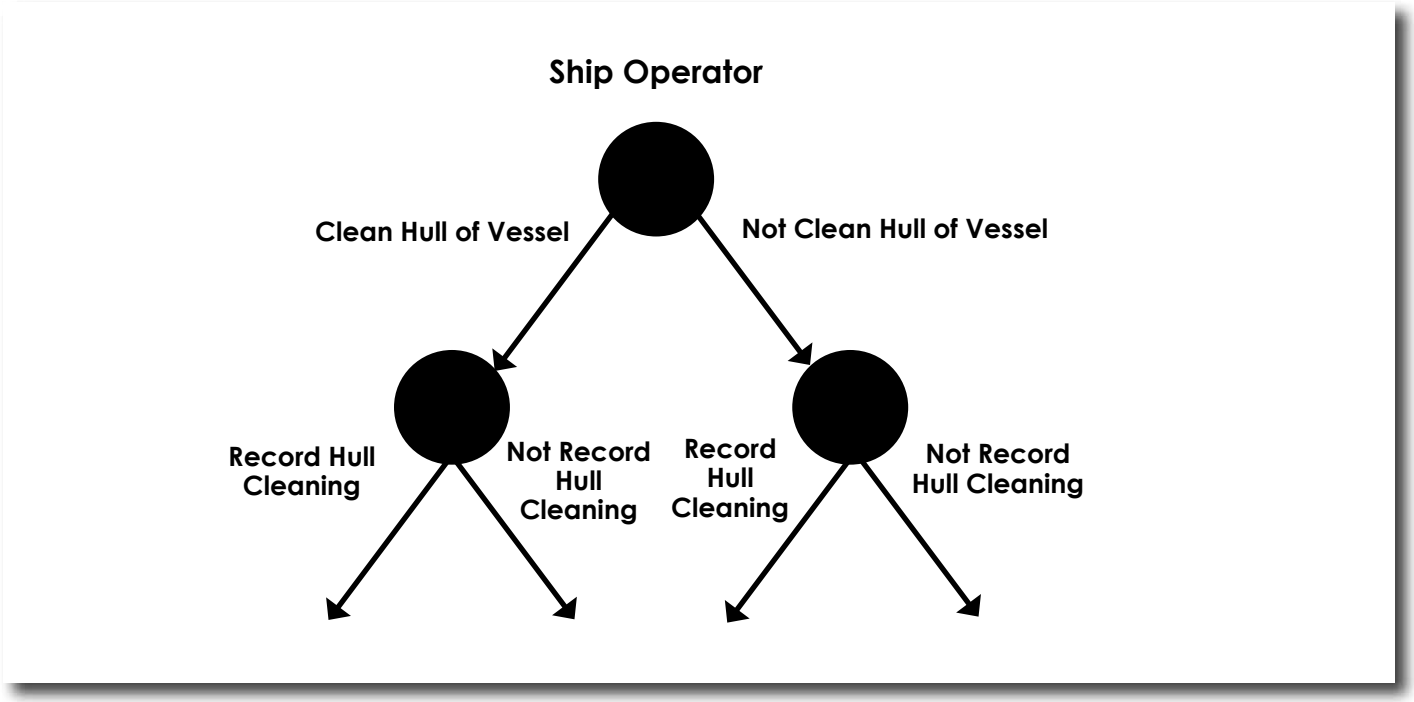


Figure 3: Decisions available to risk-creators as they (or their goods) arrive into Australia

To demonstrate the potential use of these economic ideas, we focus on two types of application. The first is referred to as 'system pathway overhaul'. Biofouling is our case study for this type of reform. The second application involves fine-tuning the existing system. We have selected cut flowers as the case study for this application.

Future outlook

Work programs have been developed for year 2 of the project for each of the case studies.

Biofouling

- Risk rating methodology: Activities proposed include the development of a model/algorithm to determine the risk rating for each inbound vessel. This involves defining the information to be included in the best management practices for inbound vessels and creating a menu of incentive-compatible vessel entry contracts relevant to low- through to high-biofouling risk status.

- Design the incentive structure for each contract and between contracts: Design the incentive structure for each vessel entry contract so that the dominant strategy of the vessel operator is to truthfully reveal information needed to determine the biofouling risk rating. Design the incentive structure between contracts so that each vessel operator selects the optimal level of biofouling effort.

- Reinsurance strategy: Identify the advantages and disadvantages of government reinsurance versus commercial reinsurance options.

Cut flowers

The work program for cut flowers is to:

- identify the specific pathway(s) within cut flowers in which to establish the economic design/ empirical evaluation techniques needed to identity efficient and effective fine-tuning of the biosecurity system

- design the data system needed to support empirical analysis

- design the structure of real-world experiments for the specific pathway

- collect data from import transactions

- complete statistical analysis of data.

2021–22 milestones completed

Milestone 1: Project start meeting	✓
Milestone 2: Workshop on case study 1 – biofouling	✓
Milestone 3: Collation of required data for case study 1	✓
Milestone 4: Workshop on methodology to identify vulnerabilities	✓
Milestone 5: Workshop on draft methodology	Workshop postponed to November 22
Milestone 6: Draft interim report for year 1	✓
Milestone 7: Interim report for year 1	✓

21D: VALUE ADDED – MODELLING THE MARGINAL RETURN ON INVESTMENT WITHIN AND ACROSS PATHWAYS

CEBRA lead: Aaron Dodd

Sponsor: Peta Lane, First Assistant Secretary, Biosecurity Strategy and Reform Division

Project lead: Blaine Wentworth, Director, System Modelling; Risk, Intelligence and Strategy Branch, Biosecurity Strategy and Reform Division

Theme: Better allocate resources to biosecurity risk

Budget 2021–22: $249,000

Project dates: 2021–23

Summary

Increases in the volume, diversity and complexity of introduction pathways present an existential threat to Australia's biosecurity system with increased risk outpacing both increased resources and new technological solutions. In response, the department has sought to identify 'low-return' activities that can be reduced and/or stopped to release additional resources; however, these have now largely been exhausted and only marginal reductions remain. This project seeks to develop a transparent and repeatable model for comparing the relative costs and benefits of different levels of intervention within and across two pilot pathways as a proof of concept.

Progress to date

The initial phase of the project focused on what could best be described as user requirements analysis. That is, working closely with both the Biosecurity Operations and Compliance divisions to understand what specific functionality they require from a resource allocation tool, including how that functionality will be used to inform decision-making. The project team then undertook a desktop literature review to determine the most suitable statistical method, or combination of methods, for delivering on those user needs. This was followed by the development of a 'minimal reproducible example', for validation by Biosecurity Operations Division, that demonstrated how such a tool might work based on dummy data (deliverable 1).

Work then commenced on the first of two full-scale pathway models (i.e. containers), following the specification described in the user requirements and the feedback received on the minimal example. Development of this model has been informed by several sources including: the existing RRRA pathway models, the department's instructional materials library, external sources such as the ISPMs, and close collaboration with the pathway managers. To date, a conceptual model of the pathway has been developed, and a structural Bayesian network (BN) model that formalises its logic drafted.

Future outlook

Refinement and parameterisation of the BN model continues with a draft for consultation scheduled for completion by the end of September 2022. Pending the successful delivery of this pilot model (deliverable 2), a second pathway model (TBC) will be developed during October 2022 – March 2023 (deliverable 3). Both models will then be deployed within an upgraded version of the minimal example that incorporates an enhanced version of the CEBRA value model (deliverables 4 and 5) – allowing the estimation of marginal benefit curves and small-scale brute force optimisation within and across the two pathways. A final report outlining the project's findings will also be delivered (deliverable 6).

2021–22 milestones completed

Milestone 1: Project start meeting	✓
Milestone 2: User needs analysis	✓
Milestone 3: Desktop review	✓
Milestone 4: Minimal reproducible example (deliverable 1)	✓

21E: A BIOSECURITY RISK RESEARCH PLATFORM TO INFORM DECISION-MAKING

CEBRA lead: Les Kneebone, Andrew Robinson

Sponsor: Peta Lane, First Assistant Secretary, Biosecurity Strategy and Reform Division

Project lead: Jessica May, Director, Research and Innovation, Biosecurity Strategy and Reform Division

Theme: System enhancements

Budget 2021–22: $141,000

Project dates: 2021–23

Summary

A key challenge in managing biosecurity risk is to efficiently invest research effort – asking the most important questions and sourcing the best strategic advice efficiently. This project will develop a research portal that is structured by key questions that are based on a model of the biosecurity system. The department and CEBRA will use this infrastructure to identify gaps in the biosecurity research body, identify overlaps in areas, and efficiently identify parallel work that has been done elsewhere.

Progress to date

Key questions have been gathered via a survey and used, firstly, to define the scope of the platform content and, secondly, as one of the word-stock inputs to a biosecurity taxonomy that underpins the platform discovery layer.

Terms gathered from key questions priority lists, glossaries and research documents have been extracted and, using artificial intelligence methods, flagged for membership in a biosecurity thesaurus. Unique identifiers have been assigned to thesaurus concepts, allowing concepts to be intersected within graphic representations that expose gaps and overlaps in the research corpus.

A trial license for a discovery layer has been procured so as to deliver the proof of concept as part of a project gateway to be held in late August 2022.

Effort to source, curate and transform content and metadata has been extensively documented. There is a significant effort involved in managing multiple pipelines, or collectors that get content from external source libraries and websites. Requirements for sustaining such pipelines are currently being defined.

Future outlook

The proof of concept trialled content from four sources. In the coming year, 17 additional sources will be connected to the project. Therefore stakeholder engagement and management will be a significant component in the near future. Development of metadata profiles and guidelines to assist content suppliers up-stream will be needed. Technical pipelines will need to be built and scheduled, monitored and fixed as required.

Metadata development, especially taxonomies (controlled vocabularies) will be ongoing and will reflect the corpus content as well as user information seeking behaviour.

Beyond the proof of concept, an application stack needs to be purchased, hosted and managed. Several options are in analysis as part of an issues report in development.

2021–22 milestones completed

Milestone 1: Project start meeting	✓
Milestone 2: Workshops to review and update logic model	✓
Milestone 3: Workshops to identify key questions	Cancelled
Milestone 4: Key questions identification and distillation	✓
Milestone 5: Case studies	In progress

21G: IMPORT POLICY 'HEALTH-CHECK' FRAMEWORK

CEBRA lead: Susie Hester

Sponsor: Robyn Martin, First Assistant Secretary, Biosecurity Animal Division

Project lead: Peter Finnin, Assistant Secretary, Animal Biosecurity Branch, Biosecurity Animal Division

Theme: Better allocate resources to biosecurity risk

Budget 2021–22: $216,000

Project dates: 2021–22

Summary

Many Australian import policies are based on risk analyses that were conducted some period prior to the current time. In some cases, those analyses date back decades. Any such analysis may become out of date. This represents a strategic risk to the department. To achieve the consistent level of assurance required by the department, and to demonstrate confidence to stakeholders that risk analyses are current, the department needs to strengthen its processes for continual review of risk analyses. This research project tackled the challenge of designing a strengthened process.

Progress to date

This project developed a framework containing various procedural steps that could be incorporated into the department's current risk analysis and monitoring processes. Importantly, the framework builds upon the current processes and the expertise of subject matter experts, adding a more structured and formal process to minimising errors that stem from missed information and the consequences of this. In this process some peripheral recommendations have been suggested that may improve current practices.

Future outlook

This project is to be completed by end August 2022.

2021–22 milestones completed

Milestone 1: Project start meeting	✓
Milestone 2: Desktop review	✓
Milestone 3: Draft framework	✓
Milestone 4: Case study	✓
Milestone 5: Draft procedure	✓
Milestone 6: Update to risk analysis template	✓
Milestone 7: Draft report	✓
Milestone 8: Department feedback to CEBRA	✓
Milestone 9: Submission to the Scientific Review Panel	✓
Milestone 10: Department policy and operation reviews complete	In progress
Milestone 11: Department endorsement of final report	

21K: AUTOMATED IMAGE ANALYSIS FOR IDENTIFYING THE BIOFOULING RISK OF VESSELS: EXPLORING DEPLOYMENT STRATEGIES AND ANALYSING VIDEO FOOTAGE

CEBRA leads: Nathaniel Bloomfield, Andrew Robinson
Sponsor: Robyn Martin, First Assistant Secretary, Animal Biosecurity Division
Project lead: Bartholomew Woodham, Marine Biosecurity Unit, Animal Biosecurity Division
Theme: System enhancements
Budget 2021–22: $69,601
Project dates: 2021–24

Summary

Biofouling is recognised as a significant pathway for the introduction of non-indigenous marine species causing severe social, environmental, and economic impacts. In-water inspections are key to ensuring this risk is being managed appropriately, but such inspections are currently costly. Therefore, the development of an automated system to identify and classify biofouling risk is required to allow the department to efficiently assess the condition of vessels.

This project will build on CEBRA project 190801, which was a proof of concept project that demonstrated that the use of image analysis to automatically detect the level of biofouling in images is viable. This proposed extension will aim to:

- develop a methodology for more efficiently labelling biofouling imagery datasets in future
- extend the models to analyse video data
- develop a prototype user interface that can be used by the Marine Biosecurity Unit to scope their business requirements.

At the end of this project, the department will be able to develop a business case for the development of a final product which can be incorporated into their systems and work processes.

Progress to date

In collaboration with the Marine Biosecurity Unit, we have successfully put together a dataset of around 55,000 biofouling images. This dataset is much more diverse than the dataset considered in 190801, as it features a number of different survey methodologies. This dataset is being used as the test case for a more efficient labelling methodology, which we are close to finalising. This method builds upon existing self-supervised and semi-supervised learning methods for training image classification models. This enables the use of unlabelled data in training, and our method also allows points to be selected for labelling in an optimal fashion.

We have also successfully developed a prototype user interface that the Marine Biosecurity Unit can use to apply our models. This was completed in December 2021. This has given a basis for the Marine Biosecurity Unit to reach out to other organisations working within this space, to determine how this functionality can be provided into the future. The Marine Biosecurity Unit was successful in contracting a start-up, Envir AI, to host the models for a trial period. This start-up has since been supported by Microsoft to integrate their tools into the Azure cloud, and other areas of the department have also expressed interest in having similar capability. Further negotiations in regard to model deployment with Envir AI are ongoing.

Future outlook

The outlook of the project is positive. We are close to completing the first stage of the project, to develop more efficient labelling methodologies and train new models on a more diverse dataset. The implementation of these models is also looking positive, with conversations currently ongoing with Envir AI (supported by Microsoft) that may also lead to the outcomes being used more widely across the department.

2021–22 milestones completed

Milestone 1: Project start meeting	✓
Milestone 2: Workshop to identify use cases and requirements for prototype user interface	✓
Milestone 3: Development of prototype user interface	✓
Milestone 4: Provision of additional data	✓
Milestone 5: Cleaning and labelling of data provided in milestone 4	In progress
Milestone 6: Development of semi-automated labelling approach	In progress

Continuing projects

The following projects started prior to July 2021, and continued during the 2021–22 reporting period.

Name	Department or ministry sponsor	CEBRA Lead	Completed during 2021–22
Data and intelligence			
20100201: Review of document assessment processes in relation to their management of biosecurity risk	Col Hunter	Nathaniel Bloomfield	✓
20100401: User consultation to guide uptake of, and improvements to, the spatio-temporal asset damage model developed during CEBRA Project 170713	Peta Lane	Aaron Dodd	✓
Risk analysis (assessment, management and communication)			
20111101: Environmental biosecurity risk assessment for conservation areas	Robyn Clelland	Terry Walshe	✓
Surveillance diagnostics and screening			
20121501: Modelling the spread of African swine fever in feral pigs and the epidemiological impact on domestic pig herds	Robyn Martin	Richard Bradhurst	✓
NZ MPI			
20NZ01: Design a statistically valid pathway slippage audit system	Michael Ormsby	Andrew Robinson	✓
17062102: System implementation of risk–return model	Michael Ormsby	Andrew Robinson	
19NZ03: Risk–return: Economic measurement of impacts	Michael Ormsby	Tom Kompas	✓

Additional Activities

Additional activities

CEBRA contributed to the following grants and consultancy projects during the 2021–22 reporting period. Being involved in these projects expands CEBRA's knowledge and skill base, enhances engagement and builds important relationships.

Client	Start	Duration	Budget (ex GST)
Cawthron Institute Trust Board	Nov-19	36 months	$102k
Aquatic Health Research Programme – Aquaculture health strategies to maximise productivity and security This work involves strategic biosecurity risk analysis through enhancing modelling of marine biosecurity risk.			
Australian Research Data Commons (ARDC)	Jan-21	2.5 years	$1.3m
Biosecurity Commons – cofounded by the ARDC, the Australian Government Department of Agriculture, Fisheries and Forestry (DAFF) and the Queensland Government's Department of Agriculture, Water and Fisheries This initiative involves the development of infrastructure to host key biosecurity software, including outcomes from CEBRA projects. The Biosecurity Commons platform will increase Australia's strategic biosecurity risk analysis capability, build on investment and enhance CEBRA's impact.			
Victorian Government Department of Environment, Land, Water and Planning **Victorian Government Marine and Coastal Council**	Mar-21	7+ months	$214k
The economics of damages and the cost of adapting Victorian coastal communities to climate impacts This project focused on the costs of projected damage from sea level rise and storm surge on coastal communities and coastal assets, and the relative costs of investment in adaptation measures – for selected cases – to mitigate that damage.			
NSW Food Authority, NSW Department of Primary Industries	Apr-21	14 months	$187k
Development of a risk-estimation tool, fast cost–benefit analysis, and consequence measures to manage biosecurity and food safety This project involved development of both an Excel and MATLAB tool to allow NSW Biosecurity and Food Safety to estimate the risk of a pest incursion, conduct a cost–benefit analysis and establish sound consequence measures for a potential incursion. This work built on core CEBRA expertise and enhanced our impact.			
New Zealand's Scion	May-21	18 months	NZ$160k
Climate change – trade and biosecurity This project involves analysing the potential impact of climate change on New Zealand and resulting changes in pest pathways through changes in international trade from the impacts of global warming. It builds on CEBRA core expertise and will enhance our impact.			

Department of Primary Industries and Regions (PIRSA), South Australian Research and Development Institute (SARDI)	Jun-21	6 months	$67k
Fruit fly modelling This project was designed to assist PIRSA in developing an enhanced fruit fly risk management risk framework. Our contribution highlighted the need for appropriate risk mapping and pathway analysis, suitable spread modelling of an incursion and optimal trapping programs. This work built on CEBRA core expertise and enhanced our impact.			
DAFF Biosecurity Operations Division	Jun-21	6 months	$125k
21H: CBIS and HCI: an unholy union – research and analysis to evaluate an instance-based compliance-based inspection (CBIS) scheme This piece of tactical biosecurity risk research evaluated a more efficient way to implement CBIS within the department. It enhanced the impact of earlier CEBRA work.			
Queensland Cyber Infrastructure Foundation (QCIF)	Jun-21	8 months	$40k
EcoCommons This work involved development of infrastructure to host key biosecurity software, including outcomes from CEBRA projects. This work will assist with strategic biosecurity risk analysis, builds on past investment and enhanced CEBRA's impact.			
New Zealand's Ministry for Primary Industries	Aug-21	12 months	$240k
21Q: M. bovis predictive modelling This work involved enhancing the AADIS model for application to testing surveillance regimes for use by MPI upon *M. bovis*. This strategic or tactical analysis of biosecurity risk will support MPI in finalising its world-first eradication of *M. bovis* and enhances CEBRA's reputation in New Zealand.			
DAFF - Biosecurity Strategy and Reform Division	Sep-21	6 weeks	$22.5k
21P: Strategic research priorities This work involved strategic biosecurity risk analysis through developing research project ideas for future funding. It identified gaps in existing research investment and established direction for future CEBRA projects.			
DAFF	Sep-21	10 months	$112k
Extend the scope of the AADIS-ASD model from a regional Queensland model to a national scale Australian model This strategic or tactical biosecurity risk analysis involved enhancing the AADIS model to enable national-level simulation of African Swine Fever incursion scenarios, informing surveillance and post-detection responses. It built on past investment and enhanced CEBRA's national standing.			
DAFF Biosecurity Operations Division	Oct-21	12 months (extended)	$132.5k
21N: Air cargo (non-commercial) assurance program survey models C07276 This project considers tactical biosecurity risk through the design of endpoint/leakage surveys to enable more efficient risk management in non-commercial air cargo. This work is an important strategic contribution to biosecurity risk management.			

ARC Discovery	Nov-21	48 months	$771k
Nature futures: mapping pathways to prosperity for people and nature (DP210103460) This project utilises a novel modelling framework and high-performance computing and integrates economic, land use and biodiversity models to evaluate: • policies and incentives for increasing national vegetation cover for carbon sequestration and habitat • global risks to nature posed by land use change under future geopolitical scenarios.			
ARC Discovery	Jan-22	48 months	$642k
Is climate change altering the carrying capacity of the world's forests? (DP220103711) Planting trees at a global scale has been proposed as a key strategy to reduce global atmospheric carbon dioxide levels. However, changing climatic conditions threaten the ability of forests to be net carbon dioxide absorbers. In a warmer and drier future, forests may not be able to support as many trees. This project aims to identify how climate will alter forest carrying capacity across millions of hectares of the world's forests. By combining recent advances in forest modelling with large-scale and long-term forest inventory data, the project will develop a novel framework to forecast forest dynamics under climate change. It will provide specific guidelines to inform global reforestation strategies and foster climate-smart forest management.			
ARC Discovery	Jan-22	48 months	$525k
Remote sensing of biotic stress with hyperspectral-fluorescence imaging (DP220101495) This project aims to investigate new indicators of crop biotic stress using innovative airborne remote sensing and imaging spectroscopy for biosecurity applications. Current satellites used to monitor crops and forests do not meet the spectral and spatial details that are required for the early pre-visual detection of biotic and abiotic stress. Accordingly, this project's significance focuses on new insights to detect the alteration of photosynthetic indicators of plant functioning, building on recent breakthroughs with airborne hyperspectral imaging and remote sensing technologies. The outcomes will provide significant benefits to Australia in the detection of harmful diseases and improved water and nutrient monitoring methods.			
DAFF	Feb-22	7 months (extended)	$184k
22A: Sea cargo postcode classification review C08809 This work involves tactical biosecurity risk analysis through the development of algorithms for risk-based classification of domestic locations to enhance management of the biosecurity risk presented by shipping containers. This is an important analytical contribution.			
Australian Centre for International Agricultural Research (ACIAR)	Mar-22	5 months	$150k
Valuing the contribution of ACIAR to biosecurity in Australia and Overseas This work established a methodology to evaluate ACIAR's activity in the Indo-Pacific region in relation to enhanced biosecurity, food security and adapting to the impacts of global warming. It has helped CEBRA establish an ongoing relationship with ACIAR and assist with their biosecurity measures.			
Defence	Mar-22	3 months	$67k
Attack path risk resolution – Structured expert judgment for defence posture (posture review elicitation) This project involved strategic risk analysis by assisting Defence in assessing the effects of actions upon risk. This project enhanced CEBRA's national reputation and provided insight into new ways of thinking about risk management. These projects followed from an established relationship.			

DAFF	Apr-22	15 months	$275k
Extend AADIS-ASF model incorporating indirect transmission C08655 This project involves strategic or tactical biosecurity risk analysis through the enhancement of the AADIS model to include indirect transmission of ASF associated with vehicles transporting pigs to and from abattoirs, improved tracking and reporting of infected animals going to non-farm destinations such as abattoirs and export facilities and expanded surveillance and control options for feral pigs to better align with the Australian Veterinary Emergency Plan. This work builds on past investment and will enhance CEBRA's national standing.			
DAFF	Apr-22	8 months	$258k
22B: Increase the efficiency and transparency of biosecurity risk management of sea containers and their cargoes C09476 This tactical biosecurity risk analysis aims to increase the efficiency and transparency of biosecurity risk management of sea containers and their cargoes by identifying appropriate intervention rates, providing a sustainable balance between heightened measures targeted to the highest risk pathway and reduced or streamlined measures for compliant/lower risk pathways.			
Australian Pork Limited	Apr-22	16 month	$57k
Camera trap assessment of feral pigs: Understanding feral–domestic pig interactions The proximity of feral pigs to domestic piggeries presents a strong potential for transmission of exotic disease such as African swine fever (ASF) and foot-and-mouth disease (FMD), as well as endemic diseases of concern. There is limited Australian data on contact rates and the likelihood of disease transmission between feral pigs and domestic pigs. This work will aim to better understand the direct and indirect interactions between feral pigs and domestic pigs that could lead to disease transmission.			
DAFF	May-22	1 month	$0
FMD outbreak risk update In 2021, CEBRA undertook a structured expert judgement exercise to estimate the probability of one of four potential animal-health outbreak scenarios within the next five years, namely, foot-and-mouth disease, African horse sickness, African swine fever and lumpy skin disease. This project used a short structured expert judgement exercise to update the estimate for foot-and-mouth disease.			

Additional activities highlight: FMD workshop

What is the probability of a foot & mouth disease (FMD) outbreak in Australia in the next 5 years?

March 2021

9%[1]

range: 1 – 19%[2]

June 2022

11.6%[1]

range: 3 – 20.5%[2]

In a structured expert judgement (SEJ) exercise involving experts on FMD, there was a small increase in the perceived probability of an FMD outbreak in Australia, since 2021. This was in light of the disease's spread through the region, proximity to Australia, and regional contexts that impact disease response and control efforts. The result was not unexpected and reflects Australia's robust biosecurity system and its capability to keep pace with the FMD threat.

However, the situation remains volatile due to numerous factors identified; some well understood, some uncertain. To ensure our FMD freedom, Australia must maintain vigilance and continue to improve its biosecurity measures and preparedness.

Uncertainty is an intrinsic part of the exercise. Divergent and uncertain views were expressed on the significance of:

- Different FMD virus strains
- Geopolitical forces
- The COVID-19 pandemic
- Bioterrorism
- Actions, priorities, and policies of regional countries

Safety factors

Australia's biosecurity system

Our robust import & border control measures are critical in keeping the virus out

Awareness

By Governments, industries, producers and our near neighbours

Improved profiling & technology

Reduces the risk of virus entering via incoming travellers, mail, cargo and returning stockpersons

Risk factors

Closer proximity

With recent outbreaks in the region, FMD is drawing closer to Australia

Poor control in the region

Limited success in controlling FMD within the region increases its pathways to enter Australia

International activity

Increasing import volume, mail, cargo, travellers and their luggage

Competing priorities

Economic pressures, food security agendas, and rising feed prices may diminish the regional priority on biosecurity

The SEJ process

On 3 June 2022, to estimate the updated probability of an internationally-notifiable FMD outbreak in Australia in the next 5 years...

21 Participants

Facilitated by

cebra

Undertook

2 hrs discussion

SEJ is an internationally-recognised process that has been used to obtain data on a range of complex uncertain systems. It provides a systematic approach that minimises individual and group cognitive biases, surface assumptions, and contextualises outcomes.

A similar exercise was conducted in March 2021

The results of this exercise and estimated probabilities should be interpreted and used with caution. Limitations of SEJ processes can include a homogeneity of expertise, rapidness of the exercise, and the level of uncertainty expressed during the session.

Risk pathways identified for FMD entry into Australia includes:

- Incoming travellers, mail, luggage
- Importation of contaminated products
- Fomites
- Illegal/ unregulated pathways

1 Percentage probabilities denotes the mean of participant estimates between the 0.1 quantile and 0.9 quantile

2 Estimated ranges denote the 0.1 quantile and 0.9 quantile – providing an 80% coverage interval

3 June 2022

Additional activities highlight:
Biosecurity Commons

Biosecurity Commons is a multi-partner initiative aiming to make ecological and biosecurity modelling and data more readily available via a cloud-based web platform. CEBRA is heavily involved with this initiative, with many of our researchers including providing input, support and development.

Biosecurity Commons received investment (https://doi.org/10.47486/PL021) from the Australian Research Data Commons (ARDC). The ARDC is funded by the National Collaborative Research Infrastructure Strategy (NCRIS).

Students

CEBRA invests in today's students to build biosecurity skills and knowledge for the future.

PhD candidate: Nathaniel Bloomfield

Supervisors: Andrew Robinson and Howard Bondell

Working title: *Active, self and semi-supervised learning: label efficient approaches and the cold-start learning problem*

Summary
Supervised deep learning approaches benefit from having large amounts of labelled data to train models. However, labelling large datasets, with sufficient quality, is a major challenge in many computer vision machine learning projects. Large datasets or complex labelling requirements, such as requiring multiple labels per image from labellers, can restrict opportunities to apply these technologies. This is a particular problem in fields such as biosecurity, where expertise may need to be drawn from a confined pool of experts and resources are limited. New approaches in self-supervised and semi-supervised learning are starting to achieve very promising results. These methods are able to utilise a small number of labelled examples, together with the rest of the unlabelled data, to obtain results that are competitive with supervised learning approaches. However, a key decision is left up to the practitioner. Given the limited resources available, which images should be selected to be labelled first? We will refer to this problem as cold-start learning, and solving it would allow machine learning models to be much more easily trained, through identifying the most informative data examples to consider first.

PhD candidate: Maddie Oberin

Supervisor: Richard Bradhurst (co-supervisor)

Working title: *A camera trap study of feral pigs to better understand the risk of transmission of African swine fever between feral and domestic pigs*

Summary
African swine fever (ASF), a contagious viral disease of pigs, is an ongoing threat to Australia's pork industry. While ASF has to date not been detected in Australia, it has spread across Europe and Asia in recent years. As such, Australian Pork Limited has provided a $41,000 grant to support ASF fieldwork. This PhD involves conducting a camera trap study to better understand the epidemiological interface between domestic and feral pigs. The work will be undertaken in Queensland, which has a sizeable feral pig population.

Intern: Lin Naing

Supervisor: Richard Bradhurst

Summary
Lin Naing was an intern at CEBRA during the period 1 March – 30 June 2022. This internship was a component of Lin's Master of Agricultural Sciences studies undertaken within the Faculty of Veterinary and Agricultural Sciences. During his internship, Lin worked on an Australian Animal Disease Spread (AADIS) model development project funded under the Department of Agriculture, Fisheries and Forestry's Biosecurity Innovation Program. The project team was tasked with developing a national-scale epidemiological model of ASF and included veterinary epidemiologists, animal health specialists, and epidemiological modellers from the University of Melbourne, the Department of Agriculture, Fisheries and Forestry, Biosecurity Queensland and the SunPork Group. The resulting decision-support tool assists in the formation of animal health policy by allowing disease managers to explore the potential spread and control of ASF in domestic pigs and the risk of transmission between domestic and feral pigs.

Under the guidance of Tom Kompas and Christine Li, Lin contributed to the development of a methodology prepared for the Australian Centre for International Agricultural Research (ACIAR) to value the contribution of ACIAR to biosecurity in country partners in Asia, Africa and the Pacific. ACIAR has been investing in biosecurity related research and capacity building in Australia and overseas since the 1980s. The project team developed a draft methodology to conduct ex-post impact evaluation that can be applied retrospectively to ACIAR's portfolio of biosecurity related projects.

COMMUNICATIONS

Communications

Project reports

For more information about our research, and to access reports, please visit: overview.cebra.unimelb.edu.au

Publications

As a member of the academic community, CEBRA endeavours to share research through peer-reviewed papers, where practical. This ensures our contribution is accessible to – and scrutinised by – a wide range of interested parties, via academic journals.

H-index

As at 22/8/22:

- CEBRA's h-index: **51**
- ACERA's h-index: **72**
- Combined ACERA/CEBRA h-index: **87**

The h-index aims to measure the cumulative impact of a researcher or organisation's output. The advantage of the h-index is that it combines an assessment of both quantity (number of papers published) and quality (impact, or paper citations).

Impact factor

The impact factor is a measure of the frequency with which the average article in a journal has been cited in a particular year or period. The InCites impact factor in Table XX is calculated as the number of current year citations of items published in a journal, divided by the number of items published in that journal during the previous two years.

A full list of CEBRA publications can also be accessed at: cebra.unimelb.edu.au/engage/journal-articles

Table 1: CEBRA publications summary with average citations and InCites impact factor as at 20/8/2022

Calendar year	Total publications	Total citations	Average citations	Average InCites impact factor (2021)	CEBRA project-specific publications
2021	28	115	4.11	6.22	2
2020	20	906	45.3	5.12	2
2019	18	437	24.28	5.82	6
2018	26	870	33.46	5.3	8
2017	37	2095	56.62	4.95	14
2016	29	1734	59.79	5.39	8
2015	29	2122	73.17	7.87	12
2014	16	1155	72.19	7.41	3
2013	27	9564	354.22	6.38	11
Total	230	18998	-	-	66

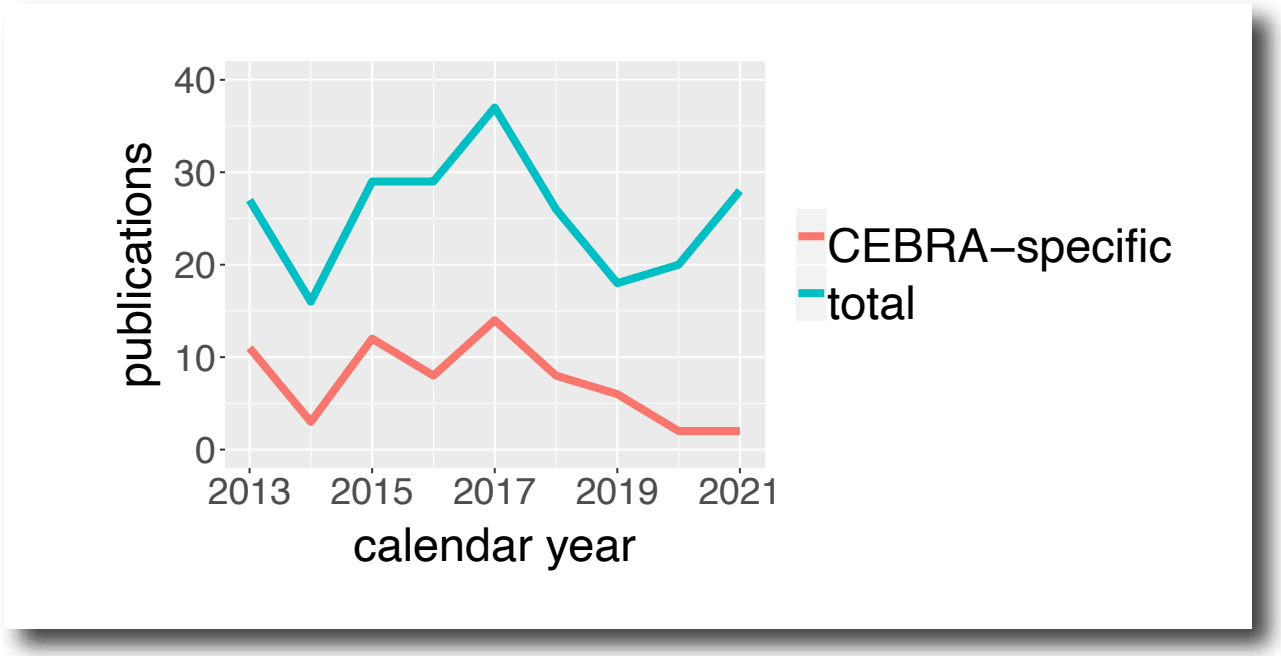


Chart 1: The number of publications (total and CEBRA-specific) by CEBRA researchers, during 2013–21

Events and media engagements

CEBRA work is regularly shared and communicated at domestic and international conferences, symposiums and other meetings. During the period 2021–22, CEBRA staff members gave presentations (in real life and online), ran workshops, chaired sessions, featured on panels and more. CEBRA researchers also shared insights with a wider audience through media engagements. Note that some activities were restricted during 2021–22 due to the pandemic.

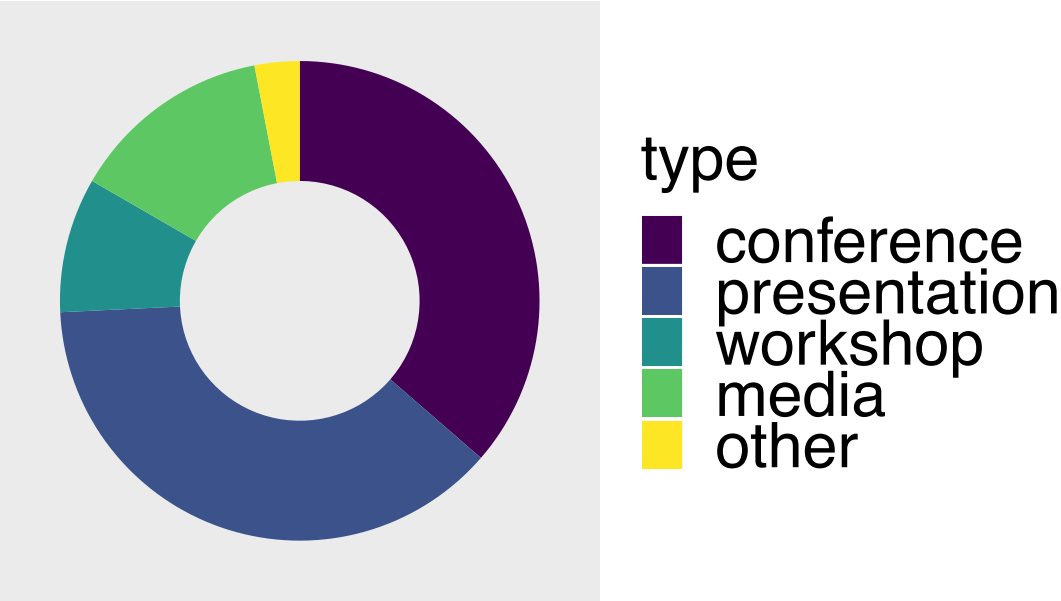


Chart 2: A summary of CEBRA's engagements during 2021–22, segmented by event type

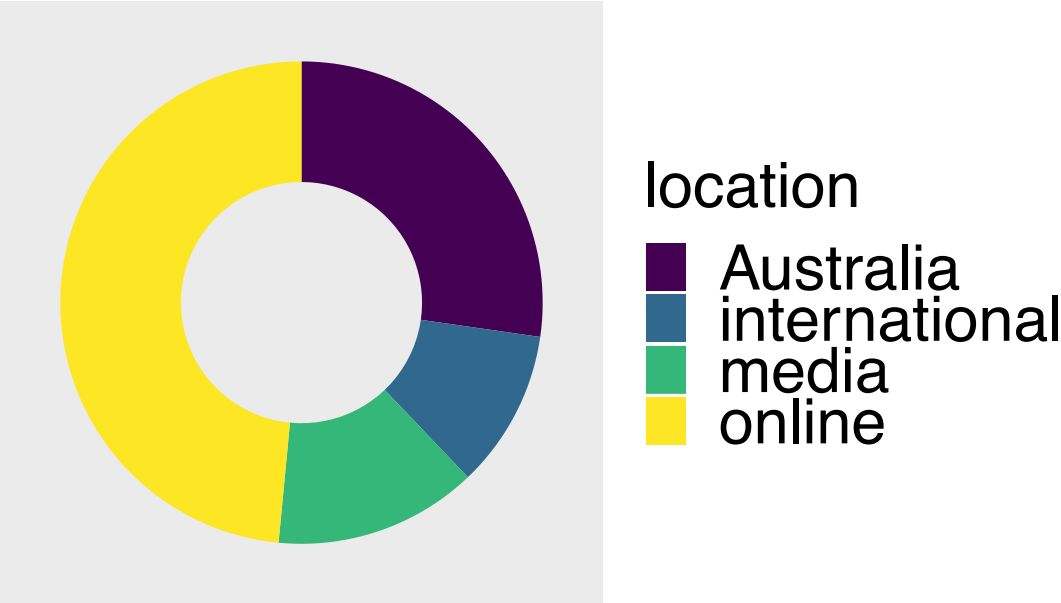


Chart 3: A summary of CEBRA's engagements during 2021–22, segmented by location

Event highlights

Australian Biosecurity Symposium

CEBRA was a proud sponsor of the recent Australian Biosecurity Symposium, which was held from May 3–5 on Queensland's Gold Coast. The symposium was hosted by Animal Health Australia, the Invasive Species Council, the Centre for Invasive Species Solutions and Plant Health Australia.

The MC for the event was environmental educator and gardening personality Costa Georgiadis. Keynote presenters included health journalist Dr Norman Swan, farming systems expert Dr Anika Molesworth and CSIRO epidemiologist Dr Debbie Eagles. Over 400 delegates from academia, industry and government attended the event.

Twelve CEBRA personnel attended the event, giving the following presentations and workshops:

- Aaron Dodd: *Biosecurity is valuable: right?*
- Tom Kompas: *Optimal surveillance against bio-invasions:* the sample average approximation method applied to an agent-based spread model
- Andrew Robinson: *A high-level approach to assessing pests and pathways*
- Edith Arndt: *Improving the resilience of the biosecurity system: why should we care?*
- Les Kneebone: *Raiders of the Lost Arts: research archaeology for biosecurity risk*
- Richard Bradhurst: *Modelling the spread of African Swine Fever in Queensland domestic and feral pig populations*
- Christopher Baker: *What can biosecurity learn from COVID?*
- Nathaniel Bloomfield: *Machine learning and biosecurity: a pathway to making interventions scalable*
- Aaron Dodd and Saras Windecker: *Biosecurity Commons workshop: an innovative cloud-based modelling and analytics platform*

These talks and workshops were positively received. Our delegate table – crewed by Cassie Watts and Erica Kecorius – provided a focus for CEBRA activities and a meeting point for attendees interested in our work.

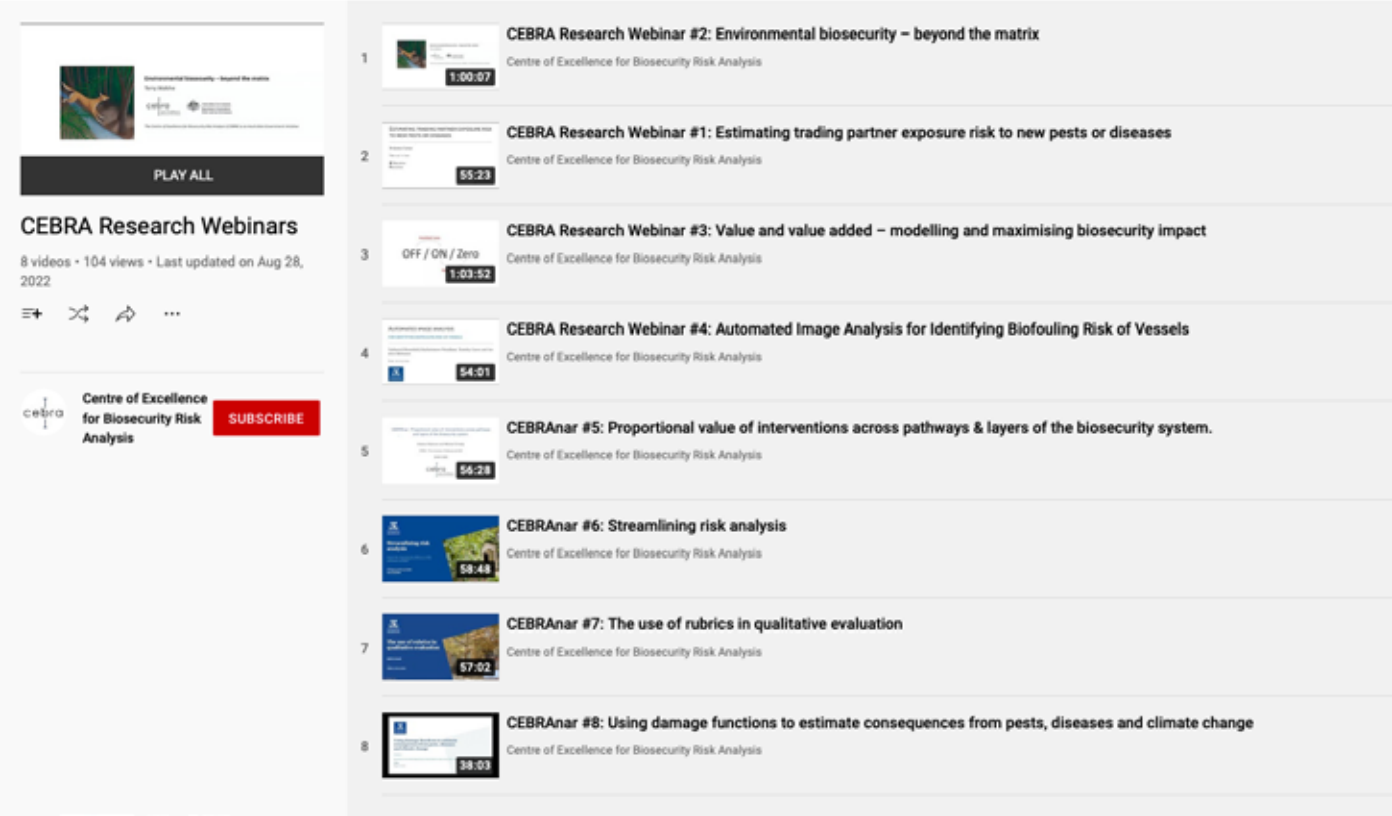
Dr Edith Arndt

CEBRAnars

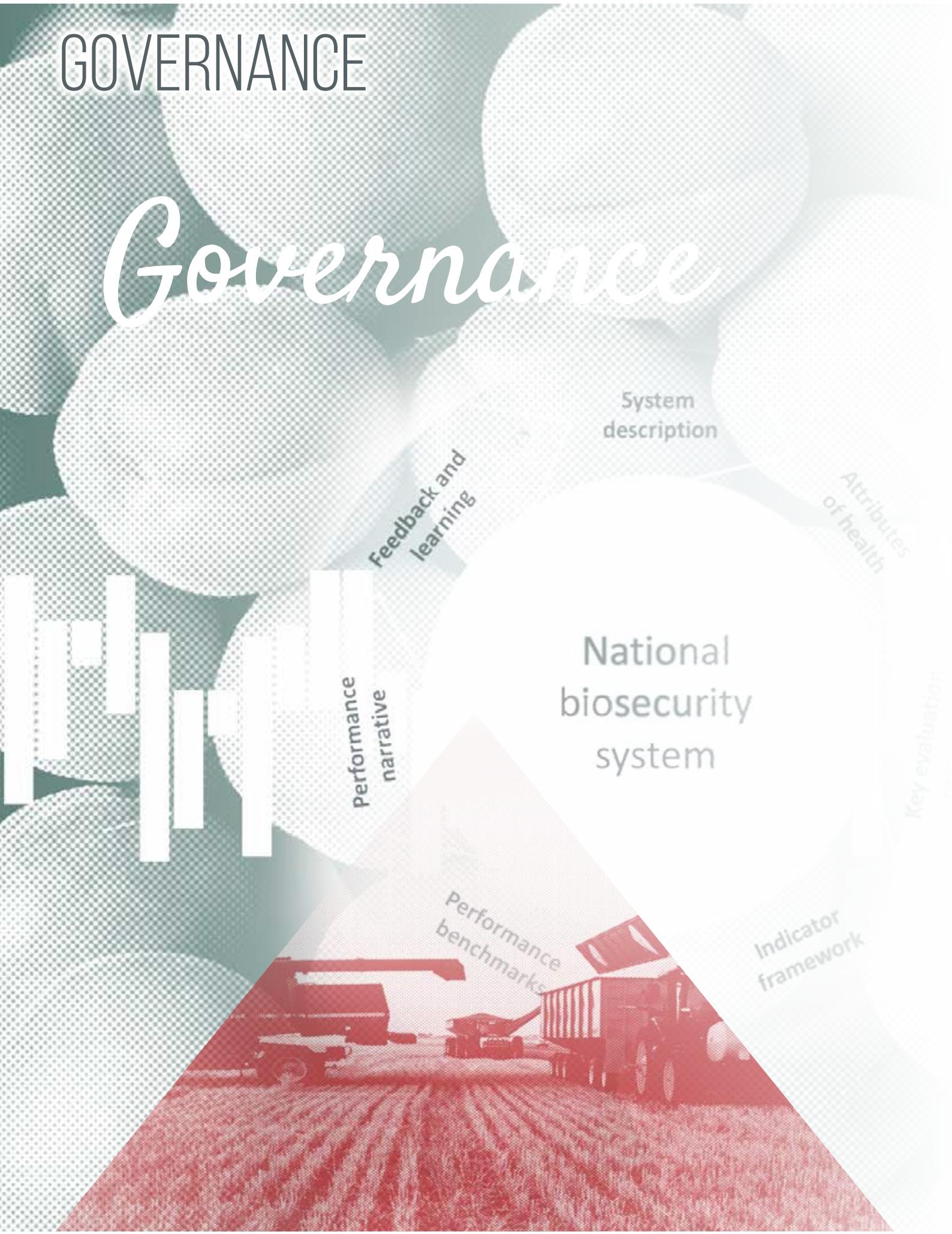
CEBRA and the department host regular seminars (or 'CEBRAnars'), in order to showcase CEBRA work and communicate our research with a wider audience. Recordings of these webinars are available on CEBRA's youtube channel.

Recent CEBRAnars include:

- November 2021: Dr James Camac presented on *Estimating trading partner exposure risk to new pests or diseases*
- February 2022: Dr Terry Walshe presented on *Environmental biosecurity – beyond the matrix*
- March 2022: Dr Aaron Dodd presented on *Value added – modelling the marginal return on investment within and across pathways*
- April 2022: Nathaniel Bloomfield presented on *Automated image analysis for identifying biofouling risk of vessels*
- May 2022: Professor Andrew Robinson presented on *Proportional value of interventions across pathways and layers of the biosecurity system*
- June 2022: Dr Tim van Gelder and Dr Ariel Kruger presented on *Streamlining the risk assessment process*



Governance


System description
Attributes of health
Key evaluation
Indicator framework
Performance benchmarks
Performance narrative
Feedback and learning
National biosecurity system

CEBRA Board members

Name	Position	Organisation
Ms Lindy Hyam	Chair	Independent
Professor Andrew Robinson	CEO	CEBRA, The University of Melbourne
Professor Jodie McVernon	Core member	Doherty Institute, The University of Melbourne
Mr Terry Charlton	Core member	Independent
Professor Margie Mayfield	Core member	BioSciences, The University of Melbourne
Dr Bruce Christie	Advisory member	Independent
Ms Sarah Corcoran	Advisory member	Plant Health Australia
Professor Michael McCarthy	Advisory member	Ecosystem and Forest Sciences, The University of Melbourne
Professor Ian Robertson	Advisory member (Scientific Review Panel Chair)	School of Veterinary Science, Murdoch University
Professor Peter Taylor	Advisory member	Mathematics and Statistics, The University of Melbourne
Mr Peter Gooday	DAFF advisory member	ABARES
Dr Robyn Martin	DAFF advisory member	Biosecurity Animal Division
Dr Michael Ormsby	MPI advisory member	Biosecurity New Zealand

Scientific Review Panel terms of reference

The Scientific Review Panel (SRP) reviews and approves alldraft project plans and provides an assessment of all final reports.

The role of the SRP will be to:

- Assist the CEO in evaluating research proposals based on criteria of:
    - scientific and practical merit for risk analysis
    - capacity/capability to deliver
    - budget viability
- Obtain peer reviews of final reports prior to submission to the Department of Agriculture, Fisheries and Forestry (DAFF) and NZ Department of Primary Industries (NZ MPI) for endorsement.
- Provide relevant advice to researchers conducting CEBRA projects, as requested by the CEO.

The composition of the SRP will be:

- Chair: Professor Emeritus Ian Robertson
- A broad group of members covering relevant fields of environmental, animal and plant sciences, biosecurity, physical mathematical and social sciences, psychology, philosophy and statistics.

The responsibilities of SRP members will be:

- Chair will seek advice and peer reviews from appropriate SRP members and other colleagues on proposals, interim and final reports, as appropriate. Reviews will be forwarded to investigators for their consideration.
- SRP members may be provided with copies of project proposals or interim reports, and may be invited, without obligation, to provide advice to researchers or the SRP.
- Chair will attend CEBRA board meetings to report on SRP matters.

It is anticipated that most of the business of the SRP will be conducted electronically. Formal meetings may be called at the discretion of the chair in consultation with the CEO.

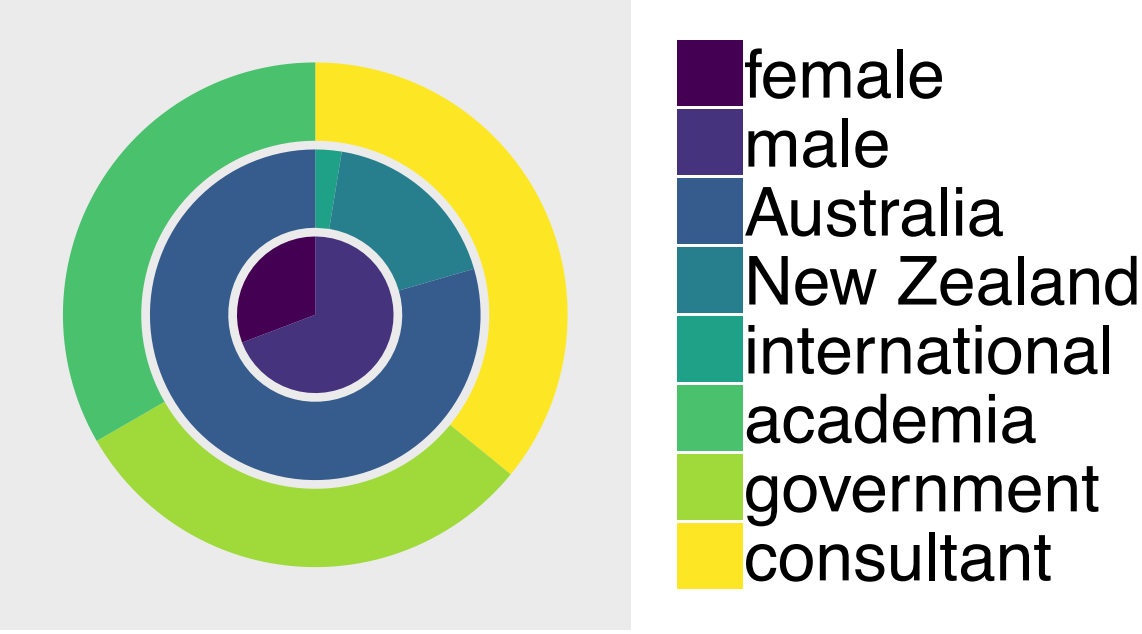


Chart 4: SRP reviewers segmented by sex, location and sector

Key performance indicators

We measure our activities against a range of key performance indicators, to ensure that we are on track. This is a broad overview only (see appendix for details).

During 2021–22, CEBRA performed strongly across all major measures:

Core stakeholder engagement

Research, development and extension activities

Collaboration

Excellence

Governance

Monitoring and evaluation

1. Core stakeholder engagement

Description: Engage core stakeholders to identify research, development and extension (RD&E) priorities and activities that are expected to provide benefits to Australian and New Zealand biosecurity, and provide strategic advice and guidance on biosecurity trends and risks, and priority areas for research investment (including new approaches or technologies).

Outcomes

4 board meetings

13 environmental scan meetings

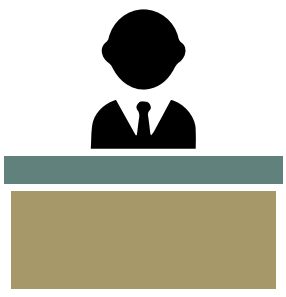
19 DAFF secretariat briefings

7 DRISC meetings

3 SAP meetings

3 progress reports

2021–22 work plan approved
2022–23 work plan submitted



CEO present at DRISC and SAP meetings

To be completed: MPI Science Committee meetings, customer satisfaction survey

2. Research, development and extension activities

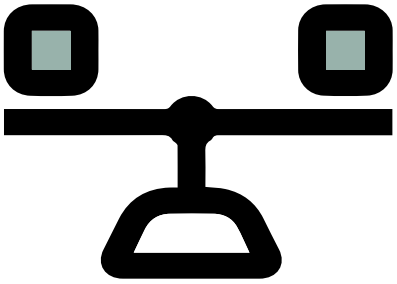
Description: Ensure that RD&E activities, including rapid response to critical biosecurity situations, provide benefits to Australian and New Zealand biosecurity. Balance long-term, short-term, high and low risk, and strategic and adaptive research activities. Demonstrate impact.

Outcomes

1 DAFF and MPI project	2 MPI projects
5 DAFF projects	

Projects align with *Biosecurity 2030* priority areas

Budget spread across priority areas



Projects balanced across long-term, short-term, high- and low-risk, strategic

Rapid response to emergent issues
FMD, Lumpy Skin Disease, Japanese Encephalitis

H-index
CEBRA - 51
ACERA - 72
Combined - 87

To be completed: stakeholder survey

3. Collaboration (non-core stakeholder engagement)

Description: Undertake strategic and sustained cross-industry and cross-sectoral collaboration that addresses shared challenges and draws on experience from other sectors.

Outcomes

Non-core projects	
4 complete	15 underway

Non-core project budget
$5,398,500

☑ non-core research projects cover a range of sectors

Stakeholders

To be completed: stakeholder survey

4. Excellence

Description: CEBRA is recognised as excellent within the context of its remit (domestically and internationally), engages a range of disciplinary skills relevant to contemporary risk analysis to ensure governments remain at the forefront of biosecurity risk analysis, and assists in developing Australia's biosecurity risk analysis research capability, including its collaboration with and connectedness to capabilities overseas.

Outcomes

Publications

49 academic papers published since 1 January 2021

H-index

CEBRA: 51
ACERA: 72
Combined: 87

Core skills

Collaborators

MONASH University

BIOFOULING SOLUTIONS

Australian National University

NRMT90002 course enrolled student numbers	
2021: 46 students	2022: 61 students

1 PhD student

To be completed: stakeholder survey

5. Governance

Description: Governance arrangements and practices to fulfill legislative requirements and align with contemporary Australian best practice for open, transparent, and proper use and management of funds.

Outcomes

4 board meetings	19 DAFF secretariat briefings
4 finance reports adopted at board meetings	6 governance items endorsed by board

100% milestones approved

Financial audit complete

Adhered to all UoM policies

6. Monitoring and evaluation

Description: Demonstrate positive outcomes and delivery of RD&E benefits to core stakeholders and the Australian community in general, and continuous improvement in governance and administrative efficiency.

Outcomes

2 newsletters	6 CEBRAnars (CEBRA webinars)
60+ presentations, workshops and media engagements	
3 communiques	3 progress reports

Annual report complete

To be completed: stakeholder survey

FINANCIALS

Financials

CEBRA is primarily funded by the Australian Government Department of Agriculture, Fisheries and Forestry, New Zealand's Ministry for Primary Industries and our host, the University of Melbourne. During the period 2021–22, our total income amounted to $2,416,500, while expenditures totalled to $2,285,160. See Chart 5 for a breakdown of expenses.

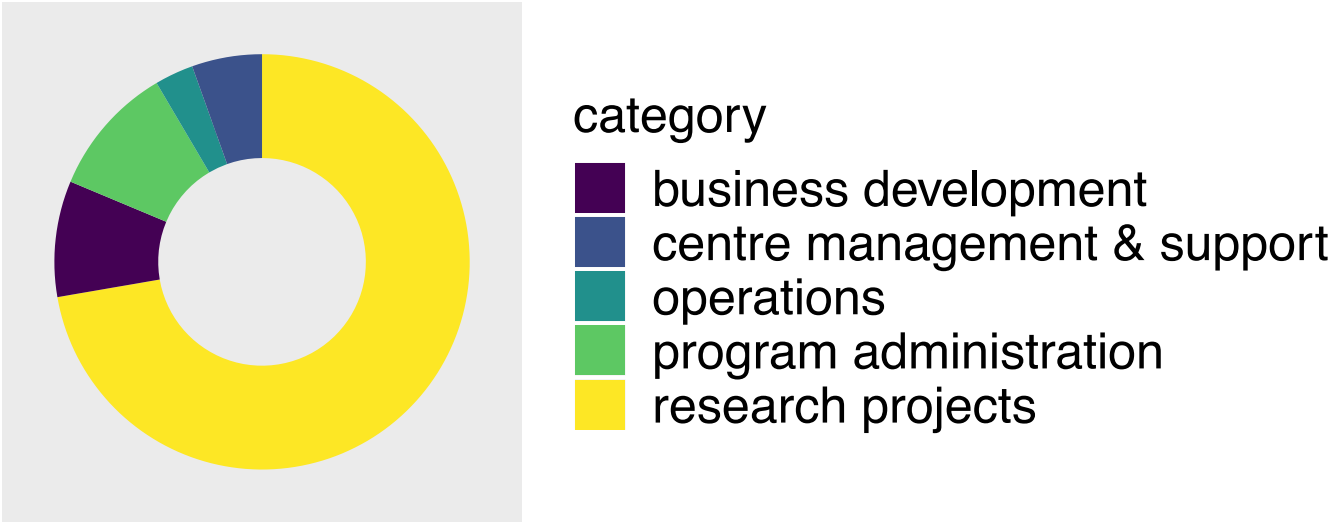


Chart 5: Expenses by category

DENCH McCLEAN CARLSON

CORPORATE ADVISORY

26 August 2022

INDEPENDENT AUDIT REPORT

TO COMMONWEALTH OF AUSTRALIA – DEPARTMENT OF AGRICULTURE, WATER AND THE ENVIRONMENT (DAWE) IN RELATION TO THE FUNDING AGREEMENT FOR THE CENTRE OF EXCELLENCE FOR BIOSECURITY RISK ANALYSIS (CEBRA)

I advise that an audit has been conducted of the Financial Statement and In-kind Support Statement for the Centre of Excellences for Biosecurity Risk Analysis (CEBRA) the period 1 July 2021 to 30 June 2022.

AUDIT OBJECTIVE

The objective of the audit was to provide an auditor's report in accordance with clause 6.12 of the Funding Deed dated 25 June 2021. Specifically, this includes forming an opinion on whether the financial reports provided under this clause are true and fair and the University of Melbourne has complied with its obligations to expend grant payments in accordance with the Agreement.

AUDIT SCOPE

The audit was conducted in accordance with Australian Auditing Standards to provide reasonable assurance as to whether the financial statements are free of material misstatement. The audit procedures included an examination, on a test basis, of evidence supporting the amounts in the financial statements. The funds form part of the University's overall accounts, which have been audited and signed off by the Victorian Auditor-General's Office.

The prevention and detection of fraudulent activity is the responsibility of University of Melbourne management. Our audit procedures were conducted with a focus on addressing specific objectives from a control systems design perspective. We did not examine all transactions over the defined review period, and while an outcome of these procedures may be the detection of fraud, this was not the objective of the review. As a consequence, we do not provide a guarantee that all errors or omissions, whether intentional or otherwise were detected.

AUDIT OPINION

I confirm that in my opinion:

- the University has incurred $2,285,160 expenditure on the Project;
- the contributions of the University are $562,500 in cash and $2,501,942 in-kind in accordance with the terms of the Agreement; and
- the Net Surplus at 30 June 2022 is $131,339.

The Financial Statement and Summary of In-kind Support Statement signed by the Director of the Centre of Excellence for Biosecurity Risk Analysis (CEBRA), in accordance with the Agreement are attached.

Craig Geddes
Partner
Dench McClean Carlson Pty Ltd

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Website: www.dmcca.com.au

FUTURE OUTLOOK

Future outlook

In 2021–22, Australian agriculture, fisheries and forestry production had a gross value of close to $80 billion, a 7% (adjusted for inflation) increase since 2002[1]. Tourism, also a multi-billion dollar industry for Australia, is another sector that benefits from a well functioning biosecurity system. Other areas closely linked to biosecurity include natural ecosystems and human health.

In the coming years, climate change presents a significant challenge. Climate Change in Australia predicts that over the coming decades, Australia will experience further increases in temperature, more frequent and severe marine heatwaves, changes in rainfall patterns and more drought. These changing climatic conditions can affect risks of invasive species through shifts in environmental suitability.

With COVID-related restrictions easing, the past six months have brought a five-fold increase in traveller arrivals into Australia, though numbers are still only about half of what they were pre-pandemic[2]. These numbers will likely rise as international restrictions ease further and traveller confidence returns.

A number of biosecurity threats remain prominent through the rest of 2022 and into 2023. In NSW, the detection rate of new varroa mite infestation sites has decreased in recent weeks. The response will next turn its eradication efforts towards feral honeybee colonies within the emergency eradication zone. FMD, Japanese encephalitis and lumpy skin disease also remain of higher than usual concern in the region.

The Australian Government Department of Agriculture, Fisheries and Forestry and New Zealand's Ministry for Primary Industries stand well prepared to tackle these challenges. The Commonwealth Biosecurity 2030 roadmap was released in 2021, with the goal of building a stronger, smarter biosecurity system. CEBRA is actively assisting both the department and the ministry to extend on existing practises and further embed risk-based methodology into future processes.

CEBRA have continued to provide world-class research during the first year under our new grant agreement with the department and the University of Melbourne. With Australia and New Zealand currently facing a number of challenges, the need for informative biosecurity modelling, science and economics is more pressing than ever.

1 ABS International Trade in Goods and Services (cat. 5368)

2 abs.gov.au/statistics/industry/tourism-and-transport/overseas-arrivals-and-departures-australia/latest-release

2022–23 research projects

BETTER ANTICIPATE BIOSECURITY RISK

$358,103

Project ID: 21B

Project title: Biosecurity risk from changes in climate, trade and pest and disease pathways

CEBRA project lead: Tom Kompas and James Camac

Department project lead: Shalan Schofield

Department project sponsor: Peter Gooday

2022–23: $358,103

BETTER ALLOCATE RESOURCES TO BIOSECURITY RISK

$502,090

Project ID: 21D

Project title: Value added - modelling the marginal return on investment within and across pathways

CEBRA project lead: Aaron Dodd

Department project lead: Blaine Wentworth

Department project sponsor: Peta Lane

2022–23: $259,000

Project ID: 22C

Project title: Effectively engaging the community in the biosecurity system

CEBRA project lead: Susie Hester

Department project lead: Dr Heleen Kruger

Department project sponsor: Dr Robyn Cleland

2022–23: $243,090

SYSTEM DESIGN AND REGULATORY INCENTIVES

$338,000

Project ID: 21C

Project title: Incentive-compatible biosecurity policies – a framework for regulatory design

CEBRA project lead: Susie Hester

Department project lead: Rachelle Clarke

Department project sponsor: Peta Lane

2022–23: $338,000

SYSTEM ENHANCEMENTS

$222,553

Project ID: 21E

Project title: A Biosecurity Risk Research Platform to inform decision-making

CEBRA project lead: : Andrew Robinson

Department project lead: Jessica May

Department project sponsor: Peta Lane

2022–23: $143,706

Project ID: 21K

Project title: Automated image analysis for identifying the biofouling risk of vessels: exploring deployment strategies and analysing video footage

CEBRA project lead: Nathaniel Bloomfield and Andrew Robinson

Department project lead: Bart Woodham

Department project sponsor: Robyn Martin

2022–23: $78,847

Glossary

AADIS: Australian animal disease (model)

AARES: Australian Agricultural and Resource Economics Society

ABARES: Australian Bureau of Agricultural and Resource Economics and Science

ACIAR: Australian Centre for International Agricultural Research

ARDC: Australian Research Data Commons

ASF: Australian swine fever

BN: Bayesian network

CEBRA: Centre of Excellence for Biosecurity Risk Analysis

DRISC: Data, Research and Intelligence Sub-committee

DAFF: Australian Government Department of Agriculture, Fisheries and Forestry

DJPR: Department of Jobs, Precincts and Regions

FMD: Foot-and-mouth disease

GTAP: Global Trade Analysis Project

ISPM: International Standards for Phytosanitary Measures

MPI: New Zealand's Ministry for Primary Industries | Manatū Ahu Matua

NFFC: National Fruit Fly Council

PHA: Plant Health Australia

PIRSA: Department of Primary Industries and Regions

RD&E: Research, development and extension

ROV: Remotely operated vehicle

RRRA: Risk–return resource allocation model

SAP: Science Advisory Panel

SARDI: South Australian Research and Development Institute

SETAC: Society of Environmental Toxicology and Chemistry

SRP: Scientific Review Panel

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POST

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Australian Government
Department of Agriculture, Fisheries and Forestry

THE UNIVERSITY OF MELBOURNE

Ministry for Primary Industries
Manatū Ahu Matua

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