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Centre of Excellence for Biosecurity Risk Analysis

CEBRA

ANNUAL REPORT 2017–2018

Australian Government
Department of Agriculture and Water Resources

THE UNIVERSITY OF MELBOURNE

Ministry for Primary Industries
Manatū Ahu Matua

Contents

Director's Introduction

It is my privilege and pleasure to introduce the 2017-18 Centre of Excellence for Biosecurity Risk Analysis (CEBRA) Annual Report.

As Managing Director for the Centre of Excellence for Biosecurity Risk Analysis, I welcome readers to our annual report for the year ended 30 June 2018.

Protecting Australia and New Zealand's industries, environment and people against biosecurity threats is an ongoing challenge. By providing innovative, practical research, CEBRA continues to support the Australian and New Zealand governments in this critical endeavour. CEBRA's position at the intersection of government and academia provides a stable platform for fruitful, collaborative science that underpins risk analysis and management for biosecurity.

CEBRA is growing. Last year, we welcomed Professor Ian Robertson as Scientific Advisory Committee (SAC) chair, and Dr Jason Whyte from the School of Mathematics and Statistics. To ensure that we continue to provide quality outputs for our stakeholders, in November I appointed Dr Susie Hester, Dr Aaron Dodd and Dr Steve Lane as joint deputy directors. Susie, Aaron and Steve play distinct and essential roles in steering CEBRA's strategic direction, and have engaged with their new responsibilities whole-heartedly and to great effect. We also bade sad farewells, with many thanks for their excellent work, to Jess Holliday and Dr Tracey Hollings.

CEBRA continues to engage widely across government, academia and industry. In April, CEBRA hosted the first International Biosecurity Data Analytics Working Group meeting at the University of Melbourne. The weeklong meeting gave participants an overview of regulatory biosecurity analytics across Australia, New Zealand, Canada and the USA. Meetings like this are invaluable for risk practitioners, allowing us to share knowledge and keep informed about developments in the fields of biosecurity and data analysis.

Last November, CEBRA organised the joint conference of the Society for Risk Analysis Australia and New Zealand (SRA–ANZ), and the Australasian Bayesian Network Modelling Society. This conference brought together researchers and stakeholders across academia, government and industry. CEBRA continues to support SRA–ANZ, which focuses on cross-disciplinary risk analysis, because we highly value the opportunities for engagement across a range of expertise.

The strength of CEBRA lies in the skills and professionalism of our team, and the high quality of our relationships with our colleagues in the Department of Agriculture and Water Resources and the Ministry for Primary Industries. I thank them warmly for their continued engagement and diligence.

Associate Professor Andrew Robinson
Managing Director, CEBRA

Core Activities

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Summary of Core Activities

The core activities that CEBRA undertook during the financial year 2017–18 comprise the following projects, approved by the Biosecurity Research and Innovation Steering Committee.

Table 1 : Core Activities for 2017-2018

Project	Title	2017–2018 Budget
	Strengthening Surveillance	
170602	Increasing confidence in pre-border risk management	$97,000
170604	Australian Zones and Compartments: new client service models for the agricultural export trade	$60,000
170606	Developing models for the spread and management of National Priority Plant Pests	$140,000
170607	Developing scientifically robust risk maps for priority plant pests	$170,000
170608	CBIS/CSP sensitivity analysis	$55,000
170615*	Assessing ant pathways to better inform site selection for ant surveillance	$90,000
170618*	Optimising New Zealand's marine biosecurity surveillance programme	$70,000
170621*	Proportional value of interventions across pathways and layers of the biosecurity system (extension of 1606E)	$50,000
	Building Scientific Capacity	
170713	Value of Australia's biosecurity system (extension of 1607A)	$230,000
170714	Health of Australia's biosecurity system (extension of 1607B)	$220,000
	Data and Information	
170805	Optimisation of national resources for animal disease surveillance	$115,000
170820*	Biosecurity response decision support framework	$68,000
	Total:	**$1,365,000**

*Ministry for Primary Industries led projects

CEBRA Biosecurity Research Projects

July 2017–June 2018

Themes

Strengthening Surveillance $732,000

Project ID: #2 170602 SH
Project Title: Increasing confidence in pre-border risk management
Division: Biosecurity Animal
2017-18: $97,000

Project ID: #4 170604 TK
Project Title: Australian Zones and Compartments: new client service models for the agricultural export trade
Division: Biosecurity Animal
2017-18: $60,000

Project ID: #6 170606 TK
Project Title: Developing models for the spread and management of National Priority Plant Pests
Division: Biosecurity Plant
2017-18: $140,000

Project ID: #7 170607 AR
Project Title: Developing scientifically robust risk maps for priority plant pests
Division: Biosecurity Plant
2017-18: $170,000

Project ID: #8 170608 SH
Project Title: CBIS/ CSP sensitivity analysis
Division: Biosecurity Plant
2017-18: $55,000

Project ID: #15 170615 ❖AR
Project Title: Assessing ant pathways to better inform site selection for ant surveillance
Division: NZ MPI DSSO
2017-18: $90,000

Project ID: #18 170618 ❖AR
Project Title: Optimising New Zealand's marine biosecurity surveillance programme
Division: NZ MPI DSSO
2017-18: $70,000

Project ID: #21 170621 (extension of 1606E) ❖AR
Project Title: Proportional value of interventions across pathways and layers of the biosecurity system
Division: NZ MPI BSFSRARA
2017-18: $50,000

Building Scientific Capability $450,000

Project ID: #13 170713 (extension from 1607A) ♦TK
Project Title: Value of Australia's biosecurity system
Division: Biosecurity Policy & Implementation
2017-18: $230,000

Project ID: #14 170714 (extension of 1607B) ♦KS
Project Title: Health of Australia's biosecurity system
Division: Biosecurity Policy & Implementation
2017-18: $220,000

Data and Information $183,000

Project ID: #5 170805 TK
Project Title: Optimisation of national resources for animal disease surveillance
Division: Biosecurity Animal
2017-18: $115,000

Project ID: #20 170820 (extension of 1608F) ❖SH
Project Title: Biosecurity response decision support framework
Division: NZ MPI RRSO
2017-18: $68,000

Projects

FUNDING
2017–18: $1,365,000

Key
AR – Andrew Robinson
SH – Susie Hester
TK – Tom Kompas
KS – Karen Schneider
❖ – NZ MPI project
♦ – Collaborative with NZ MPI

Last updated
31 July 2017

Project Summaries

Strengthening Surveillance

170602: Increasing confidence in pre-border risk management

The department acknowledges it requires a monitoring system at the border to ensure Competent Authority (CA) compliance with Australia's import requirements. Currently, most CA-certified goods arriving at the Australian border are 'released on documents' — typically no additional inspection or testing of the good is required. The post-arrival programs under development by the department provide additional checks to a 'release on documents'.

This project will evaluate the likelihood that CAs will comply with Australia's biosecurity requirements for particular pathways. It will identify strategies used by CAs, and the exporters they certify, to meet Australia's biosecurity requirements. Where it is demonstrated that Australia's advance loss of profit is unlikely to be met, the project will recommend appropriate changes to regulations. This may include modifications to post-arrival programs where surveillance could be used to provide assurance that pathogens of biosecurity concern are below acceptable thresholds.

Strengthening Surveillance

170604: Australian Zones and Compartments: new client service

Global trade in animals and animal products is becoming more and more compartmentalised year-in year-out. To deal with biosecurity issues related to globalised trade, the World Organisation for Animal Health (OIE) has developed the principle of compartmentalisation as a means for governments to facilitate trade in animals and animal products without compromising biosecurity risk. The compartmentalisation principles have been developed as guidelines and added as chapters to the OIE Terrestrial and Aquatic Codes. Member countries agree with, and recognise the international framework, which can be used by bilateral and multilateral trading partners to establish compartments for the purposes of safe trade.

The OIE Performance of Veterinary Service Pathway has been established to evaluate Competent Authority (Veterinary Services) critical and essential competencies, of which, the ability to operate compartments is listed. When a CA embarks on a program to develop compartmentalisation competency the OIE recommends that a cost–benefit analysis (feasibility study) be conducted.

Australia does not currently have an official compartmentalisation program available for willing and suitable industry participants to gain export market access. This project will develop a structured and comprehensive program based on the international standards for approving, operating and assessing the competency and functionality of services required to operate a compartment. An official program such as this also provides a professional, consistent and comprehensive format on which trade negotiations can be based. The program format also allows a trading partner to easily recognise and evaluate a proposal when considering safe market access. This project will develop a generic compartmentalisation policy and program under the control of the relevant Australian CA and conduct a cost–benefit analysis for participants to consider when applying for export market access under this program.

Strengthening Surveillance

170606: Developing models for the spread and management of National Priority Plant Pests

The department is the major contributor of resources for eradication and containment activities and plays a coordinating role in early detection surveillance for National Priority Plant Pests (NPPP). Effective deployment of resources for early detection surveillance will pre-emptively lower Australia's potential liability for incursion costs.

Emergency responses to major pests consume significant resources which can be reduced by a more informed understanding of the relationship between pests, the incursion environment and surveillance information. Modelling can provide guidance to the Consultative Committee on Emergency Plant Pests, National Management Group and advisory groups on the appropriate course of action for response management, including technical feasibility and the cost–benefit of eradication or containment. Managing incursions of priority plant pests is often confounded by a poor understanding of the distribution of the pest. Surveillance activity tries to refine the potential distribution over time, but it can be difficult to understand the hidden incursion process in relation to presence and absence data, particularly for pests with broad host ranges, complex spread pathways and poor detectability. Custom-made models have been constructed in response to emergency plant pest incursions in the past, but the Australian Animal Disease (AADIS) model (Bradhurst et al., 2015), will provide the basis for a better maintained departmental system that will help prepare for high priority pests, as well as being adaptable for use in responses to other pests.

This project will produce mechanistic and statistical models to support the management of NPPP incursions. Eradication and containment models will be based on plausible pest establishment and detection scenarios in operational settings. Managing incursions requires that knowledge of pest ecology/ epidemiology will work in conjunction with surveillance data to guide the appropriate zoning and implementation of control measures. Models will simulate the spread of incursions from potential establishment locations through natural and human-assisted spread. The capacity for surveillance data to delimit incursions with respect to control technologies will be determined through statistical modelling.

Strengthening Surveillance

170607: Developing scientifically robust risk maps for priority plant pests

The department plays a major role in surveying for the early detection of high impact invasive plant pests. Surveillance for early detection of invasive plant pests is labour intensive and costly to maintain. Efficient allocation of increasingly scarce surveillance resources across all risk areas presents a significant challenge for DAWR. Compounding the issue of prioritising which pest species to target in early detection surveillance, little to no information is available about where, when and how a new pest species is likely to arrive and establish in Australia.

In order to determine where surveillance resources should be allocated to maximise early detection or confidence in pest-freedom, it is imperative we have an understanding of how risk of pest establishment varies across space (Wintle et al 2012, Hauser et al 2009). Fundamentally, the risk that a pest arrives and establishes at a location is a function of three primary processes:

1. its ability to arrive at the given location
2. the environmental suitability of that location
3. the presence of hosts/vectors at that location.

Several approaches exist to estimate each of these processes (Dodd et al. 2016, Barry et al. 2016, Elith 2011, Václavík and Meentemeyer 2009, Work et al. 2005). However, previous CEBRA projects (e.g. 1402B - Barry et al. 2016; 1302A - Burgman et al. 2014) have highlighted that different methods can give very different results, likely as a consequence of making different assumptions and having differing data requirements (Guillera-Arroita et al. 2015). These studies have also highlighted that there is no single 'best' approach to estimating invasive species distributions (Barry et al. 2015). The combination of these uncertainties has made it difficult for decision makers to decide how best to estimate pest climate suitability, arrival rates, potential invasive pest distributions, and consequently, how to develop scientifically defensible maps of risk of establishment.

The primary objective of this three-year project is to develop a standardised approach for estimating risk maps that incorporate pest arrival rates, environmental suitability and the presence of hosts. Specifically, the project will develop practical guides (i.e. decision trees) for deciding how 'best' to estimate environmental suitability and arrival rates, in the face of varying data quantities/qualities, pest biology, and uncertainty about the most appropriate model fitting approach. These practical guides will then permit a standardised approach for the development of scientifically defensible maps of risk of pest establishment.

Strengthening Surveillance

170608: Compliance Based Inspection Scheme/Continuous Sampling Plan sensitivity analysis

The department manages biosecurity risk using various tools and processes to reduce the risk pre-shipment and remedial actions on arrival if necessary. However, there are other information sources, intelligence and industry practices that could contribute to the effective management of biosecurity risks, which are evident in many highly compliant imported products, but which are not recognised as official controls. This project will investigate how these diverse types of information—such as Hazard Analysis and Critical Control Point (HACCP)—could enhance the rollout of the Compliance Based Inspection Scheme (CBIS) in the department.

The objective of this project is to develop practical, rigorous and transparent guidelines that will allow pathway managers to determine the appropriate CBIS parameter values that should be applied on a particular pathway.

Specifically, deliverables are envisaged as:

1. an assessment or investigation into how offshore hazard controls may interact with our onshore mechanisms such as the CBIS (HACCP)
2. guidelines for staff to assist them determine and calibrate CBIS eligibility and processes
3. a spreadsheet-based simulation tool that can help officers to test the effects of offshore control points on CSP parameters.

Strengthening Surveillance

170615: Assessing ant pathways to better inform site selection for ant surveillance

The National Invasive Ant Surveillance programme (NIAS) detects 10–12 exotic ants per year at Ports and targeted Transitional facilities (devanning sites). With each incursion, the origin of the exotic ants that were detected is unknown, and it is impossible to trace the incursion. Due to the fact that the ants move from the containers to a food source by the time of sampling, there is generally no association of the ants with specific containers. Understanding the relative origin of ant incursions would better inform the risk around surveillance sites and help with selecting transitional facilities for future surveillance. There are thousands of transitional facilities clustered throughout the country and 'smart' site selection is needed to target the risk associated with transitional facilities.

At present, risk variables such as first port of origin and volume of containers; commodity type; and sites of previous detections of ants or other insects are used to determine which transitional facilities are surveyed. There is no evidence however, that these variables are important for predicting where ant incursions may occur, and consequently whether they are important for site selection. It would be useful to know if these (and other) variables are key components for site selection, and to identify the aetiology of ant arrivals to New Zealand to inform where ant surveillance can be targeted.

The main objective of this project is to develop a better understanding of the patterns of ant arrivals to New Zealand. The project aims to predict risk in relation to sites, and in particular transitional facilities, where ants are more likely to arrive. The development of such risk profiles will enable scientifically defensible rationale to select sites for targeted surveillance within the NIAS program.

Strengthening Surveillance

170618: Optimising New Zealand's marine biosecurity surveillance programme

Ocean-going vessels have been identified as the major vector for the global translocation of non-indigenous marine species (NIS) (Bell et al. 2011). The biofouling pathway is of particular importance and it has been estimated that 69–90% of established NIS in New Zealand are likely to have been introduced via this pathway, with ballast water being the second most important pathway (Cranfield et al. 1998).

In order to detect NIS early in the invasion process the Marine High-Risk Site Surveillance Programme (MHRSS) was established in 2002 and provides site-based surveillance at selected "high-risk" sites (ports and marinas) throughout New Zealand. MPI currently invests over $2M annually in the MHRSS and the associated Marine Invasives Taxonomic Service.

Currently 11 sites are surveyed biannually (summer and winter seasons) with survey effort distributed evenly across each site (~243 survey areas per site), with the exception of Auckland, which receives double the survey effort (~486 survey areas).

Since the inception of the MHRSS, survey methods for NIS have continually been refined, however, reprioritisation of "high-risk" surveillance sites at a national scale considering changes since 2002 to vessel traffic patterns or behaviour (e.g., sites visited, duration of stay, ballast water discharge volumes) has not occurred. Additionally, allocation of survey effort between surveillance sites is not related to the relative likelihood of NIS entry and establishment at each site.

As such, the current design of the MHRSS may not match the profile for NIS entry and establishment to New Zealand. Therefore, the development of a systematic statistical likelihood-based methodology that can determine the relative likelihood of NIS entry and establishment at sites (ports and marinas) using updated data is required for the optimisation of the MHRSS. Marine surveillance in Australia has been restricted due to the considerable costs of implementing a nationwide programme despite the development of guidelines in the 1990s.

The outcomes of this project will be:

- recommendations on which surveillance sites have the highest relative likelihood of NIS entry and establishment, and how survey effort should be assigned
- a systematic statistical likelihood-based methodology that can be used to:
    - o select sites prior to commencing a marine surveillance programme
    - o periodically investigate whether the MHRSS or other marine surveillance programmes are optimised for the detection of NIS
- an understanding of how any recommendations, if implemented, will affect the detection and interpretation of any long-term trends in the data set.

The model outputs will provide probabilities of the risk of NIS entry and subsequent establishment to a given port in NZ.

Strengthening Surveillance

170621: Proportional value of interventions across pathways and layers of the biosecurity system

This project is an extension of project 1606E: Scoping the value of performance of interventions across the NZ Biosecurity system.

The MPI biosecurity system faces increasing pressure from significant increases in goods and passengers, changing pathways and types of goods. With this increasing pressure, all layers of the system need to work together cost-effectively to maximise the reduction of biosecurity risk to New Zealand under sharply constrained resources.

In order to increase the efficiency of biosecurity investment and to identify opportunities for substantial improvement, the Ministry needs to determine the relative contribution of each layer towards biosecurity effectiveness. Presently, there is no agreed framework or process available to evaluate the comparative value of biosecurity activities implemented at intersecting sites across the biosecurity system matrix. Without knowledge on the likely effectiveness and costs of activities and control measures, risk management decisions on measures and allocation of resources at different 'nodes' cannot be systematically evaluated.

This project seeks to further develop a decision support framework that would significantly improve risk management decisions and resource allocation throughout the biosecurity system (from pre-border to pest management) by applying a systematic risk/return approach and evidence-based analysis. The project will focus on extending current work on a high-level framework and example case studies e.g. fruit flies and brown marmorated stinkbug, to provide a much more comprehensive tool to populate with data across all major pathways.

The project objectives are an extension to those provided for project 1606E:

1. Develop a fit-for-purpose pathway-based framework using the seven layers of the NZ biosecurity system that will allow risk management decisions to be made on a risk/return basis.

2. Provide specific performance outputs for specified pests e.g. fruit fly, BMSB, and selected pathways.

Comparative analyses will ultimately, after

(i) the completion of this scoping project,

(ii) appropriate generalization of its outcomes, and

(iii) implementation of its recommendations:

- illlustrate the value of the current allocation of biosecurity activities and resources
- inform and justify reallocation of resources where needed
- provide evidence-based information for adjustment of existing measures at specific nodes in the biosecurity system matrix
- support communication of the holistic and interdependent nature of the biosecurity system to all stakeholders.

170713: Value of Australia's biosecurity system

This project is an extension of project 1607A: Value of Australia's biosecurity system, for a second year to 30 June 2018.

Australia's biosecurity system provides a substantial benefit to the Australian community by managing the risks of pests and diseases entering, establishing and spreading, causing harm to human, animal and plant health, the environment and the economy. Australia also benefits from an effective biosecurity system by being better positioned to export high quality agricultural produce into premium international markets.

We know the system is inherently valuable but its value is difficult to quantify. This is because the system has a complex interplay of parts across supply chains, geographies, jurisdictions and stakeholders. Past attempts to value the biosecurity system have been based on ad hoc and qualitative statements of overall benefits or limited to specific cases, such as an estimate of the cost to Australia of an incursion of foot and mouth disease and other major invasive pests and diseases.

The current review of the Intergovernmental Agreement on Biosecurity (IGAB), additional biosecurity related investments arising from the Australian government White Papers on Agricultural Competitiveness and Developing Northern Australia, and the regulatory reform agenda would all benefit from an improved ability to describe the value of the biosecurity system.

The research will serve multiple purposes for the department such as: contributing to an assessment of the health of the biosecurity system through annual reporting requirements; providing evidence and context in conversations with governments from all jurisdictions, industry and the community; and informing and contributing to a national biosecurity strategy, IGAB and the National Environmental Biosecurity Response Agreement (NEBRA) reviews.

The overall objective of the multi-year project is to:

1. set out and design the methods that are needed to measure the value of the biosecurity system as a whole, and its various components

2. further develop and adapt the preferred approach for valuation and the aggregation of values specific to the Australian context

3. map value measures with risk-return trade-offs, especially for cases where resources are being directed to generate highest returns

4. work towards providing component measures and an aggregate value measure of the biosecurity system across different biosecurity measures and threats, taking into account different desired outcomes.

The outcomes sought from this project are to:

1. estimate a defensible value of the biosecurity system and indicate best ways to maximise rates of return with value-added measures for biosecurity

2. understand where the components that make up that value are generated across the biosecurity system, and where net returns may be highest

3. create a benchmark value for comparison with future value estimates.

170714: Health of Australia's biosecurity system

This project is an extension of project 1607B: Health of Australia's biosecurity system, for a second year to 30 June 2018.

The objectives of the department include maintaining and enhancing Australia's favourable animal and plant health status. This objective is underpinned by evidence-based policy, delivered through Australia's national biosecurity system.

The national biosecurity system is a combination of interventions that help Australia anticipate, prevent, prepare for, detect, respond to, and recover from, or adapt to, biosecurity risks – This includes activity pre-border, at the border and within Australian territory, and work to support Australia's access to export markets.

The performance, or 'health' of the biosecurity system is a measure of the system's capacity to deliver its key functions and activities, namely:

- biosecurity intelligence that provides timely knowledge of the pest and disease threats approaching Australia (anticipate)
- pre and at-border controls to prevent, or reduce to an acceptable level, the likelihood that pests and diseases are present on the goods and conveyances that approach and enter Australia (prevent)
- border screening to detect potential incursions of pests and diseases (screen)
- policy, planning and tools that facilitate responses to biosecurity incursions (prepare)
- post-border surveillance to detect incursions of pests and diseases (detect)
- responses to pest and disease incursions that minimise their impacts (respond)
- recovery after successful eradication programs or adaptation to established pests and diseases through activities that minimise costs and support continued market access (recover or adapt).

The national biosecurity system should be capable of delivering these activities in an effective, efficient, robust, resilient and sustainable manner.

The department is seeking a framework and methodology to measure and report on the health, or performance, of the Australian biosecurity system. This should build on existing capability and develop new methods that can be used repeatedly to articulate the health of the biosecurity system at the national level, against agreed performance criteria.

The need for this project arises because the department does not currently have a system for articulating the performance of the biosecurity system that captures all elements of the system and all participants in the system; that articulates relevant attributes of system performance and establishes qualitative and quantitative measures of performance; that can be repeated at agreed intervals; and that can be used to support decision making, particularly related to the quantity and allocation of investments in the biosecurity system.

The department currently relies on qualitative pathway specific risk analyses and reviews to assess and, if necessary, address potential unacceptable exposure to risk. Some work has been done collaboratively by government jurisdictions under the Intergovernmental Agreement on Biosecurity (IGAB) to evaluate the effectiveness of resource allocations for surveillance and emergency response activities. However, the department does not currently have a means of estimating the health of the national biosecurity system as a whole against appropriate performance criteria. This is a serious gap that limits the capacity of the department to evaluate the adequacy of investment across the biosecurity system.

Clearly defined criteria and indicators describing the performance or health of different elements of the national biosecurity system, and of the system as whole, would enable the department to identify on the basis of sound evidence where system improvements are required.

Such a system would aid decision making in relation to investments and other elements of responses to, for example, the Australian government White Papers on Agricultural Competitiveness and Developing Northern Australia, the review of the IGAB, and the regulatory reform agenda.

The department requires a means of assessing the performance or 'health' of the biosecurity system but there is no existing framework to facilitate this. This project addresses this shortfall by building a framework to evaluate Australia's national biosecurity system. This is defined as the combination of activities that help Australia anticipate, prevent, prepare, screen, detect, respond to, and recover from or adapt to, biosecurity risks. This includes: activities carried out pre-border, at the border and within Australian states and territories. Biosecurity activities include those undertaken by the Australian, state and territory governments, industry, landholders and the Australian community.

The primary objective of the project is to develop a framework and methodology to measure and report on the health, or performance, of the Australian biosecurity system that can be repeated at regular intervals. This should capture all elements of the biosecurity system and all participants in the system; articulate relevant attributes of system performance; and establish qualitative and quantitative measures of performance and associated performance indicators.

Key outputs from the project will include:

1. a program logic description of the activities undertaken in the biosecurity system, their intended outputs and their direct, system level and external outcomes
2. a list and definition of the attributes of biosecurity system health against which the performance of the biosecurity system's outputs and outcomes
3. a list of the qualitative and quantitative measures of performance and associated performance indicators for outputs and outcomes and an evaluation of their sensitivity to changes in the biosecurity system
4. case studies on each element of the biosecurity system that identify how the framework will be implemented for this element
5. a list of data sources for each performance indicator and identification of gaps in data and information needed as input to metrics or measures, in particular data that are currently not collected but would be of benefit for determining the health of the biosecurity system or individual elements of the system.

170805: Optimisation of national resources for animal disease surveillance

Australia relies heavily on animal health surveillance to protect the health and productivity of its livestock and other animal industries, protect human and wildlife health and support trade and market access. In the current world trade environment, the ability to demonstrate freedom from disease is crucial for maintaining export trade in livestock products and for re-establishing trade as soon as possible after an outbreak has occurred. There is growing recognition by Australia's national and jurisdictional governments and agricultural industries that Australia needs to strengthen its surveillance arrangements to be able to mitigate biosecurity threats while continuing to facilitate and enhance trade (East et al. 2016). The reliability of Australia's surveillance system has been questioned, largely owing to reductions in expenditure on agriculture and a reduction in the veterinary services in rural areas (Nairn et al., 1996; Frawley, 2003; Matthews, 2011; OIE 2015).

Resources for surveillance are finite and therefore need to be allocated optimally. The Intergovernmental Agreement on Biosecurity (IGAB) promotes a risk-based approach to biosecurity i.e. prioritising the allocation of resources to the areas of greatest return. Current surveillance activities include:

- general surveillance at the jurisdictional level i.e. detection, investigation and reporting of disease syndromes (this is relied upon to detect most outbreaks of livestock disease)
- active/targeted national surveillance programmes (e.g. National Transmissible Spongiform Encephalopathy Surveillance Program and the National Arbovirus Monitoring Program)
- various regional surveillance projects that have been developed independently, operate in one or only a few jurisdictions and contribute to the national surveillance effort (e.g. knackery surveillance in Victoria).

Despite considerable investment by Commonwealth and jurisdictional governments, there is currently no national agreement or consistency around prioritisation, rationalisation or optimisation of activities for onshore (post-border) animal disease surveillance. Efficient and defensible allocation of increasingly scarce surveillance resources across all risk areas presents a significant challenge for the department and our jurisdictional colleagues.

This project aims to provide a mechanism that enables a rational, consistent and optimal allocation of national resources for terrestrial animal disease surveillance.

The project outcomes include:

1. Developing and refining methods for which finite animal disease surveillance resources can be allocated at the national and jurisdictional level, based on robust, agreed processes, ultimately leading to a national surveillance portfolio that can efficiently and effectively detect and monitor animal disease threats. Victoria is taken as a case study of this approach, and as a leading example of how the project may be extended to other jurisdictions
2. Increasing stakeholder confidence in Australia's animal health status.

Data and Information

170820: Biosecurity response decision support framework

This project is an extension of project 1608F: Biosecurity response decision support framework, for a second year to 30 June 2018.

The overarching purpose of this project is to improve and strengthen MPI's decision making surrounding new pest or disease incursions that may pose a risk to the economic, environmental, human health and socio-cultural values of New Zealand. Its specific objectives are three-fold:

1. to review MPI's current decision-making framework and process for responding to new pest and disease incursions across all sectors of the New Zealand economy, environment and community
2. to review MPI's investment into new pest and disease incursions over the last 5 years across the entire biosecurity response portfolio
3. to recommend ways in which the decision-making framework may be improved and updated.

Outputs linked to the above key activities are:

1. NMV workshop: guidelines for incorporation of non-market impacts into response decision making
2. data analysis: past patterns of investment by pest, sector affected, knowledge of pest etc. (included in final report)
3. simulation modelling: a report detailing the simulation modelling process, and recommendations for future decision making in the response context.

The original business case notes the key drivers for this research are:

1. the need for a consistent and transparent methodology that links NZ MPI's overarching (existing) decision-making framework, response prioritisation process and support tools to the influence of other factors that come into play during biosecurity response decision making and allocation of response effort
2. the need to accurately, transparently and rigorously incorporate non-market values into the decision-making process, particularly with the introduction of Government Industry Agreements (GIA). Although non-market values (e.g. environmental, conservation, socio-cultural, or Maori values) may be considered in response decision making, it is extremely difficult to reconcile them using traditional cost–benefit analysis (CBA) techniques
3. the concern, resulting from 2., that there is too little investment in the management of exotic organisms that impact on non-market values.

The original project envisaged the outputs from the project would include an updated and improved decision-making framework, support tools and templates within MPI's Response Knowledge base. The project outputs would be used to strengthen MPI's response decision making across various economic (e.g. plant and animal) and environmental (e.g. land-based, freshwater and marine), and community (e.g. Maori, recreational users, regional communities) sectors, and could also be applied to help guide and justify cost sharing with industry under (GIA) arrangements.

Continuing Projects

The following projects were approved in the 2016/2017 Work Plan, and were approved to continue in 2017/2018:

- 170621: Proportional value of interventions across pathways and layers of the biosecurity system (extension of 1606E)
- 170713: Value of Australia's biosecurity system (extension of 1607A)
- 170714: Health of Australia's biosecurity system (extension of 1607B)
- 170820: Biosecurity response decision support framework (extension of 1608F)

Deliverables and Milestones Achieved

The following table lists the key project outputs. It also details which outputs will be submitted to the Commonwealth for endorsement in accordance with clause 3.9 of the Funding Agreement.

Table 2: Research Outputs

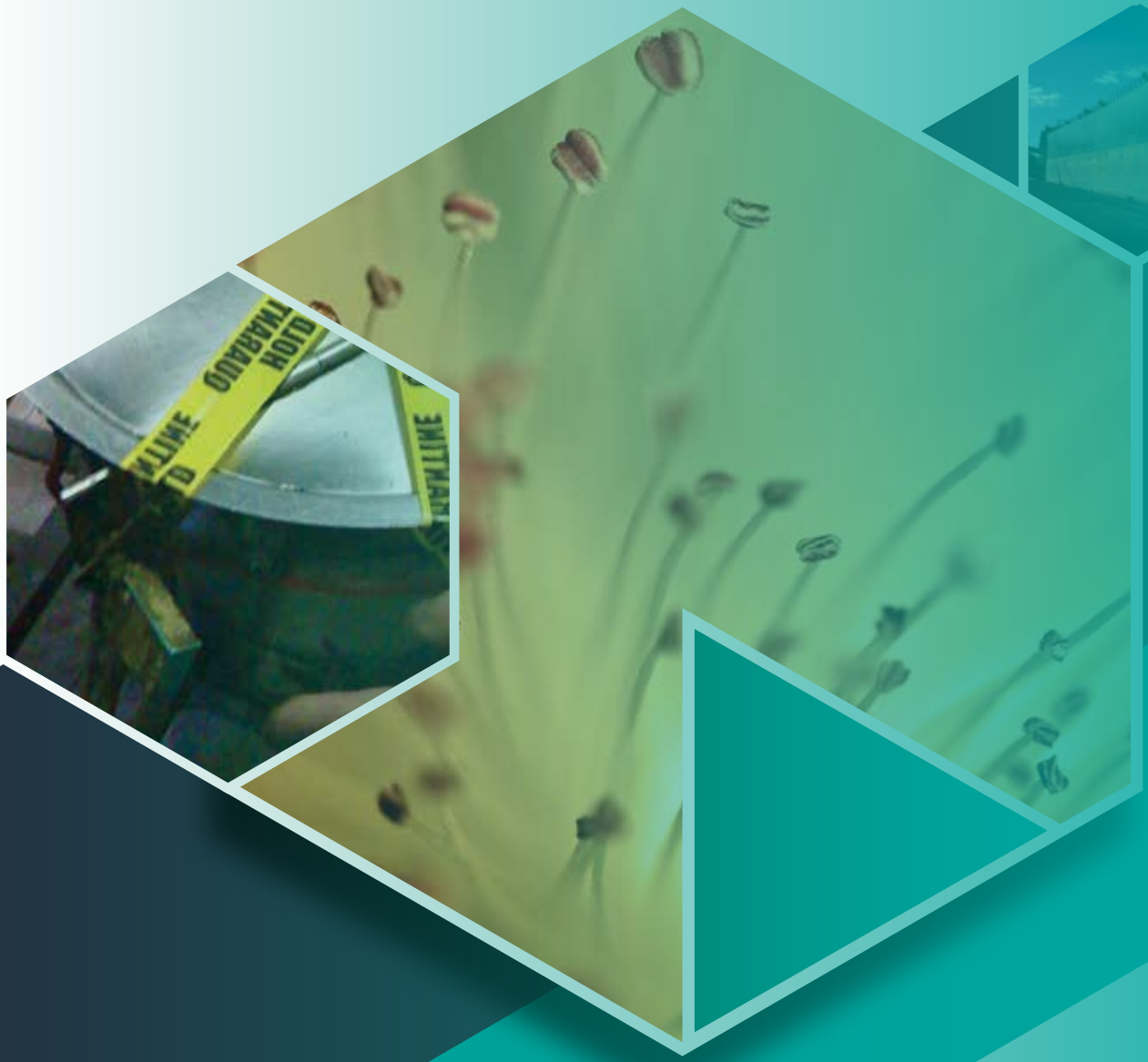
Project	ID	Output	Milestone Date	For Endorsement	Status
Strengthening Surveillance					
170602	1	Workshop to scope problem and refine nature of analysis, pathways of interest, availability of data.	Aug 2017	N	Completed
	2	Interim Report on the investigation into compliance by Competent Authorities.	Jun 2018	N	In progress
	3	Workshop to confirm plan for stage 2 of project: analysis, pathways, experiments, etc.	May 2018	N	In progress
170604	1	Identify the legal authority and international agreements and standards under which the program will operate i.e. develop the policy. Evaluation and approval. Officially endorsed agreements.	Jul 2017	N	Completed
	2	Construct a generic operational framework for the program, including all Competent Authority requirements for: biosecurity plan, surveillance plan, approved diagnostics, approved laboratories, traceability, certification, inspection and audit. Add schedule to National Association of Testing Authorities Memorandum of Understanding.	Apr 2018	N	Completed
	3	Develop a generic quality management framework for industry participants, including: quality management system, administration, risk management, hazard analysis and critical control point, third party accreditation standards, non-compliance, continual improvement and reporting.	May 2018	N	Completed
	4	Cost–benefit analysis and final report.	Jun 2018	Y	In progress
170606	1	National Priority Plant Pests (NPPP) incursion and spread workshop, including: • review of existing Australian Animal Disease model (AADIS) spread mechanisms for applicability to NPPP • identification of NPPP functional groups to test the suitability of data and parameterisation for the AADIS spread mechanisms • formulation of NPPP incursion and spread case studies.	Aug 2017	N	Completed
	2	Workshop report provided to DAWR.	Sep 2017	N	Completed
	3	Data and parameterization needed for NPPP incursion and spread case studies provided by DAWR.	Oct 2017	N	Completed
	4	Interim software delivery.	Feb 2018	N	In progress
	5	Draft report provided to DAWR project leaders for comment.	May 2018	N	In progress
	6	Year 1 final report and final software delivery.	Jun 2018	Y	In progress

Project	ID	Output	Milestone Date	For Endorsement	Status
Strengthening Surveillance					
170607	1	Meeting to develop a decision tree for choosing between species distribution models as a function of pest biology, pest origin, data availability and model assumptions. Also identify appropriate case studies to test and refine decision tree.	Nov 2017	N	Completed
	2	DAWR to provide national occurrence records that are otherwise not publicly available and data on various pathways for each case study identified (these data to include interception data, volumes of imports and any secondary movements of imports).	Dec 2017	N	Completed
	3	Dealing with uncertainty in predictor selection.	Jan 2018	N	Completed
	4	Use identified NPPP case studies and simulations to illustrate (and refine) decision tree.	May 2018	N	In progress
	5	Examine utility of using random effects to improve species distribution models for data poor species.	May 2018	N	In progress
	6	Prototype decision tree.	Jun 2018	N	In progress
170608	1	Establish a DAWR Advisory Group, hold workshop.	Sep 2017	N	Complete
	2	Complete preliminary data acquisition (sufficient for identifying potential pilot pathways).	Apr 2018	N	In progress
	3	Complete analysis and report.	Jun 2018	N	In progress
170615	1	List of databases for mining-meta-analysis.	Aug 2017	N	Completed
	2	Data mining and extraction.	Mar 2018	N	Completed
	3	Cursory analysis of mined data.	May 2018	N	Completed
	4	Decision tree around choice of network (draft report).	May 2018	N	Completed
170618	1	Meet with project team to discuss project and governance.	Jul 2017	N	Completed
	2	Provide a detailed project plan, including data source selection, statistical analysis methodologies.	Oct 2017	N	Completed
	3	MPI agreement of project plan.	Nov 2017	N	Completed
	4	Milestone report detailing the collection and utility of data sources delivered on time and requiring minimal editing.	Feb 2018	N	Completed
	5	MPI acceptance of milestone report.	Mar 2018	N	In progress
170621	1	Case studies with aggregated values.	Dec 2017	N	In progress
	2	Post-border model.	Jun 2018	N	In progress
	3	Recommendation for dealing with uncertainty.	Mar 2018	N	In progress
	4	Draft report with case studies.	May 2018	N	In progress
	5	Final report with case studies.	Jun 2018	Y	In progress

Project	ID	Output	Milestone Date	For Endorsement	Status
Strengthening Surveillance					
170713	1	Project start and planning meeting.	Aug 2017	N	Completed
	2	Meeting and documentation of Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) planned work and agreed deliverables for this phase of the project.	Oct 2017	N	Completed
	3	Extended work on non-market values and interim report, with recommendations on what further measures are needed. Additional values measures from existing or ongoing studies identified, with a determination of what can be included in the draft and final report, and possible incorporation of value-added measures using the department's risk/return resources allocation model.	Jan 2018	N	Completed
	4	Draft final report, including components from the ABARES work.	May 2018	N	In progress
	5	Final report.	Jun 2018	Y	In progress
170714	1	Workshop to review outputs of phase 1.	Aug 2017	N	Completed
	2	Interim report.	Dec 2017	N	Completed
	3	Workshop to review interim report.	Feb 2018	N	Terminated
	4	Draft final report.	May 2018	N	Completed
	5	Final report.	Jun 2018	Y	In progress
Data and Information					
170805	1	Project preparation and meetings with key participants.	Aug 2017	N	Completed
	2	Project workshop/meetings with the Department of Agriculture and Water Resources, ABARES and stakeholders to discuss risk criteria and approaches to prioritisation.	Oct 2017	N	Completed
	3	Project workshop to discuss the best ways to approach the case study and confirm data needs and availability.	Feb 2017	N	Completed
	4	Draft final report (Year 1).	Apr 2018	N	Completed
	5	Final report (Year 1).	Jun 2018	Y	In progress
170820	1	Draft guidelines for undertaking primary NMV studies.	Feb 2018	N	Completed
	2	Workshop to test guidelines for NMV.	Mar 2018	N	Completed
	3	Final report (incl. data analysis, contribution to GIA).	Jun 2018	Y	In progress

Research and Develop Risk Methods

02



Impact and Adoption Activities

CEBRA plays an important role in supporting biosecurity risk management. Our research tackles challenging real-world questions, providing scientific backing for biosecurity practice and strategic decision making.

Our risk analysts employ techniques such as intelligence gathering, data mining, cost–benefit analysis and spatial analysis. Using our expertise, we investigate data and develop associated methods, protocols and tools.

The aim is to ensure that CEBRA research outcomes provide knowledge about—and are effectively integrated into—the biosecurity system. Adoption impact has been reported on the following projects:

1503A: Intelligence gathering and analysis: International Biosecurity Intelligence System

The International Biosecurity Intelligence System (IBIS) project aimed to develop a practical and accessible biosecurity information gathering and analysis tool, building upon the proof-of-concept tool developed under previous ACERA projects.

Information gathering and analysis was not a new activity to the two agencies (MPI and the department) at the time of the inaugural CEBRA IBIS project in 2013–14, but there was a need for a more efficient, robust, formalised and systematic information gathering and analysis capability to enhance its effectiveness as an intelligence tool.

From 2013–14, research was undertaken through CEBRA on the range of 'biointelligence' systems and two software companies were appointed to conduct IT development and maintenance of the IBIS tool. Several priorities were pursued, such as a generic platform; a visualisation dashboard; automated translation; analysis tools and greater stability and efficiency.

Focus on outcomes

IBIS was successfully used as a business-as-usual activity in some areas and was the catalyst for some important biosecurity actions. For example, information about lumpy skin disease in EU countries led to import conditions changes, and the department was able to confirm its salmon import requirements with Norway after an infectious salmon anaemia outbreak. Other areas experienced difficulties in uptake of the tool, though this may have been related more to governance problems than using the tool itself.

In 2014 the system reached its limits and there was a need to progress infrastructural and architectural change. Changes in developers led to issues, with one company steering development direction into areas that were questionable and costly. In April 2016 IBIS became fully funded by the department and a new developer was appointed through the ICT Panel. This has resulted in redevelopment of the system onto a new IT platform and greater promise of originally envisioned priorities being achieved.

Additional funding was given to IBIS from the Agricultural Competitiveness White Paper allocation in 2016 as part of the investment to improve biosecurity surveillance and analysis to better target critical biosecurity risks.

Where to from here

The new IBIS was deployed in June 2017 and is available to the Marine Pests unit and the Compliance Division. Other divisions and external agencies (e.g. OIE) have expressed interest in IBIS and this will be a focus of activities in the coming years. It is envisaged IBIS will eventually be maintained by the Information Services Division and will be a component of the Biosecurity Integrated Information System (BIIS).Improvements in technology since the development of the BWRA methodology may be able to provide sea water temperature for all ports, in particular data derived from satellite sea surface temperature (SST) imagery. This project researched the most appropriate method for collecting sea water temperature data for integration into the BWRA.

1501C: Ballast Water Risk Tables

The project also aimed to utilise shipping data to provide estimates of risk that consider traffic volumes so as to a) prioritise the activities of compliance and enforcement officers and b) identify which ports, if surveyed for the seven species considered in the BWRA, could result in significant reductions in high-risk voyages and consequently reduce compliance costs for industry.

During 2015–16, the project collected and analysed shipping data from Lloyds International. The project also accessed and processed satellite sea surface temperature (SST) data. However, accessing the SST data took substantially longer than it should have done, principally due to aging software and computer resources in the department. The consequence of this was that it was not possible to compare current BWRA life cycle completion simulations for non-tide gauge ports, based on interpolated water temperature, with those modelled using directly measured satellite SST data.

Focus on outcomes

On the whole, tide gauge and satellite SST data are both suitable sources of water temperature data for life cycle completion models at a port. Minor differences between tide gauge and satellite SST data were identified however it was reasonably clear that the tide gauges and satellite SST were measuring small variations in the same phenomenon.

- Variation in water temperature at the same latitude on the east and west coasts of Australia indicates that interpolation based on latitude is likely to give misleading results.
- The project recommended that the SeaFRAME tide gauge data be replaced with satellite SST data as the data source for the BWRA risk tables.
- Shipping data from Lloyds is an accurate guide to vessel traffic but it is not possible to distinguish between ships carrying cargo and ballast water. However, the project was able to provide indications of expected domestic shipping arrivals in Australian ports in order for the department to estimate compliance and enforcement resources required.

Where to from here

Additional research is required to continually improve the BWRA, including research to obtain empirical evidence that provides insight into how well the life cycle models represent actual risk in current day, noting that the BWRA was developed between 2004 and 2009.

1404D/1504D: Using decision support tools in emergency animal disease planning and response: Foot-and-mouth disease

1404D/1504D: Using decision support tools in emergency animal disease planning and response: Foot-and-mouth disease (FMD) started in 2014 and, with a one year extension, was completed in 2016. It was designed to assess the factors that influence the severity of an outbreak of FMD in order to assist decision making on appropriate response strategies, focusing on the use of vaccination. It also looked at managing potentially conflicting management objectives during an FMD response.

The approach was based on studying simulated FMD outbreak scenarios in Australia and New Zealand.

- **In Phase 1** the Australian and NZ FMD simulation models were used in parallel to model selected FMD outbreak scenarios in Australia and NZ. Comparisons were made on the basis of duration of an outbreak, number of Infected Premises (IPs), spatial distribution of IPs, and number of premises vaccinated to achieve eradication.
- **In Phase 2** various metrics and outbreak parameters that would be available to disease managers early in an outbreak were tested, using multivariate analytical and Bayesian techniques for their value to predict the subsequent size (severity) of an outbreak.
- **In Phase 3** optimisation techniques were used to determine the most appropriate size of vaccination zones for FMD control under selected outbreak scenarios.

Focus on outcomes

- Both Australian and NZ models predicted similar outbreaks during the silent spread phase in both countries. They also predicted similar outcomes for control. The study has provided a high degree of confidence that the newly developed Australian FMD model (Australian Animal Disease Spread model - AADIS) is performing appropriately and in a manner required for disease planning.
- The study has improved understanding of factors influencing severity of an FMD outbreak.
- We found that relatively simple metrics (number of IPs, number of pending culls, area under control, estimated dissemination ratio, and cattle density around the index herd) available early in a control program (at days 7, 14 and 21) can be used to indicate the likely magnitude of an FMD outbreak under Australian and New Zealand conditions.
- Predictability improved at later time points in the outbreak.
- The study confirmed that vaccination zones of 3-5 km around infected premises are optimal in terms of balancing disease control objectives while minimising impacts on uninfected producers.
- Following successful testing, the AADIS model is currently being deployed for use by jurisdictions and research agencies to support FMD preparedness. A workshop training jurisdictional and other staff was held in March 2017.
- While confirming that vaccination may be a useful (perhaps) essential component of an FMD response, it has raised questions in terms of post-outbreak management of vaccinated animals to minimise adverse trade impacts. This area is currently being pursued through CEBRA Project 1604D 'Incorporating real-time economic components in Australia's FMD modelling capability and evaluating post-outbreak management to support return to trade' and will be a major focus of research under the CSIRO/MLA Rural R and D for profit FMD project.
- This project has resulted in a spin-off international collaboration project currently being undertaken by QUADS (quadrilateral countries, Australia, New Zealand, Canada and the United States of America) on early decision-indicators for FMD. It has also resulted in further work being identified in the department to test decision criteria for implementing vaccination (currently on-hold due to resourcing issues) and a spin-off project by NZ MPI.
- Findings from this study have been made available to AHC (Animal Health Committee), through the FMD Vaccination Expert Advisory Group and to AHA (AUSVETPLAN Technical Reference Group).

Where to from here

- The current challenge is to try and minimise adverse trade impacts associated with an FMD outbreak by reducing time to regain FMD free status and regain market access. CEBRA project 1604D is currently building capability to allow different approaches to post-outbreak surveillance to be quantitatively assessed and compared.
- Further work on FMD preparedness with a particular focus on decision support capability and post-outbreak FMD management is planned under the CSIRO/MLA Rural R and D for Profit project.

1502E: Risk maps for optimising biosecurity surveillance

Biosecurity agencies aim to establish surveillance systems that focus limited resources as effectively as possible. Typically, the earlier that invasive and damaging pests and diseases are detected along an exposure pathway, the easier they are to control and eradicate. However, despite each jurisdiction's best efforts at offshore biosecurity measures, some pests pass through biosecurity systems undetected and others enter along unregulated pathways. There is a need to take a more proactive approach to managing this risk by using more detailed, quantitative spatial representations to assess where pests are likely to appear and establishment is likely to occur. This information should be integrated with information on the costs of surveillance to design cost-effective surveillance systems.

The existing New Zealand forest industry forest health surveillance program must protect all of New Zealand's planted forest estate from exotic pests efficiently. That is, surveillance effort should be in proportion to relative biosecurity risk and would ideally detect incursions before they reach the main forest areas. To allocate resources optimally, relevant information on exposure pathways needs to be linked with information on the costs and efficacy of alternative surveillance methods to allocate resources optimally.

A Bayesian network model was developed. It consisted of:

- separate sub-models for each pest and pathway generated according to input parameters per pathway
- two main aspects: substrate volume (e.g. sea containers) and pest tracking (e.g. gypsy moth eggs on a container)
- development of template Bayesian networks for each pathway along with node definitions (e.g. ports, container unloading depots)
- meta-template Bayesian networks (sub-models) for pest arrivals at nodes
- a script that ties the model together plus a configuration spreadsheet
- a script to generate maps in GIS.

Data was gathered from existing datasets held by MPI and Scion (a NZ Crown Research Institute) as well as additional information from publicly available datasets. Expert elicitation was used to derive parameters for identified gaps.

The model was parameterised using gathered data. Exposure levels at geographic locations were generated by the model and exposure risk was mapped into a geospatial environment. These pathway risk maps were then assessed for validity and sensitivity analysis was carried out.

In addition, a Better Border Biosecurity (B3) project:

- overlaid the exposure risk data on habitat and climate suitability models to produce expected establishment by area
- added in effectiveness and cost of different survey techniques
- optimised the allocation of surveillance resources for the various options available.

Focus on outcomes

Key insights; what was learned or discovered:

- Bayesian models are very effective for modelling a known system
- substrate volumes can give a good idea of area-relative risk, even if we don't have a good idea of absolute probabilities of infestation
- while general allocation of risk matched expectations, spatially mapping the risk enabled better visualisation of the problem (and better decision making)
- increasing pathway numbers spread the risk wider in the environment than previously thought.

Positive effect the project has had or is expected to have on the biosecurity system (including stakeholders/community):

- more effective allocation of surveillance resources for MPI's High Risk Site Surveillance programme (HRSS)
- better protection of the NZ plantation forest estate from biosecurity risk by providing better coverage of risk
- earlier detection of pests and diseases before they reach the forest (because more surveillance in urban areas rather than forests)
- supporting collaboration between between MPI, the Forestry Industry and CRIs in New Zealand in jointly working on and funding the research projects. As a result the science contributed to joint outcomes.

Current status of adoption or implementation (as appropriate) including adoption to date, plans for the future, and expected advantages and impediments:

- The model was used for planning for this seasons High Risk Site Surveillance programme (2017–18) and was therefore fully adopted by MPI.
- The New Zealand forest industry are still in the process of piloting the models' outputs in three regions of New Zealand. Once they have gathered enough data from this project the plan is to implement a new Forest Biosecurity Surveillance (FBS) programme based on the outputs of this model in January 2018.

What needs to be done and by whom to encourage adoption/implementation:

- The model is flexible enough in set up to also provide exposure risk maps for individual pests so MPI is evaluating its use for the Asian Gypsy Moth surveillance programme.

Any known uptake or extension activities of the research being progressed by other areas of the department or externally:

- A B3 project is underway to join this Bayesian model (focused on post-border) with another Bayesian model developed recently focusing on pre-border pathways. By joining the two models together MPI hopes to create a model covering the full range of interventions. This will improve surveillance planning and allow comparison of the effectiveness of different interventions along the whole pathway.

Where to from here

Further work planned by NZ Forest Owners Association (FOA):

- test outputs operationally in Southland, Taupo and Auckland
- update risk
- update costs
- evaluate and add other survey methods into model
- evaluate efficiency of field crews compared to model after implementation
- look at adding pest impact and rate of spread into model

Further work planned by MPI:

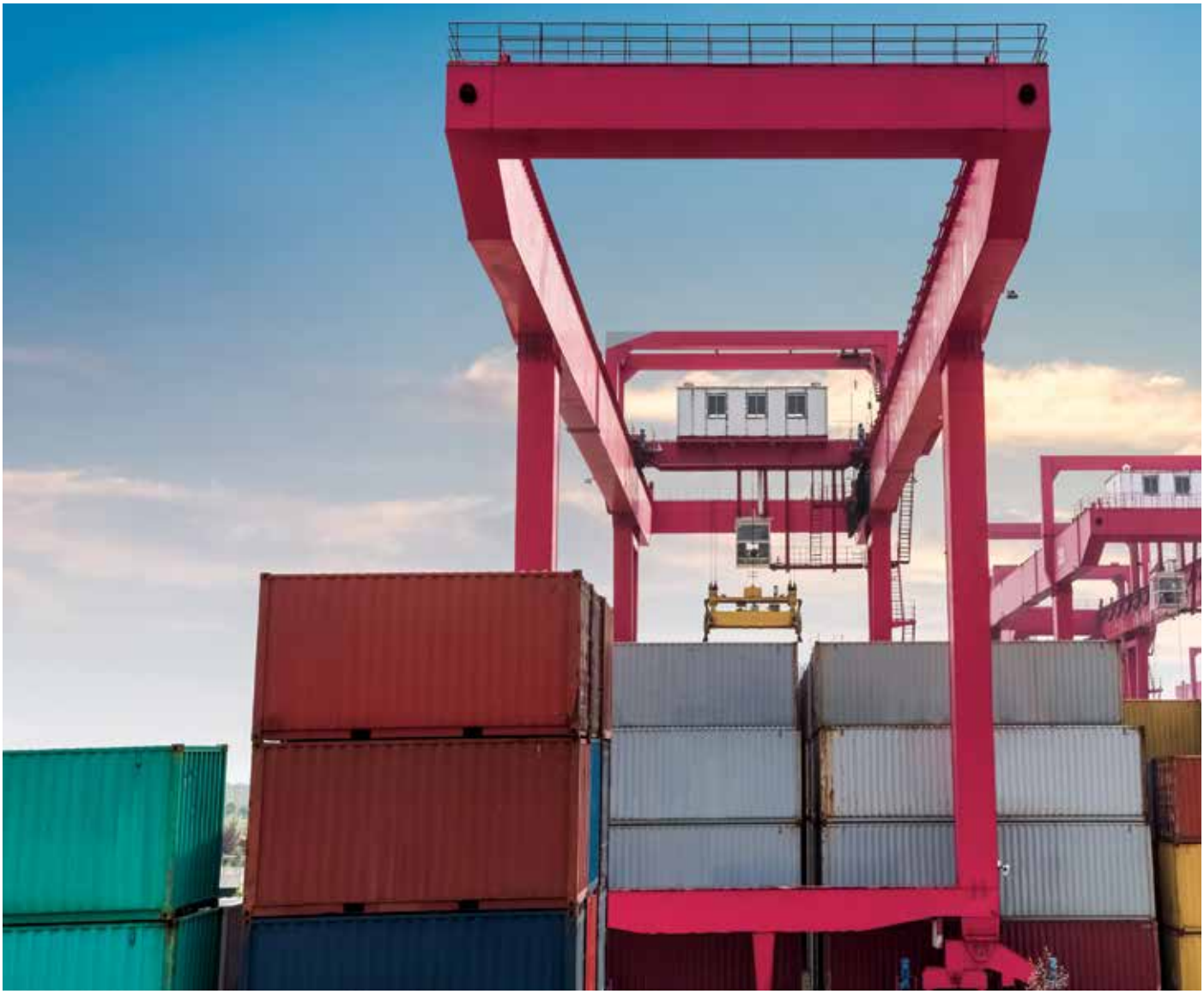
- compare results from previous years HRSS with latest year (with new model inputs)
- evaluate and add other pathways into model
- validate model for other MPI surveillance programmes (e.g. Asian Gypsy Moth, Ants)
- model risk for other new pests (e.g. Brown Marmorated Stink Bug) and evaluate effectiveness of new surveillance programmes for these pests.

1402A: Development of a marine spatial analysis model for improved biofouling risk assessment and 1302A: Evaluating spatial analysis tools for surveillance and monitoring in marine and terrestrial environments

These projects aimed to create a model to evaluate biosecurity risk (likelihood of marine pest establishment) based on the vessels movement history and Marine Growth Risk Assessment (MGRA). Project outputs enable additional information on vessel biofouling risk to be incorporated into the overall risk assessment system for the proposed biofouling management arrangements.

Focus on outcomes:

- These projects have not been adopted by the department due to a policy change that took place after the projects were completed that fundamentally changed the biofouling policy landscape. This change came about due to an election promise in 2013 to move from a species based approach, to a volume of growth based approach. The volume of growth approach was industry preferred and a more useful way of determining risk.
- As a result, the foundation of the projects was no longer valid, and there has not been full implementation. This is a valid and good reason not to implement the project findings.
- The projects did, however, expand the departments understanding of biofouling, and understanding of the strengths and benefits of species based approaches.



1304B: Handling uncertainty in the Risk/Return Resources Allocation (RRRA) model

This project evaluated various methods of dealing with uncertainty in a complex stochastic model and identified technical solutions for incorporating the developed method into the risk/return resources allocation (RRRA) model.

The RRRA model was first reviewed by CEBRA in 2013, when the basic structure was complete. The 2013 review found the model to be conceptually and theoretically workable.

The 2013 review identified the importance of the data used to run the model and the need to consider the sensitivity of the model to those inputs. CEBRA Project 1304B was subsequently commissioned, in early 2014, by the RRRA project team to develop a practical method for uncertainty to be incorporated into the RRRA model.

CEBRA engaged Steven Mascaro, a programmer and statistical modeler operating within Bayesian Intelligence, to undertake the work. Steven spent time with the RRRA model project team learning about the model and its component parts.

The project report provided the statistical and theoretical reasoning to incorporate uncertainty into the RRRA model analysis. The core elements of the approach are to:

- provide uncertainty distributions for input parameters of the model
- implement a model review process to identify parts of the model that can be treated as certain
- group parameters and take advantage of local structure wherever possible to reduce the effort needed for confidence assessments and sensitivity analyses
- treat the RRRA model as a hierarchy of models, and analyse each part of the hierarchy separately (with a summary of the analysis from lower levels feeding into higher level metamodels.

A sensitivity analysis technique was well-suited to the RRRA model. An approach developed based on this technique allows a decision maker to directly compare the uncertainty around model predictions under different investment scenarios.

- The technique involved the use of a Monte Carlo method for variance-based sensitivity analysis.

A subsequent independent review of the RRRA model was completed in April 2018. Professor Simon McKirdy (Murdoch University) led the review, supported by Tom Kompas (CEBRA) and Tony Arthur (ABARES).

The review panel found that: 'the model was unique and represented a significant potential for DAWR as well as the rest of the Australian biosecurity system. The RRRA model can provide useful benefits to the operations of DAWR currently. Further, the model has the potential to set a benchmark to assist biosecurity resource allocation decision making throughout the world'.

The review panel noted the importance of data inputs to the model and the uncertainty associated with those inputs. The panel recommended that work: 'continue to develop methods for the incorporation of uncertainty into model output and communication of the results. Future work should consider (i) uncertainty about the effectiveness of controls; (ii) incorporation of stochastic uncertainty; and (iii) case studies where the differences between the scenarios tested are less extreme'.

Focus on outcomes

- CEBRA project 1304B formed the basis of ongoing work to develop and incorporate processes that enable uncertainty to be represented in RRRA model outputs and from that, the level of confidence that can be attributed to model outputs.
- Subsequently, through a direct contract with Bayesian Intelligence in 2016, Steve Mascaro was again contracted, to develop the necessary computer code.
- To date the work has culminated in a 'beginning to end' representation of the RRRA model sea container pathway in which inputs subject to large uncertainty were represented as probability distributions rather than fixed values. This demonstrated the practical application of the method to incorporate uncertainty. However, significant work remains to extend this to the entire RRRA model.
- The 2018 review recommendations on uncertainty confirm the importance of the work to date dealing with uncertainty and the continuation of that work.
- Eventually, through the full incorporation of uncertainty, we will provide even clearer guidance on the level of confidence that can be associated with to model outputs, particularly when comparing investment scenarios.
- This will facilitate sound decision making leading to improved efficiency and/or effectiveness of biosecurity controls.

Graduate students

CEBRA continues to make substantial investments in postgraduate research training. We produce graduates in all disciplines with specialist skills in risk analysis, with the objective to build biosecurity risk analysis capacity and capability in Australia.

Table 3: Current and completed (in 2017–2018) PhD students

Student	Title	Supervisor
Current PhD Students		
Thiripura Vino	PhD: Spatio-temporal modelling of Group A Streptococcal infection in Northern Australia	Assoc Prof Andrew Robinson
Nayomi Attanyake	PhD: Efficient estimation of hazard cut-points for risk-based fleet management	Assoc Prof Andrew Robinson
Gayan Dharmarathne	PhD: Exploring the statistical aspects of expert elicited experiments	Assoc Prof Andrew Robinson
Completed PhD Students		
Decky Junaedi	PhD: Trait-based approach of the management of invasive exotic species from botanic gardens in the tropical ecosystem	Prof Mark Burgman
Matthew Malishev	PhD: Feeding ecology and behavior	Prof Mark Burgman

Institutional contracts and consultancies

CEBRA conducts robust scientific analysis and provides expert advice on national biosecurity issues, with a focus on practical, policy-relevant research outcomes. Here are the institutional contracts and consultancies we have been awarded, relevant to the 2017–2018 financial year.

Table 4: Institutional Contracts and Consultancies

Client	Year	Project	Amount	Investigators
Department of Agriculture and Water Resources	2018–2019	Sampling of seeds imported for the purposes of sowing	A$100,000	Assoc Prof Andrew Robinson
Department of Agriculture and Water Resources	2018	Sampling for Proof of Freedom Guidelines	A$50,000	Assoc Prof Andrew Robinson
AgResearch Limited (NZ)	2018	Better Border Security	NZ$15,000	Assoc Prof Andrew Robinson
Department of Environment, Land, Water and Planning (DELWP)	2016–2017	Report on electricity and gas network safety performance data integrity and analysis	A$32,742	Assoc Prof Andrew Robinson
Border Management Division, Department of Immigration and Border Protection	2016–2018	Examine the existing sampling methodology used in the cargo environment to determine whether the current approach remains relevant and to identify opportunities for further improvement	A$99,770	Assoc Prof Andrew Robinson Mr Matthew Chisholm
Australian Research Council (ARC)	2017–2019	DP160100745 Maximising the benefits of emerging technologies for ecological survey	A$350,600	Assoc Prof Andrew Robinson Adjunct Prof Andrew (Sandy) Liebhold Dr Joslin Moore
Australian Research Council (ARC)	2017–2019	DP170104795 Predicting the ecological and economic outcomes of trade	A$588,500	Prof Brendan Wintle Prof Tom Kompas Prof Mark Burgman
IARPA	2017–2018	CREATE	USD $6,815,969	Prof Mark Burgman Assoc Prof Tim van Gelder Assoc Prof Richard de Rozario Dr Fiona Fidler

Document and Communicate Findings

03

Publications

At CEBRA, we use defensible scientific, economic and sociological methods to tackle real-world problems. Our research is published in a range of peer-reviewed journals. For a full list of publications, please visit https://cebra.unimelb.edu.au/engage/journal-articles.

Table 5: CEBRA Publications summary

Calendar Year	Total publications	Total citations	Average citations	Average ISI Impact factor	CEBRA project specific publications
2017	36	124	3.44	3.20	13
2016	29	221	7.62	3.74	8
2015	29	549	18.93	6.05	12
2014	16	445	27.81	5.84	3
2013	26	3071	118.12	5.45	11

Table 6: CEBRA Publications with Inernation Scientific Indexing (ISI) Impact Factor and Citations

CEBRA project-specific publications

	ISI Impact Factor 2017	No. of Citations as at 29/06/18
IN PRESS/EARLY VIEW		
Barons, MJ, Hanea, AM, Wright, SK, Baldock, KCR, Wilfert, L, Chandler, D, Dattah, S, Fannon, J, Hartfield, C, Lucas, A, Ollerton, J, Potts, SG, and Carreck, NL (2018) *Assessment of the response of pollinator abundance to environmental pressures using structured expert elicitation.* **Journal of Apicultural Research**	**1.015**	**0**
Gill, SD, Lane, SE, Sheridan, M, Ellis, E, Smith, D & Stella, J (2018) *Why do 'Fast Track' patients stay more than four hours in the Emergency Department? An investigation of factors that predict length of stay.* **Emergency Medicine Australasia**	**1.353**	**0**
Hanea, A, McBride, M & Burgman, M & Wintle, B (2018) *The Value of Performance Weights and Discussion in Aggregated Expert Judgments.* **Risk Analysis**	**2.898**	**1**
Hanea, AM, Nane, GF, Cooke, RM & Wielicki, BA (2018) *Bayesian Networks for identifying incorrect probabilistic intuitions in a climate trend uncertainty quantification context.* **Journal of Risk Research**	**1.376**	**0**
Hollings, T, Burgman, M, van Andel, M, Gilbert, M, Robinson, T, and Robinson, AP (2018) *How do you find the Green Sheep? A critical review of the use of remotely sensed imagery to detect and count animals.* **Methods in Ecology and Evolution**	**6.363**	**3**
Hoshino, E, Pacoe, S, Hutton, T, Kompas, T & Yamazaki, S (2017) *Estimating maximum economic yield in multispecies fisheries: A review.* **Reviews in Fish Biology and Fisheries**	**3.299**	**0**
Kissling, WD, Ahumada, JA, Bowser, A, Fernandez, M, Fernández, N, García, EA, Guralnick, RP, Isaac, NJB, Kelling, S, Los, W, McRae, L, Mihoub, J-B, Obst, M, Santamaria, M, Skidmore, AK, Williams, KJ, Agosti, D, Amariles, D, Arvanitidis, C, Bastin, L, De Leo, F, Egloff, W, Elith, J, Hobern, D, Martin, D, Pereira, HM, Pesole, G, Peterseil, J, Saarenmaa, H, Schigel, D, Schmeller, DS, Segata, N, Turak, E, Uhlir, PF, Wee, B & Hardisty, AR, (2018) *Building essential biodiversity variables (EBVs) of species distribution and abundance at a global scale.* **Biological Reviews**	**11.7**	**14**
Lane, SE, Gao, R, Chisholm, M & Robinson, AP (2017) *Statistical profiling to predict the biosecurity risk presented by non-compliant international passengers.* **arXiv**	**n/a**	**0**

Lane, S, Hollings, T, Hayes, KR, McEnnulty, FR, Green, M & Robinson, AP (2018) *Risk factors for fouling biomass: Evidence from small vessels in Australia*. **bioRxiv**	**n/a**	**0**
Malishev M, Bull, CM & Kearney, MR (2018) *An individual-based model of ectotherm movement integrating metabolic and microclimatic constraints.* **Methods in Ecology and Evolution**	**6.363**	**1**
Van Andel, M, Hollings, T., Bradhurst, R, Robinson, A.P., Burgman, M, Gates, C, Bingham, P, and Carpenter, T. (2018). *Does size matter to models? Exploring the effect of herd size on outputs of a herd-level disease spread simulator.* **Frontiers in Veterinary Science**	**n/a**	**0**
2018		
Bonneau, M, Hauser, CE, Williams, NSG & Cousens, RD (2018) *Optimal schedule for monitoring a plant incursion when detection and treatment success vary over time.* **Biological Invasions**	**3.054**	**0**
Decrouez, G, & Robinson, AP (2018). *Bias-corrected estimation in continuous sampling plans.* **Risk Analysis**	**2.898**	**0**
Hanea, AM & Nane, GF (2018) *The asymptotic distribution of the determinant of a random correlation matrix*. **Statistica Neerlandica**	**0.465**	**2**
Hanea, AM, Burgman, MA & Hemming, V (2018) *IDEA for uncertainty quantification* in Dias LC, Morton A & Quigley J (Eds) *Elicitation: The Science and Art of Structuring Judgement.* **Springer**	**n/a**	**4**
Hemming, V, Burgman, MA, Hanea, AM, McBride, MF & Wintle, BC (2018) *A practical guide to structured expert elicitation using the IDEA protocol.* **Methods in Ecology and Evolution**	**6.363**	**6**
Hemming, V, Walshe, T, Hanea, A, Fidler, F & Burgman, M (2018) *Eliciting improved quantitative judgements using the IDEA protocol: A case study in natural resource management*. **PLOS one**	**2.766**	**0**
Spring, DA, Croft, L, Bond, NR, Cunningham, SC, Mac Nally, R & Kompas, T (2018) *Institutional impediments to conservation of freshwater dependent ecosystems.* **Science of the Total Environment**	**4.61**	**0**
Werner, C, Hanea, AM & Morales-Napoles, O (2018) *Eliciting multivariate uncertainty from experts: Considerations and approaches along the expert judgement process* in Dias LC, Morton A & Quigley J (Eds) *Elicitation: The Science and Art of Structuring Judgement.* **Springer**	**n/a**	**0**
2017		
Camac, J.S., Williams, R.J., Wahren, C., Hoffman, A.A and Vesk, P.A. (2017) *Climatic warming strengthens a positive feedback between alpine shrubs and fire.* **Global Change Biology**	**8.997**	**4**
Capes, H, Maillardet, RJ, Baker, TG, Weston, CJ, McGuire, D, Dumbrell, IG & Robinson, AP (2017) *The allometric quarter-power scaling model and its applicability to grand fir and eucalyptus trees.* **Journal of Agricultural, Biological, and Environmental Statistics**	**1.072**	**1**
Clarke, S, Hollings, T, Liu, N, Hood, G & Robinson, A (2017) *Biosecurity risk factors presented by international vessels: a statistical analysis.* **Biological Invasions**	**3.054**	**1**
Dodd, AJ, Ainsworth, N, Hauser, CE, Burgman, MA & McCarthy, MA *Prioritizing plant eradication targets by re-framing the project prioritization protocol (PPP) for use in biosecurity applications.* **Biological Invasions**	**3.054**	**1**
Elith, J (2017) Chapter 5: *Predicting distributions of invasive species* in Robinson, A, Walshe, TR, Burgman, MA & Nunn, M (Eds.) *Invasive Species: Risk Assessment and Management.* **Cambridge University Press**	**n/a**	**30**
Elith, J & Franklin, J (2017) *Species distribution modeling.* **Reference Module in Life Sciences. Elsevier**	**n/a**	**0**
Fraser, F, Soanes, K, Jones, S.A, Jones, CS and Malishev, M (2017) *The value of virtual conferencing for ecology and conservation.* **Conservation Biology**	**5.89**	**6**

Grafton, RQ, Kompas, T & Long, NV (2017 early view) *A Brave New World? Kantian-Nashian interaction and the dynamics of global climate change mitigation.* **European Economic Review**	**1.54**	**0**
Hanea, AM, Nane, GF & Cooke, RM (2017) *Integrating disparate information sources for equilibrium climate sensitivity with NPBNs.* **International Conference on Structural Safety and Reliability** (refereed conference paper)	**n/a**	**0**
Hauser CE & Rout TM (2017) *Optimising resource allocation* in Robinson, A, Walshe, TR, Burgman, MA & Nunn, M (Eds.) *Invasive Species: Risk Assessment and Management.* **Cambridge University Press**	**n/a**	**0**
Hauser, CE, Rout, TM, McCarthy, MA and Moore, JL(2017) *Adaptive management improves decisions about where to search for invasive species.* **Biological Conservation**	**4.66**	**0**
Hester, SM and Cacho, OJ (2017) *The contribution of community surveillance to invasive species management.* **Biological Invasions**	**3.054**	**6**
Hester, SM, Hauser, CE & Kean, JM *Tools for designing and evaluating post-border surveillance systems* in Robinson, A, Walshe, TR, Burgman, MA & Nunn, M (Eds.) *Invasive Species: Risk Assessment and Management.* **Cambridge University Press**	**n/a**	**0**
Hollings, T, Robinson, A, van Andel, M, Jewell, C & Burgman, M *Species distribution models: A comparison of statistical approaches for livestock and disease epidemics.* **PloS one** 1	**2.766**	**0**
Hradsky, BA, Penman, D, Ababei, A, Hanea, A, Ritchie, EG, York, A & Di Stefano, J (2017) *Bayesian networks elucidate interactions between fire and other drivers of terrestrial fauna distributions.* **Ecosphere**	**2.671**	**0**
Jäger, WS, Christie, EK, Hanea, AM, den Heijer, C & Spencer, T (2017) *A Bayesian network approach for coastal risk analysis and decision making,* **Coastal Engineering**	**2.674**	**7**
Kompas, T, Nhu Che, T, Van Ha, P & Chu, L (2017) *Cost–benefit analysis for biosecurity decisions in* Robinson, A, Walshe, TR, Burgman, MA & Nunn, M (Eds.) *Invasive Species: Risk Assessment and Management.* **Cambridge University Press**	**n/a**	**0**
Kompas, T, Van Ha, P, Nguyen, HTM, East, I, Roche, S, Garner, G (2017) *Optimal surveillance against foot-and-mouth disease: The case of bulk milk testing in Australia.* **Australian Journal of Agricultural and Resource Economics**	**1.486**	**1**
Landers, S, Hely, A, Harrison, B, Maister, N, Hely, R, Lane, SE et al. (2017) *Protocol for a single-centre, parallel-arm, randomised controlled superiority trial evaluating the effects of transcatheter arterial embolisation of abnormal knee neovasculature on pain, function and quality of life in people with knee osteoarthritis.* **BMJ Open**	**2.413**	**0**
Lane, SE, Arthur, AD, Aston, C, Zhao, S & Robinson, AP (2017) *When does poor governance presage biosecurity risk?* **Risk Analysis**	**2.898**	**0**
Mata, L, Garrad, GE, Kutt, A, Wintle, BC, Chee, YE, Backstrom, A., Bainbridge, B, Urlus, J, Brown, G, Tolsma, A, Yen, A, New, T & Bekessy, S (2017) *Eliciting and integrating expert knowledge to assess the viability of the critically endangered golden sun-moth Synemon plana.* **Austral Ecology**	**1.73**	**1**
McNeill, MR, Phillips, CB, Robinson, AR, Aalders, L, Richards, N, Young, S, Dowsett, C, James, T & Bell, N (2017) *Defining the biosecurity risk posed by transported soil: Effects of storage time and environmental exposure on survival of soil biota.* **NeoBiota**	**3.405**	**3**
Morán-Ordóñez, A, Lahoz-Monfort, JJ, Elith, J & Wintle, BA (2017) *Evaluating 318 continental-scale species distribution models over a 60-year prediction horizon: what factors influence the reliability of predictions?* **Global Ecology and Biogeography**	**5.958**	**10**
Nguyen, HTM, Kompas, T, Breusch, T & Ward, MB (2017) *Language, mixed communes and infrastructure: Sources of inequality and ethnic minorities in Vietnam.* **World Development**	**3.166**	**8**

Owen, R (2017) *Role of human action in the spread of honey bee (Hymenoptera: Apidae) pathogens.* **Journal of Economic Entomology**	**1.936**	**1**
Roberts, DW, Bahn, V, Ciuti, S, Boyce, MS, Elith, J et al. (2017) *Cross-validation strategies for data with temporal, spatial, hierarchical, or phylogenetic structure.* **Ecography**	**4.52**	**24**
Robinson, AP & Turner, KF (2017) *Hypothesis testing for topological data analysis.* **Journal of Applied and Computational Topology**	**n/a**	**1**
Robinson, A, Walshe, T, Burgman, M and Nunn, M (2017) *Invasive Species: Risk Assessment and Management*. **Cambrige University Press**	**n/a**	**0**
Rossiter, A, & Hester, SM (2017). *Designing biosecurity inspection regimes to account for stakeholder incentives: An inspection game approach.* **Economic Record**	**0.875**	**0**
Sperfeld, E, Wagner, N, Halvorson, HM, Malishev, M & Raubenheimer, D (2017) *Bridging ecological stoichiometry and nutritional geometry with homeostasis concepts and integrative models of organism nutrition*. **Functional Ecology**	**5.491**	**10**
Trouve, R, Nitschke, CR, Robinson, AP,& Baker, PJ (2017) *Estimating the self-thinning line from mortality data.* **Forest Ecology and Management**	**3.169**	**1**
van Andel, M, Jewell, C, McKenzie, J, Hollings, T, Robinson, AP, Burgman, M, Bingham, P & Carpenter, T (2017) *Predicting farm-level animal populations using environmental and socioeconomic variables.* **Preventive veterinary medicine**	**1.924**	**0**
Van Ha, P, Kompas, T, Nguyen, HTM, & Long, CH (2017) *Building a better trade model to determine local effects: A regional and intertemporal GTAP model.* ***Economic Modelling***	**1.696**	**1**
Vino, T, Singh, GR, Davison, B, Campbell, PT, Lydeamore, MJ, Robinson, AP, McVernon, J, Tong, SYC, & Geard, N (2017) *Indigenous Australian household structure: a simple data collection tool and implications for close contact transmission of communicable diseases.* **PeerJ**	**n/a**	**0**
Werner, C, Bedford, T, Cooke, RM, Hanea, AM & Morales-Napoles, O (2017) *Expert judgement for dependence in probabilistic modelling: A systematic literature review and future research directions,* **European Journal of Operational Research**	**3.428**	**7**

Presentations

Building networks and communicating our research connects CEBRA to our stakeholders and colleagues. To share our research and stay knowledgeable about the latest developments in biosecurity and risk analysis, our researchers represent CEBRA at meetings in Australia and internationally. We regularly chair, address and facilitate workshops and conferences. A summary of our endeavors is provided below.

Table 7: List of Presentations

Dates of Event	Topic | Event	Location	Organisation	Facilitator
03–07 July 2017	Winter School in Mathematical and Computational Biology	Brisbane	Institute for Molecular Bioscience	Dr Cindy Hauser
04–06 July 2017	The IDEA protocol: Framework and recent application | The State of the Art in Expert Judgement Conference	Delft, Netherlands	European Cooperation in Science and Technology	Dr Anca Hanea
21–27 July 2017	Hot, hungry, and tired: Individual-based models of animal dispersal using energetics and climates | International Congress for Conservation Biology 2017	Cartagena, Colombia	Society for Conservation Biology	Matt Malishev
17–28 July 2017	Risk quantification, risk management, expert judgement and safety issues | Data Assimilation Summer School	Sibiu, Romania	Statoil and the Netherlands Organisation for Applied Scientific Research	Dr Anca Hanea
24–28 July 2017	Epidemiological Modelling Workshop Featuring the Australian Animal Disease Model	Fort Collins, United States of America	Centre of Epidemiology and Animal Health, United States Department of Agriculture	Dr Richard Bradhurst
06–10 August 2017	Integrating disparate information sources for equilibrium climate sensitivity with nonparametric Bayesian networks | 12th International Conference on Structural Safety and Reliability	Vienna, Austria	International Conference on Structural Safety and Reliability	Dr Anca Hanea
07 August 2017	Using large regulatory datasets to inform science and biosecurity | New Zealand Plant Protection Society Symposium	Tauranga, New Zealand	New Zealand Plant Protection Society	Assoc. Prof Andrew Robinson
18 August 2017	Principles of biosecurity and quarantine | Lecture to students at LaTrobe Law School	Melbourne	LaTrobe University	Dr Aaron Dodd
22–23 August 2017	Nil finds matter | Department of Agriculture and Water Resources National Science Exchange Conference	Cairns	Department of Agriculture and Water Resources	Assoc. Prof Andrew Robinson
28 August–01 September 2017	Making sense of absence: A Bayesian framework for surveillance | 11th Meeting of the International Pest Risk Research Group	Ottawa, Canada	International Pest Risk Research Group	Assoc. Prof Andrew Robinson
15 September 2017	Carrots and sticks: Looking at ways to encourage compliant behavior among importers | Get-Wise Biosecurity Research Seminar Series	Canberra	Department of Agriculture and Water Resources	Dr Susan Hester

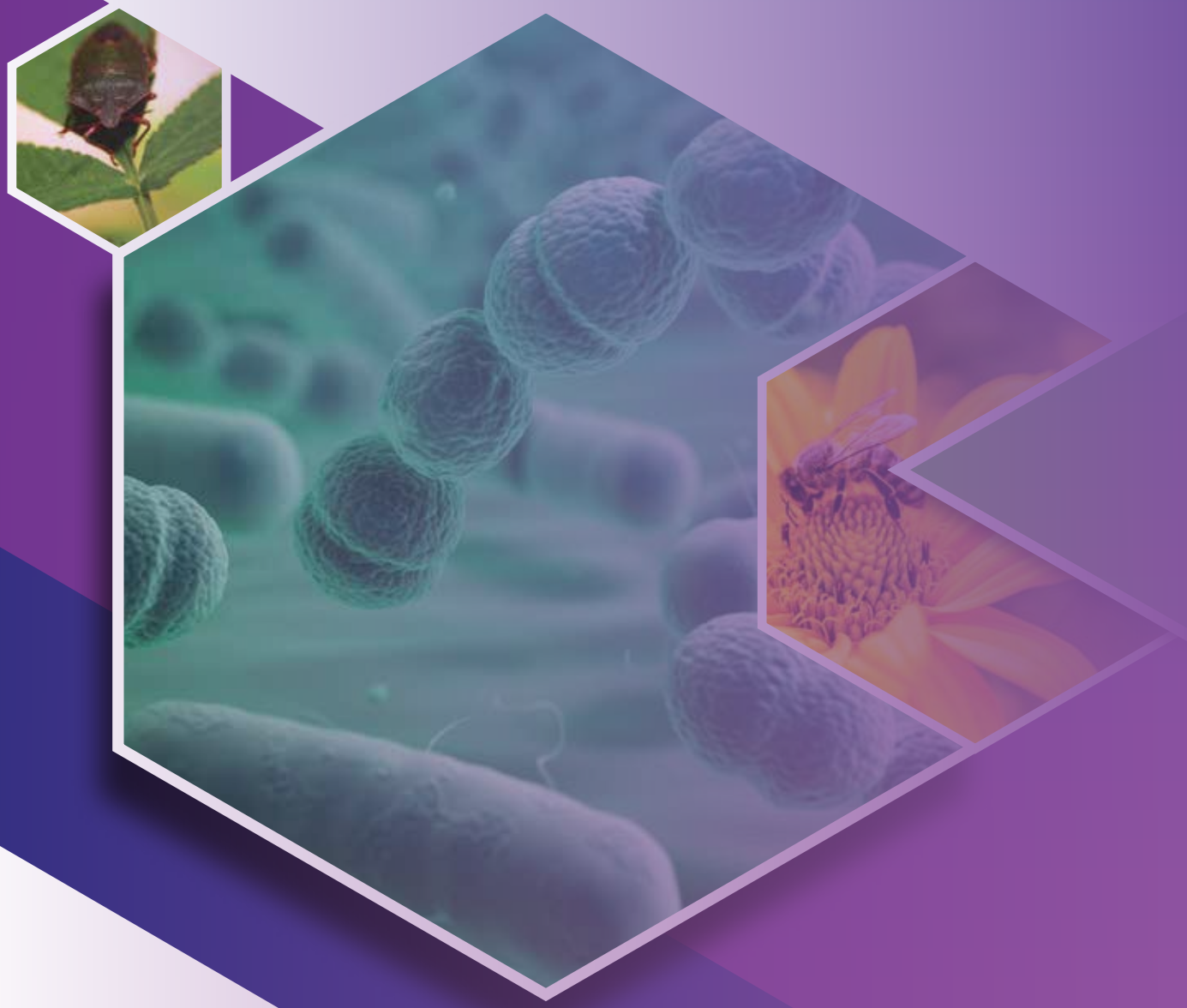
Dates of Event	Topic | Event	Location	Organisation	Facilitator
02 October 2017	An introduction to infectious disease modelling for veterinarians | Workshop for the Malaysian Department of Veterinary Services	Kuala Lumpur, Malaysia	Malaysian Department of Veterinary Services	Dr Richard Bradhurst (CEBRA), Prof Mark Stevenson and Dr Anke Wietheolter (both Faculty of Veterinary and Agricultural Sciences, University of Melbourne)
09 November 2017	Using decision support tools in emergency animal disease planning and response: Foot-and-mouth disease | Get-Wise Biosecurity Research Seminar Series	Canberra	Department of Agriculture and Water Resources	Prof Tom Kompas
22 November 2017	Plant invasions in Australia: How can decision theory inform management? | Risk in An Interconnected World, Society for Risk Analysis–Australia and New Zealand (SRA–ANZ) 2017 Conference	Melbourne	Society for Risk Analysis–Australia and New Zealand (SRA–ANZ)	Dr Aaron Dodd
22 November 2017	Simple Rules for Protecting Islands from Biological Invasions | Risk in An Interconnected World, SRA ANZ 2017 Conference	Melbourne	SRA–ANZ	Dr Danny Spring
22 November 2017	Does size matter to biosecurity risk? | Risk in an Interconnected World SRA–ANZ 2017 Conference	Melbourne	SRA–ANZ	Assoc Prof Andrew Robinson
22 November 2017	The 'curse of dimensionality' resolved! Optimal surveillance measures in large dimensional settings for early detection of pests and diseases | Risk in An Interconnected World SRA ANZ 2017 Conference	Melbourne	SRA–ANZ	Prof Tom Kompas
29 November 2017	Food Security Structured Expert Elicitation	Melbourne	Monash/ Warwick University	Dr Anca Hanea
04 December 2017	Workshop on Risk Profiling Model	Canberra	Department of Agriculture and Water Resources	Dr Anca Hanea
05–08 December 2017	Epidemiological Modelling Workshop Featuring the Australian Animal Disease Model	Vienna, Austria	The European Commission for the Control of Foot-and-Mouth Disease (EuFMD), United Nations Food and Agriculture Organisation	Dr Richard Bradhurst and Dr Graeme Garner (EuFMD)
06 February 2018	Expert judgement to assist an assessment of the risk abatement quantity is not delivered as contracted	Canberra	Clean Energy Regulator	Dr Terry Walshe
07 February 2018	Gendered patterns in authorship and careers in ecological research | Victorian Biodiversity Conference	Melbourne	Victorian Biodiversity Conference	Dr Cindy Hauser
15–16 February 2018	Structured expert judgement: the art of using subjective data as objectively as possible | Conference: A Crisis of Expertise? Legitimacy and the challenge of policymaking	Melbourne	Melbourne School of Government, The University of Melbourne	Dr Anca Hanea

Dates of Event	Topic | Event	Location	Organisation	Facilitator
05–06 April 2018	Bioeconomics: What can economics add to biological models? | Mathematics of Biological Systems Managements Symposium (MOBSYM)	Melbourne	The University of Melbourne	Dr Susie Hester
05–06 April 2018	Tend to your model or data may pull the wool over your eyes | MOBSYM	Melbourne	The University of Melbourne	Dr Jason Whyte
05–06 April 2018	CEBRA work makes an impact on both policy and practice of biosecurity | MOBSYM	Melbourne	The University of Melbourne	Assoc Prof Andrew Robinson
12–14 April 2018	The effect of natural disasters from climate change on national incomes: Solving a stochastic (jump-diffusion) intertemporal GTAP model | Fifth International Symposium in Computational Economics and Finance	Paris, France	International Symposium in Computational Economics and Finance 2018	Prof Tom Kompas
01–02 May 2018	Collaborative approaches to evidence-based policy making in biosecurity | Department of Agriculture and Water Resources National Science Exchange Conference	Canberra	Department of Agriculture and Water Resources	Assoc Prof Andrew Robinson
01–08 June 2018	R Workshop and United States Department of Agriculture Meeting	Raleigh, United States of America	Center for Integrated Pest Management, United States Department of Agriculture	Dr Stephen Lane
18 June 2018	Calibrating experts' probabilistic assessments for improved decision making | SRA Europe Conference: Risk and Uncertainty–From Critical Thinking to Practical Impact	Östersund, Sweden	Society for Risk Analysis Europe, Mid Sweden University	Dr Anca Hanea
21 June 2018	Bayesian networks in Uninet | Digital Subsurface Project Leaders Meeting	Stavanger, Norway	Equinor Norway	Dr Anca Hanea

Dr Aaron Dodd presenting at Science at the Shine Dome 2017

Governance

04



Chair's Report – CEBRA Advisory Board

CEBRA has a rigorous project proposal and output assessment to ensure that we produce quality research to target problems that matter.

In May 2019, CEBRA will enter 'teenhood'. With this anniversary approaching, I think it is constructive to look back at how CEBRA and its antecedent, ACERA, came into being, and how this entity has developed since 2006.

The origins of CEBRA date from an election commitment in December 2004, by the then Howard Government, to establish a centre of excellence to assist with understanding the risks associated with biosecurity. This commitment stemmed, in turn, from a review of quarantine conducted in 1996 by Professor Malcolm E. Nairn and others, which resulted in a report titled Australian Quarantine: A Shared Responsibility (ISBN 0 624 25971 2). The relevant recommendation (number 33) of the 108 recommendations in the review stated, 'The review committee recommends that Quarantine Australia continues to use and refine scientifically based risk analysis—comprising risk assessment, risk management, and risk communication—to develop its quarantine policies and procedures'.

The then Department of Primary Industries and Energy responded by calling a public tender in early 2005 to establish such a centre and The University of Melbourne (UoM) was one of 11 tender respondents. As an officer of the department, I was privileged to be responsible for initiating and managing this process. After a rigorous assessment process spanning several months and detailed negotiations with short listed proponents, UoM was the successful tenderer and ACERA (Australian Centre of Excellence for Risk Analysis) was born.

Since then, the Centre, as a learning and innovation organisation, has been improved and refined in many ways. It has morphed from being an exclusively Australian entity, with support from the Australian Government Department of Agriculture and Water Resources (DAWR), to a joint, international centre (CEBRA) with funding support and joint governance oversight provided by the New Zealand Government through its Ministry for Primary Industries (MPI). This change occurred in 2013 and is now well established.

While space does not allow for a detailed enumeration of initiatives and changes that have been associated with ACERA and CEBRA over thirteen years, there are a few noteworthy ones I would like to reflect on. The CAB (CEBRA's Advisory Board) has joint Australian and New Zealand membership, whereas ACERA was exclusively guided by Australian members. The CAB met in New Zealand, for the first time, in May 2018, in conjunction with a biosecurity workshop hosted by MPI and attended by industry, academia and government. It was a very well received initiative, culminating in the New Zealand Government increasing its base funding to CEBRA by 33%, in recognition of the value it attaches to CEBRA.

The Biosecurity Research and Innovation Steering Committee (BRISC), which resides in DAWR, also has joint Australian and New Zealand government membership and assists to identify and articulate the biosecurity problems and situations that face either, or both countries, and which might be amenable to CEBRA research. It prioritises its requests to CEBRA in the form of project outlines for consideration, noting that CEBRA has capability in academic disciplines covering biological sciences, mathematics and statistics, economics and social assessment.

These project outlines identify how the outcome of the research undertaken by CEBRA is likely to be taken up by proponents and what benefits the project will bring to biosecurity. In its turn, CEBRA allocates these draft projects to its Science Advisory Committee for assessment and identification of what disciplines might most appropriately apply. These assessments are undertaken as blind peer review processes by internal and external reviewers, with neither the proponent nor the reviewers—at least two for each project—being identified. When projects are underway, they are subjected randomly to seminar presentation to the CAB and on completion, to discussion on how uptake has proceeded.

Australia and New Zealand rely on and benefit in international agricultural trade from an efficient and effective biosecurity system. The rigorous CEBRA project assessment and delivery practices support such a system and it has been said of CEBRA (Burgman 2015) that it is a model for linkage between government and academia. As Chairman of the CAB, I am proud to be part of such a rigorous and effective system and on behalf of my Board colleagues, I commit to ensuring that CEBRA remains at the forefront of biosecurity risk analysis.

Colin J Grant
B.Sc.(Hons), Ph.D. JCU OA.

Burgman, M. A. (2015a). Governance for Effective Policy-Relevant Scientific Research: The Shared Governance Model. Asia and the Pacific Policy Studies, 2, 441–451. doi:10.1002/app5.104

CEBRA Advisory Board Members

Name	Position	Organisation
Colin Grant	Chair	Independent
Dr Steve Hatfield-Dodds	Board Member	Executive Director, Australian Bureau of Agricultural and Resource Economics and Sciences
Dr Marion Healy	Board Member	First Assistant Secretary, Biosecurity Plant Division, Department of Agriculture and Water Resources
Ms Christine Reed	Board Member	Biosecurity Science and Risk, Ministry for Primary Industries New Zealand
Assoc Prof Roger Paskin	Board Member	Chief Veterinary Officer,Biosecurity South Australia, Primary Industries and Regions South Australia
Prof Helen Sullivan	Board Member	Director, Crawford School of Public Policy, The Australian National University
Prof Ian Robertson	Board Member (SAC Chair)	Professor of Veterinary Epidemiology, College of Veterinary Medicine, Murdcoch University
Prof Pauline Ladiges	Board Member (Host)	Professorial Fellow, School of BioSciences, The University of Melbourne
Prof Peter Taylor	Board Member (Host)	Director, Australian Research Council, Centre of Excellence for Mathematical and Statistical Frontiers, School of Mathematics and Statistics, The University of Melbourne
Assoc Prof Andrew Robinson	Board Member (Ex Officio)	Director, CEBRA
Prof Tom Kompas	Board Member (Ex Officio)	Chief Investigator, CEBRA

Scientific Advisory Committee Terms of Reference

The Scientific Advisory Committee (SAC) reviews and approves all draft project plans and provides an assessment of all final reports.

The role of the SAC will be to:

- assist the Director 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 and Water Resources for endorsement
- Provide relevant advice to researchers conducting CEBRA projects, as requested by the Director.

The composition of the SAC will be:

- Chair: Professor Ian Robertson
- A broad committee of members covering relevant fields of Environmental, Animal and Plant Sciences, Biosecurity, Physical Mathematical and Social Sciences, Psychology, Philosophy and Statistics.

The responsibilities of SAC members will be:

- Chair will seek advice and peer reviews from appropriate SAC members and other colleagues on proposals, interim and final reports, as appropriate. Reviews will be forwarded to investigators for their consideration.
- SAC 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 SAC.
- Chair will attend Advisory Board meetings to report on SAC matters.

It is anticipated that most of the business of the SAC will be conducted electronically. Formal meetings may be called at the discretion of the Chair in consultation with the Director.

Scientific Advisory Reviewers List for 2017–2018

NAME	ORGANISATION
Dr Kirsty Bayliss	Murdoch University
Dr Arthur Campbell	Monash University
Dr Brendan Cowled	Ausvet
Dr Gary Fitt	Commonwealth Scientific and Industrial Research Organisation
Prof David Fox	Environmetrics
Dr Karyn Froud	Biosecurity Research Limited New Zealand
Dr Pablo Garcia-Diaz	Landcare Research New Zealand
Dr Grant Hamilton	Queensland University of Technology
Dr Lisa Jamieson	Plant and Food New Zealand
Dr Ryan McAllister	Commonwealth Scientific and Industrial Research Organisation
Prof Simon McKirdy	Murdoch University
Dr Hugh Millar	Hugh Millar & Associates Pty Ltd
Dr Paul Mwebaze	Commonwealth Scientific and Industrial Research Organisation
Prof John Rolfe	Central Queensland University
Assoc Prof Jenny-Ann Toribio	University of Sydney
Dr John Weiss	Plant Biosecurity Cooperative Research Centre
Dr Nick Golding	The University of Melbourne
Dr Rob Cannon	Department of Agriculture and Water Resources (former)
Prof Oscar Cacho	University of New England
Dr Sandy Clarke	The University of Melbourne
Dr Michael Ormsby	Ministry for Primary Industries New Zealand
Dr Rieks van Klinken	Commonwealth Scientific and Industrial Research Organisation
Assoc Prof Ben White	The University of Western Australia
Dr Terry Walshe	The University of Melbourne
Prof Michael Ward	The University of Sydney
Dr Peter Whittle	AgKonect Pty Ltd
Dr Sue Worner	Lincoln University

Key Performance Indicators

CEBRA's objectives and outcomes against KPIs are summarised in the following table. In the majority of cases, KPIs were on target or completed.

Activity – Research						
Strategic Objective			**Accountability**	**Rating Key**		**Progress/Outcome**
To research and develop methods relevant to biosecurity risk by engaging a range of disciplines relevant to the analysis of biosecurity risk, so that the Australian and New Zealand governments remain at the forefront of practical biosecurity risk assessment.			Director	○ Over performance ⊙ On target ☒ Target at risk ◊ Target not achieved ✪ Completed		⊙ On target
Key Performance Indicator		**Measure**	**Officer**	**Delivery Date**	**Rating**	**Progress/Outcome**
1.1	Research project quality and completion rates achieve a high standard	At least 90% of Project Proposals are approved, pending budget allocations	Director, Biosecurity Research Team, SAC	Ongoing	⊙	2018–19 continuing project proposals have been approved. MPI projects are currently undergoing SAC review.
		At least 90% of Output (milestones, reports, systems, software, guidelines etc.) completed satisfactorily	Director, Business Manager	Ongoing	⊙	The satisfactory completion of outputs continues to track above 90%.
		At least 80% outputs completed on time per year	Director	Ongoing	⊙	The on-time completion of project deliverables is currently tracking toward the 80% target.
		At least 90% of projects to be delivered on budget	Director, Business Manager	Ongoing	⊙	Projects continue to track on or below budget.
1.2	Research projects contribute positively to the University's Excellence in Research for Australia (ERA) ranking based on standard measures	Organisational H-Index ranking	Director	Ongoing	⊙	CEBRA's H index is 24 CEBRA/ACERA's combined H index is 62
		Number of Publications per year by CEBRA staff	Director	Ongoing	⊙	CEBRA staff have published several journal articles badged as CEBRA work. Details are provided in Table 6.
1.3	Biosecurity risk analysis capacity in Australia and New Zealand is enhanced	Number of research higher degree students enrolled	Director	Ongoing	⊙	CEBRA is currently supporting five higher degree students.
		Number of research higher degree students graduated	Director	Ongoing	⊙	Decky Junaedi and Matthew Malishev have completed their PhDs.
		Number of post-doctoral research fellows employed	Director	Ongoing	⊙	Eight post-doctoral research fellows are funded through the CEBRA grant and work directly on CEBRA projects: •Edith Arndt •Cindy Hauser •Richard Bradhurst •Steve Lane •James Camac •Anca Hanea •Tracey Hollings •Jason Whyte Two additional post-doctoral research fellows are funded from alternate sources but contribute to the CEBRA research portfolio: •Aaron Dodd •Danny Spring

Activity – Research					
Strategic Objective			**Accountability**	**Rating Key**	**Progress/Outcome**
To research and develop methods relevant to biosecurity risk by engaging a range of disciplines relevant to the analysis of biosecurity risk, to that the Australian and New Zealand governments remain at the forefront of practical biosecurity risk assessment.			Director	○ Over performance ⊙ On target ☒ Target at risk ◊ Target not achieved ✪ Completed	⊙ On target
Key Performance Indicator		**Measure**	**Officer**	**Delivery Date**	**Rating** / **Progress/Outcome**
1.4	Engagement and collaboration between CEBRA funding bodies and other organisations in planning and conducting CEBRA research projects	Director engages with DAWR (BRISC) to discuss context and details of research projects	Director	BRISC meetings held on: Jun 23, 2017 Sept 22, 2017 Mar 29, 2018 June 6, 2018	✪ The Centre's Executive Management have been represented at each BRISC meeting to report on Centre activities and to foster engagement with funding bodies.
		Director engages with MPI to discuss context and details of research projects	Director	Ongoing	⊙ The Director visits MPI at least four times per year to discuss projects and practices.
		At least 3 substantial collaborations with other research organisations per year	Director	Ongoing	⊙ New collaboration agreements have been executed with: • Imperial College, UK • Scion Research, NZ • Lincoln University, NZ
1.5	Peer review of all draft project plans	Scientific Advisory Committee successfully reviews and oversees revision of all project reports	Director, SAC Chair	Ongoing	⊙ The SAC will review all submitted business cases and provide constructive feedback to proponents to improve proposals.

Activity - Communications

Strategic Objective	Accountability	Rating Key	Progress/Outcome
To document and communicate research findings to governments and others engaged in biosecurity decision making in order to promote excellence in risk analysis	Director, Business Manager, Communications PR	○ Over performance ⊙ On target ☒ Target at risk ◊ Target not achieved ✪ Completed	⊙ On target

Key Performance Indicator		Measure	Officer	Delivery Date	Rating	Progress/Outcome
2.1	An effective flow of media information and publicity about the objectives and achievements of CEBRA	At least 2 informative media stories per year	Director, Business Manager, Communications PR	Ongoing	⊙	CEBRA e-newsletter distributed quarterly and news items regularly placed on website and social media.
		Use of website, blogs and social media to increase brand awareness. An average of 1,000 website page views per month				CEBRA Facebook page and Twitter account are regularly updated.
		At least 3 working groups conducted and summaries completed per year				CEBRA staff have completed at least three workshops in the reporting period. Detailed information is provided in Table 7.
2.2	Regular involvement in national and international conferences and similar forums	At least 12 national presentations by CEBRA participants (badged as CEBRA work) per year	Director	Ongoing	○	CEBRA staff have made at least twelve presentations badged as CEBRA work, detailed information is provided in Table 7.
		At least 2 international presentations by CEBRA participants (badged as CEBRA work) per year				CEBRA staff have made at least six international presentations badged as CEBRA work, detailed information is provided in Table 7.
2.3	Broad recognition of CEBRA as a Centre of standing in quality research	At least 3 invitations to chair or host conferences, or participate in key advisory forums, or similar	Director	Ongoing	⊙	CEBRA staff have made at least three plenary presentations; detailed information is provided in Table 7.
		At least 1 International Visitor per year				CEBRA has hosted: • Mark Boyce and Evelyn Merrill University of Alberta, Canada • Allan Auclair and Sandy Liebhold United States Department of Agriculture • Mark Burgman Imperial College, London, UK • Gideon Gal Israel Oceanographic and Limnological Research
		At least 1 visit to international laboratories by CEBRA personnel per year				Dr Steven Lane visited the USDA Center for Integrated Pest management in Raleigh, North Carolina from June 01–08, 2018.

Activity – Adoption

Strategic Objective	Accountability	Rating Key	Progress/Outcome
To improve the adoption of CEBRA outputs by the Australian and New Zealand biosecurity authorities in support of strengthening the integrity of biosecurity systems based on risk management	Director and Government CEBRA Advisory Board Members	○ Over performance ◘ On target ☒ Target at risk ◊ Target not achieved ✪ Completed	⊙ On target

	Key Performance Indicator	Measure	Officer	Delivery Date	Rating	Progress/Outcome
3.1	Use of CEBRA materials is routine in government biosecurity management	Each CEBRA project proposal has at its inception a clearly articulated and measureable adoption/uptake strategy (one page)	Biosecurity Research Section, DAWR and MPI	Prior to project approval	✪	Each business case in the workplan has a clearly articulated adoption/uptake section.
		Director to report on completion of CEBRA research outputs to DAWR and MPI	Director	Ongoing	⊙	Director provides summary of completed research findings to DAWR and MPI.
		DAWR and MPI CAB members to provide advice on adoption of project outputs to CEBRA Advisory Board biannually, including details of transfer of capability	Biosecurity Research Section, DAWR and MPI	Biannually	⊙	Biosecurity Research Section confirms progress towards adoption reporting is on track. DAWR and MPI provide adoption summary report to CEBRA Advisory Board biannually.
3.2	Achievement of a high rate of research project endorsement by DAWR	At least 90% of submitted project outputs are endorsed by DAWR per year	Director, BRISC	Ongoing	✪	The following reports were submitted for endorsement: 1301A Final Report 1404C Final and Supp. Reports 1501E Final Report 1502E Final Report 1606A Final Report 1606C Final Report 1607A Final Report (Yr 1) 1607B Final Report (Phase 1) 1608D Final Report 1608E Final Report Endorsements received to date: 1608D 24/01/18 1501E 14/02/18 1502E 21/02/18 1301A 27/02/18 1606A (26/04/18) 1607B (23/05/18) 1607A (25/05/18)

Activity – Governance

Strategic Objective	Accountability	Rating Key	Progress/Outcome
To manage CEBRA in accordance with the funding agreement, strategic objectives and key performance indicators, taking account of relevant industry standards and best practice guidelines	Director and Chair	○ Over performance ⊙ On target ☒ Target at risk ◊ Target not achieved ✪ Completed	⊙ On target

Key Performance Indicator		Measures	Officer	Delivery Date	Rating	Progress/Outcome
4.1	Budget and workplan developed and approved annually	Submit to DAWR and MPI a budget and workplan for research projects each financial year	Business Manager	14 July	✪	The budget and work plan was submitted to DAWR and MPI on 14/07/17.
		Review budget and workplan and approve (subject to amendments)	DAWR/MPI	31 July	✪	DAWR and MPI approved the budget and work plan on 21/07/17.
4.2	Payment of Funding in support of CEBRA	DAWR and MPI to pay CEBRA Funding Payments twice annually	DAWR/MPI	31 January 31 July	✪	Invoices issued to: DAWR Invoice No: 743946 issued on 5/07/17 Invoice No: 752883 issued on 4/01/18 MPI Invoice No: 750077 issued on 6/11/17 Invoice No: 753010 issued on 4/01/18
		The University of Melbourne contributes $450,312 in funds and $1,000,364 in-kind per annum, the latter being support for CEBRA Staff, including space for the CEBRA IT system maintenance and general administrative support	Business Manager	March	✪	$300,208 received from The University's Chancellery Strategic Investment (DVCR) on 30/01/18 $75,052 received from the Faculty of Science on 28/02/18 $75,052 received from the School of BioSciences on 31/03/18 In-kind contribution has been calculated at $1,079,482 for 2017-2018

Key Performance Indicator		Measures	Officer	Delivery Date	Rating	Progress/Outcome
4.3	Provide regular reports to funding partners on CEBRA activities as required in the Funding Agreement CEBRA to provide DAWR and MPI with a financial report for the preceding six months biannually as set out in Schedule 3 of the Funding Agreement.	CEBRA to provide DAWR and MPI with progress reports as set out in Schedule 3 of the Funding Agreement	Business Manager	31 March 31 July 30 November	✪	PR #12 was submitted to DAWR /MPI on 28/7/17 PR #13 was submitted to DAWR/MPI on 30/11/17 PR #14 was submitted to DAWR/MPI on 31/3/18
		CEBRA to provide DAWR and MPI with a financial report for the preceding six months biannually as set out in Schedule 3 of the Funding Agreement	Business Manager	January 21 July 16	✪	FR # 6 was submitted to DAWR / MPI on 14/7/17 FR # 7 was submitted to DAWR / MPI 12/01/18
4.4	Provide an Annual Report on CEBRA activities and performance annually, and an Auditor's Report confirming that CEBRA has managed funding and maintained appropriate accounts and records	CEBRA to supply DAWR and MPI with an annual report and Auditor's Report as set out in Schedule 4 of the Funding Agreement	Business Manager	Annual Report: 30 September Auditor's Report: 31 August	✪	The annual report was submitted to DAWR/MPI on 24/10/17 and the Auditor's Report was submitted to DAWR/MPI on 24/10/17
4.5	Provide a Final Report on Centre activities at the completion of the term of the Funding Agreement	CEBRA to supply DAWR and MPI with a final report for the term of the agreement as set out in Schedule 4 of the Funding Agreement	Business Manager	30 September 2021	⊙	Not required in the reporting period.
4.6	CEBRA Advisory Board advises on broad direction setting for risk analysis research	CEBRA Advisory Board meets 4 times per year with a minimum attendance of 80% of members (maximum of two members missing)	Board Chair, Director	25 August 17 November 23 February 9 May	✪	To date, all meetings were held as indicated.
		Conduct one CEBRA Advisory Board every second year in New Zealand commencing 2018	Board Chair, Director, NZ member	9 May	✪	Board meeting #20 was held in Wellington NZ on 9/5/18.
		The Board comprises a range of experience appropriate to the objectives of CEBRA as set out in Schedule 2 of the Funding Agreement	Board Chair, Director	Annual review of membership	✪	Advisory Board is comprised of an Independent Chair and members drawn from DAWR, MPI, UoM, a state jurisdiction and Tertiary Institutions.
4.7	Conduct an bi-annual review of Advisory Board performance with a view to achieving best practice in quality of advice and organisational management	Bi-annual Review Questionnaire completed by all Board Members and discussed at appropriate Board meeting	Board Chair	May–August 2019	⊙	Review to be completed and presented at mid-2019 CAB Meeting.

Financial Statement

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Financial Report Summary

CEBRA FINANCIAL STATEMENT 2017-2018	
INCOME	
Balance Brought Forward	$ 103,657
Department of Agriculture and Water Resources	$ 1,781,000
Ministry for Primary Industries	$ 266,572
Host Contribution	$ 450,312
Interest	$ 14,040
SUB-TOTAL	**$ 2,511,924**
OPERATING FUNDS (REVENUE + BALANCE CARRIED FORWARD)	**$ 2,615,580**
LESS EXPENDITURE	
Salaries	$ 306,587
Operations	$ 15,347
Business Development	$ 160,929
Research Contracts	$ 2,034,322
SUB-TOTAL	**$ 2,517,185**
BALANCE	$ **98,395**

CEBRA In-Kind Statement

	%	$
Infrastructure Costs - Staff (On Campus Laboratory) $86,490/FTER per annum (University of Melbourne funded)		
Payroll costs for Research Staff (Melb Uni funded)		
Dr J Elith (RF)	5%	$ 5,044
Dr D Spring	25%	$ 38,784
Dr A Dodd	50%	$ 77,568
	SUB-TOTAL	**$ 121,396**
Infrastructure Costs - Staff (On Campus Laboratory) $86,490/FTER per annum (Grant and University of Melbourne funded)		
Assoc Prof A Robinson	100%	$ 86,719
Prof T Kompas	50%	$ 43,245
Dr T Hollings	56%	$ 48,262
Dr S Lane	83%	$ 71,876
Dr E Arndt	60%	$ 51,894
Dr J Camac	77%	$ 66,391
Dr R Bradhurst	100%	$ 86,490
Ms K Schneider	60%	$ 51,894
Ms M Hoffmann	10%	$ 8,728
Dr A Hanea	56%	$ 48,083
Dr J. Whyte	45%	$ 39,079
Dr C Hauser	30%	$ 25,947
Ms C Watts	75%	$ 64,867
Ms E Kecorius	60%	$ 51,894
Ms J Holliday	10%	$ 8,649
Dr J Elith	5%	$ 4,324
Dr A Dodd	50%	$ 43,246
Dr D Spring	25%	$ 21,623
	SUB-TOTAL	**$ 823,211**
Infrastructure Costs - RHD Student (On Campus Laboratory) $39,000/FTER per annum		
D Junaedi	46%	$17,875
N Attanayake	100%	$39,000
T Vino	100%	$39,000
G Dharmarathne	100%	$39,000
	SUB-TOTAL	**$ 134,875**
Total		**$1,079,482**

Auditors Report

DENCH McCLEAN CARLSON

CORPORATE ADVISORY

8 August 2018

INDEPENDENT AUDIT REPORT

TO COMMONWEALTH OF AUSTRALIA – DEPARTMENT OF AGRICULTURE AND WATER RESOURCES 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 Excellence for Biosecurity Risk Analysis the period 1 July 2017 to 30 June 2018.

AUDIT OBJECTIVE

The objective of the audit was to provide an auditor's report in accordance with clause 20.4 of the Funding Agreement. 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 $2,517,185.11 expenditure on the Project; and
- the contributions of the University is $450,312.00 in cash and $1,079,482.17 in-kind in accordance with the terms of the Agreement.

The Financial Statement and Summary of In-kind Support Statement signed by the Director of the Australian Centre of Excellence for Biosecurity Risk Analysis, and a report from the Director certifying that the Centre has undertaken the Core Activities in accordance with the Agreement are attached.

Signed 

Craig Geddes
Partner
Dench McClean Carlson Pty Ltd

Dench McClean Carlson Pty Ltd ACN 050 237 315 / ABN 42 050 237 315
Level 5, 99 Queen Street, Melbourne Victoria 3000 Australia
Phone: (613) 8617 8141 Mobile 0418 349 570
E-Mail: admin@dmcca.com.au
Website: www.dmcca.com.au

Outlook

06

Future Outlook

Australia's biosecurity system is vital for maintaining the health and value of our $59 billion agriculture industry, $38 billion tourism industry, $6 trillion worth of environmental assets and 24 million people[1].

The movement of people, goods and vehicles into Australia and New Zealand continues to grow. According to the Australian Department of Home Affairs, there were over 20 million passenger arrivals via air and sea into Australia during the financial year 2017–18[2]. The number of total passenger numbers through Australian airports is expected to **double** by 2030 and total cargo volume through seaports is expected to **double** by 2040[3].

It is not just the volume of travellers and goods that is changing, but also the nature of the biosecurity risk they present. Governments, industry and community need to adopt a systematic approach to determining and planning for animal and plant pests and diseases[4]. In the face of this growing, shifting challenge, CEBRA will continue to look for smarter, evidence-based ways of protecting our industries, environment and people.

Our research priorities for 2018–19 continue to be focussed by three themes:

- **Strengthening Surveillance:** Surveillance and analysis reduce the risk of new entry of pests, diseases and weeds and allows better targeting of the risks that matter most.

- **Building Scientific Capabilities:** Effective and cutting-edge science is achieved in an increasingly complex biosecurity environment by building capacity and developing professional networks and collaborations.

- **Data and Information:** Optimising the use of data and information facilitates better biosecurity risk management.

Strengthening Surveillance

Project ID: 170602 Increasing confidence in pre-border risk management

Project ID: 170606 Developing models for the spread and management of National Priority Plant Pests

Project ID: 170607 Developing scientifically robust risk maps for priority plant pests

Project ID: 170608 CBIS/CSP sensitivity analysis

Project ID: 170615 Assessing ant pathways to better inform site selection for ant surveillance

Project ID: 170621 Proportional value of intervention across pathways and layers of the biosecurity system (extension of 1606E)

Project ID: 180601 Models for border inspection for pelleted seeds: How much assurance?

Building Scientific Capabilities

Project ID: 170713 Value of Australia's biosecurity system (extension of 1607A)

Project ID: 170714 Health of Australia's biosecurity system (extension of 1607B)

Project ID: 180702 CEBRA research: Harnessing past and new work to improve uptake and impact of best practise risk analysis approaches in MPI

Data and Information

Project ID: 170805 Optimisation of national resources for animal disease surveillance

CEBRA supports the essential work of the Australian Department of Agriculture and Water Resources and the New Zealand Ministry of Primary Industries. By sharing our research and nurturing our connections across the globe, we ensure that we remain at the forefront of practical biosecurity in Australia and New Zealand.

[1] *Australian environmental–economics accounts* (2017) Cat. No. 4655.0, Australian Bureau of Statistics, Canberra

[2] https://www.homeaffairs.gov.au/about/reports-publications/research-statistics/statistics/live-in-australia/overseas-arrivals-and-departures

[3] *Transport Security Outlook to 2025: Security Environment Review* (2017) Department of Infrastructure and Regional Development

[4] *Priorities for Australia's biosecurity system: An independent review of the capacity of the national biosecurity system and its underpinning intergovernmental agreement* (2017) Craik, W, Palmer, D and Sheldrake, R, Commonwealth of Australia

Australian Government
Department of Agriculture and Water Resources

Ministry for Primary Industries
Manatū Ahu Matua

2018–2019 Research Projects

Themes

Strengthening Surveillance $570,340

Project ID: 170602 SH
Project Title: Increasing confidence in pre-border risk management
Division: Biosecurity Animal
2018-19: $107,000

Project ID: 170606 TK
Project Title: Developing models for the spread and management of National Priority Plant Pests
Division: Biosecurity Plant
2018-19: $84,840

Project ID: 170607 AR
Project Title: Developing scientifically robust risk maps for priority plant pests
Division: Biosecurity Plant
2018-19: $130,000

Project ID: 170608 SH
Project Title: CBIS/ CSP sensitivity analysis
Division: Biosecurity Plant
2018-19: $62,000

Project ID: 170615 ❖AR
Project Title: Assessing ant pathways to better inform site selection for ant surveillance
Division: NZ MPI DSSO
2018-19: $91,500

Project ID: 170621 (extension of 1606E) ❖AR
Project Title: Proportional value of interventions across pathways and layers of the biosecurity system
Division: NZ MPI BSFSRARA
2018-19: $45,000

Project ID: 180601 ❖AR
Project Title: Models for border inspection for pelleted seeds: How much assurance?
Division: NZ MPI
2018-19: $50,000

Building Scientific Capability $527,000

Project ID: 170713 (extension of 1607A) ♦TK
Project Title: Value of Australia's biosecurity system
Division: Biosecurity Policy & Implementation
2018-19: $236,000

Project ID: 170714 (extension of 1607B) ♦KS
Project Title: Health of Australia's biosecurity system
Division: Biosecurity Policy & Implementation
2018-19: $260,000

Project ID: 180702 ❖ SH
Project Title: CEBRA research: harnessing past and new work to improve uptake and impact of best practise risk analysis approaches in MPI
Division: NZ MPI
2018-19: $31,000

Data and Information $149,904

Project ID: 170805 TK
Project Title: Optimisation of national resources for animal disease surveillance
Division: Biosecurity Animal
2018-19: $149,904

Projects

Key
AR – Andrew Robinson
SH – Susie Hester
TK – Tom Kompas
KS – Karen Schneider
❖ – NZ MPI project
♦ – Collaborative with NZ MPI

Last updated
13 Aug 2018

FUNDING
2018–19: $1,247,244

WEB

http://www.cebra.unimelb.edu.au

EMAIL

cebra-info@unimelb.edu.au

PHONE

+61 (0)3 8344 4405

POST

Centre of Excellence for Biosecurity Risk Analysis (CEBRA)
School of BioSciences, The University of Melbourne,
Victoria, Australia 3010

Australian Government
Department of Agriculture and Water Resources

THE UNIVERSITY OF MELBOURNE

Ministry for Primary Industries
Manatū Ahu Matua

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Centre of Excellence for Biosecurity Risk Analysis