cebra

Centre of Excellence for
Biosecurity Risk Analysis

ANNUAL REPORT 2016-2017

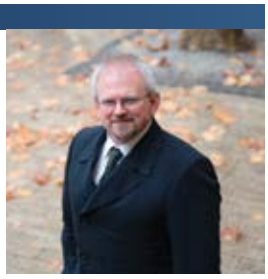
Australian Government
Department of Agriculture and Water Resources

THE UNIVERSITY OF MELBOURNE

Ministry for Primary Industries
Manatū Ahu Matua

Contents

01 Director's Introduction



It is my privilege to introduce the 2016-17 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 2017.

I'm delighted and proud to be leading CEBRA into its second decade of helping the Australian and New Zealand governments to remain at the forefront of practical biosecurity risk analysis. During this financial year our funding has been extended for another four years of service. Our innovation, effective and practical research in risk analysis will continue to address the biosecurity challenges facing Australia and New Zealand.

I'm happy to introduce several new members who have joined the CEBRA family over the past twelve months. We extend a warm welcome to Karen Schneider, James Camac, Aaron Dodd, Richard Bradhurst, Danny Spring and Cindy Hauser, and a farewell and thank you to Hannah Fraser. I would also like to acknowledge one of our ARC Future Fellows, Assoc Prof Jane Elith who was one of twenty-one of Australia's best scientists elected to the Australia Academy of Science, a rare and esteemed honour, for her outstanding contributions to science.

The year has not been without its challenges. During the year there has been a change in leadership and I acknowledge and thank both Prof Mark Burgman, our previous Managing Director, and Dr Ron Sandland, the previous chair of the CEBRA Advisory Board, for providing ten years of invaluable and inspirational leadership. Under their direction, CEBRA has grown to a position of world leadership in biosecurity risk analysis. CEBRA has grown not only in size but also in the importance that our policy colleagues, both here and in New Zealand, place on it. I warmly welcome Dr Colin Grant, formerly with the Department of Agriculture and Water Resources (DAWR), as the new chair of the Advisory Board. Colin was one of the originating members of the board, and was central in articulating the vision that began in 2006 with the Australian Centre of Excellence for Risk Analysis.

At CEBRA we have a commitment to innovation, impact and global reach. Our research challenges biosecurity thinking by developing and introducing new tools and perspectives that provide more efficient, effective and useful solutions. Solutions that connect directly to concrete problems. While we focus tightly on biosecurity regulatory undertakings, our outcomes apply broadly to regulators worldwide. Our research priorities address the challenges facing our governments, business and community and are focussed by three themes: Strengthening Surveillance, Building Scientific Capabilities and Data and Information.

This year has again seen innovative and effective work delivered and deployed by dedicated people. In the last 12 months we have had the following reports endorsed by the Biosecurity Research Steering Committee:

- Project 1304C: Market-based incentives for biosecurity compliance
- Project 1401C/D: AIMS and SAC Text Mining
- Project 1402B: Tools and approaches for invasive species distribution modelling for surveillance
- Project 1404D: Using decision support tools in emergency animal disease planning and response: Foot-and-Mouth disease

Many others are complete and are under review.

Our people are the key to our achievements and I would like to thank them for their professionalism and commitment.

Associate Professor Andrew Robinson
Managing Director, CEBRA

Core Activities

02 Summary of Core Activities

The Core Activities that CEBRA undertook during the Financial Year 2016-17 comprise the following projects approved by the Biosecurity Research Steering Committee.

Table 1 : Core Activities for 2016-2017

Project	Title	2016-2017 Budget
	Strengthening Surveillance	
1606A*	Development of a generic sample size tool for the importation of small seed lots	$45,000
1606B	Operational imports analysis on compliance	$100,000
1606C	Risk-mapping import pathways for risk-return opportunities	$60,000
1606D	Quantifying evidence of a plant pest's absence	$64,000
1606E*	Scoping the value and performance of interventions across the NZ Biosecurity system	$81,000
	Building Scientific Capacity	
1607A	Value of Australia's biosecurity system	$270,000
1607B	Health of Australia's biosecurity system	$100,000
	Data and Information	
1608A	Defensible resource allocation for plant health surveillance	$110,000
1608B	Decision support tools for vector (insect) spread animal diseases	$115,000
1608C	Testing incentive-based drivers for importer compliance *(continuation of CEBRA Project 1504C)*	$40,000
1608D	Incorporating economic components in Australia's FMD modelling capability and evaluating post-outbreak management to support return to trade	$94,000
1608E	Methodology to guide responses to marine pest incursions under the National Environmental Biosecurity Response Agreement	$70,000
1608F*	Biosecurity response decision support framework	$25,000
	Total:	**$1,174,000**

*Ministry for Primary Industries led projects

CEBRA Biosecurity Research Projects
July 2016 - June 2017

Last updated : 7 July 2016

Themes

Projects

Strengthening Surveillance $350,000

Project ID: 1606A ❖ SL
Project Title: Development of a generic sample size tool for the importation of small seed lots
Division: NZ MPI
2016-17: $45,000

Project ID: 1606B ♦ AR
Project Title: Operational imports analysis on compliance
Division: Compliance
2016-17: $100,000

Project ID: 1606C ♦ AR
Project Title: Risk mapping import pathway for risk-return opportunities
Division: Compliance
2016-17: $60,000

Project ID: 1606D EA
Project Title: Quantifying evidence of a plant pest's absence
Division: Biosecurity Plant
2016-17: $64,000

Project ID: 1606E ❖ AR
Project Title: Scoping the value and performance of interventions across the NZ Biosecurity system
Division: NZ MPI
2016-17: $81,000

Building Scientific Capabilities $370,000

Project ID: 1607A ♦ TK
Project Title: Value of Australia's biosecurity system
Division: Biosecurity Policy & Implementation
2016-17: $270,000

Project ID: 1607B ♦ EA
Project Title: Health of Australia's biosecurity system
Division: Biosecurity Policy & Implementation
2016-17: $100,000

Data and Information $454,000

Project ID: 1608A TK
Project Title: Defensible resource allocation for plant health surveillance
Division: Biosecurity Plant
2016-17: $110,000

Project ID: 1608B TK
Project Title: Decision support tools for vector (insect) spread animal diseases
Division: Biosecurity Animal
2016-17: $115,000

Project ID: 1608C (1504C) ♦ SH
Project Title: Testing incentive-based drivers for importer compliance
Division: Biosecurity Plant
2016-17: $40,000

Project ID: 1608D TK
Project Title: Incorporating economic components in Australia's FMD modelling capability and evaluating post-outbreak management to support return to trade
Division: Biosecurity Animal
2016-17: $94,000

Project ID: 1608E SH
Project Title: Methodology to guide responses to marine pest incursions under the National Environmental Biosecurity Response Agreement
Division: Biosecurity Animal
2016-17: $70,000

Project ID: 1608F ❖ SH
Project Title: Biosecurity response decision support framework
Division: NZ MPI
2016-17: $25,000

Key
SL – Stephen Lane
AR – Andrew Robinson
SH – Susie Hester
TK – Tom Kompas
EA – Edith Arndt
❖ – NZ MPI project
♦ – Collaborative with NZ MPI

FUNDING
2016-17: $1,174,000

Project Summaries

Strengthening Surveillance

1606A: Development of a generic sample size tool for the importation of small seed lots

To meet current phytosanitary requirements, Ministry for Primary Industries (MPI) has established procedures for the documentation, sampling and testing of imported viable seeds to ensure that weed seeds and seed-borne diseases are not incidentally present in consignments. Most sampling and testing requirements use 2000 – 3000 seed samples in order to achieve 95% confidence of sampling and detecting weeds and diseased seeds at a rate of 0.15% to 0.1%, which does not readily facilitate the importation of small quantities of seeds into New Zealand. Often testing is destructive which has a significant impact on the importation of high value breeders' seed.

At present there is no option for modification of sampling and testing protocols for seed lots smaller than 2000 seeds or where destructive testing affects the purpose of import or the value of the seed lot. Hence, an alternative testing protocol designed specifically for importing small seed lots is required to maximise the sustainability and growth of the New Zealand seed export industry, while minimising the biosecurity risks to New Zealand. The protocol must be flexible enough to help facilitate the frequent import of different volumes of seeds, different species of seeds and seeds from different countries. The sample size protocol developed in this project may be used directly by the Plant Imports Team at MPI to enable importers of small seed consignments to meet all biosecurity requirements. After appropriate internal and external assessment, the sampling protocol may be incorporated into the Import Health Standard for Seeds for Sowing, which is currently under review. The protocol may also be used to aid risk management decisions for border clearance of consignments

Strengthening Surveillance

1606B: Operational imports analysis on compliance

The Biosecurity Surveillance and Analytics group of projects are an outcome of Priority 5 from the Agricultural Competitiveness White Paper, which aims to improve Australia's access to premium markets for international trade by improving biosecurity surveillance and analysis nationally. The projects seek to better understand the Department of Agriculture and Water Resources (DAWR) needs for information derived from surveillance, inspection and intelligence activities and related analytics, to evaluate current capability to meet these needs, and to identify gaps and opportunities for improvement.

DAWR is seeking advice on the data required to answer some key questions on managing compliance and biosecurity risks:

- How can DAWR differentiate between administrative non-compliance and material non-compliance?
- How can DAWR differentiate between the approaching biosecurity risk that is regularly managed as part of the normal biosecurity interventions and unexpected biosecurity risk?
- How can DAWR determine the value of data collected by industry as a result of functions they provide as part of Approved Arrangements.

DAWR has done some work to improve its data capture for non-compliance in the Cargo Compliance Verification programme and is keen to apply this method to all inspections. However, there may be further improvement or refinement of this data as a result of the questions above.

Development of this project will help ensure that the focus of further investment in data capture and curation is based upon the right data for DAWR to best manage the non-compliance that matters most and unexpected biosecurity risks.

Strengthening Surveillance

1606C: Risk-mapping import pathways for risk-return opportunities

DAWR lacks formal methods for analysing the risk and performance of clients that participate in the supply chain of imported products. As a result, the Plant Division has a limited ability to tailor biosecurity risk management activities and target intervention within individual import pathways where pre-export and supply-chain measures may be in place.
The aim of this project is to develop approaches, methodologies and tools that assist DAWR better understand the risk profile of its clients operating within import pathways (commodities) to determine where to allocate resources and tailor strategies to best target risk. The development of methods to quantitatively assess how steps in production and pre-export practices reduce phytosanitary risks presents significant opportunity to build DAWR's risk profiling capacity, and tailor biosecurity risk management activities to target intervention within individual import pathways.

The exploration of a quantitative assessment model and a risk profiling case study will also be used to pro-actively drive development in DAWR's data holdings to underpin risk-based decision making. Development of this study will help ensure that the focus of further investment in data capture and curation is upon identifying the concrete problems that can be solved with new data or a new way of looking at data.

Project Summaries

Strengthening Surveillance

1606D: Quantifying evidence of a plant pest's absence

Plant health surveillance data collected from a variety of sources is used to substantiate a decision on a pest's status (e.g. presence, absence or incursion vs. intercept), which is captured in the Australian Plant Pest Status Database. Information records that report the absence of a pest are usually referred to as 'negative' surveillance data. Surveillance information (specific surveillance records, including absence information and surveillance information from third parties) could be used to determine a quantifiable level of confidence for the absence of a pest and be used to determine an acceptable 'threshold'.
A methodology to determine the level of confidence of a pest's status would inform the position underpinning market access requests and biosecurity decisions. Such an approach would also inform the need for enhanced surveillance information, and the nature and scope of additional information, for example, if the acceptable 'threshold' is not met.

Surveillance information is obtained from a variety of sources, including third party sources, such as general surveillance undertaken by farmers, scientists, tradespeople and representatives from conservation, Landcare and wildlife groups. However, the level of confidence in the outcome of information for each crop/pest surveyed is not always known and therefore may not be able to be used to support claims of area freedom or market access requests.

This project will explore alternative approaches and develop a methodology to quantify those negative surveillance data that are statistically valid for use as supportive information for specific applications. It will emphasise requirements that can be used routinely as the first step in statistically validating the establishment of pest free areas (ISPM 4) and the design of appropriate surveillance planning. The project will identify a uniform sampling strategy for collecting negative or absence data at different levels of confidence. It will also explore, as an outlook on future work, how the outputs of this statistical sampling and modelling may be combined with other relevant information such as biology, climate suitability etc. to design a framework for an effective and cost-efficient surveillance system.

Spatial Analysis

1606E: Scoping the value and performance of interventions across the NZ Biosecurity system

In order to increase the efficiency of biosecurity investment and to identify opportunities for substantial improvement, MPI needs to determine the contribution of each layer towards biosecurity effectiveness. Presently, there is no framework or process available to evaluate the value of biosecurity activities implemented at intersecting sites across the biosecurity system matrix. Without comparative 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 scope a high-level framework or approach that significantly improves 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 estimating the proportional value of biosecurity activities in one or more case studies, tentatively identified as fruit flies and brown marmorated stinkbug.

The project will seek to leverage the considerable lower level and more detailed information that is available within the MPI, such as interception, incursion and surveillance data, to help build feedback on system performance back into the higher-level risk return framework. A pilot analysis that explores any unrealised (to date) potential benefits of organism data collected across the biosecurity system (set within a valid scientific context in terms of limitations of the data) would help inform how we could better use such feedback loops in the end-to-end (i.e. pre-border to border to pest management) coverage of biosecurity regulation.

Building Scientific Capability

1607A: Value of Australia's biosecurity system

Australia's biosecurity system provides a substantial benefit to the Australian community by managing the risk of pests and diseases entering, establishing and spreading, causing harm to human, animal and plant health, the environment and the economy.

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 (FMD) 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.

A clear and sound evaluation will effectively communicate the importance of the investments made in the system across regulatory requirements, operational activities, information management and research. The project will be a first step in being able to systematically identify and address current and future weaknesses across the breadth of the system.

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

Building Scientific Capability

1607B: Health of Australia's biosecurity system

To assess the health of Australia's biosecurity system, DAWR needs to build on existing capability, and to develop new methods and processes it can use to articulate the health of the biosecurity system in clear terms, against specified benchmarks of acceptability.

DAWR currently relies on qualitative pathway specific risk analysis and reviews to assess and, if necessary, address potential unacceptable exposure to risk. Some work has been done collaboratively by government jurisdictions under the auspices of IGAB, such as stocktakes of biosecurity investment and targeted investigations to evaluate the effectiveness of resource allocations for surveillance and emergency response.

Clearly defined criteria and indicators, to be used as benchmarks to assess the health of the biosecurity system, including indicators of insufficient or excessive investment or regulation across the entire biosecurity system and for all categories of consequences (economic, environmental etc.), would enable DAWR to identify where improvements are needed based on sound evidence.

A review of 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 health of the biosecurity system.

Data and Information

1608A: Defensible resource allocation for plant health surveillance

DAWR plays a major role in surveying for early detection of high impact exotic pests along the biosecurity continuum (for instance pre-border surveillance is focused on near neighbours). Efficient and defensible allocation of increasingly scarce surveillance resources across all risk areas presents a significant challenge for DAWR.

This project is based on the requirements for allocation of resources across surveillance activities in high-risk locations along the continuum within a set budget. This project, therefore, seeks to address the issue of how to allocate resources across surveillance activities within a set budget (i.e. the portfolio investment approach) and to identify risk locations to allocate resources for specific surveillance (i.e.possible hotspots).

Application of this type of approach to plant health surveillance would be beneficial to ensure DAWR's investment in plant health surveillance activities across the continuum is cost-effective and provides the best return. However, the model, developed under preceding CEBRA projects and designed to forecast and map high risk areas of potential incursions of invasive plant pest species in Australia based on likelihood of their establishment and spread, is quite complex and there are significant data requirements. These prevent the routine use of the model, without further development, as in this proposed project. The project will finalise the model and investigate integration with the portfolio investment model wherever possible.

Data and Information

1608B: Decision support tools for vector (insect) spread animal diseases

A key component of managing emergency animal disease (EAD) incursions, and minimising their economic impact, is timely and effective decision-making in the face of uncertainty. This requires a good understanding of the potential transmission and control of EADs under Australian conditions. FMD is recognised as the single greatest disease threat to Australia's livestock industries (Matthews 2012), and DAWR has invested in the development of a new modelling capability, Australian Animal Disease model (AADIS), to support FMD preparedness and response. However, there is a range of other disease threats that Australia needs to be prepared for. In particular, arboviral diseases like bluetongue (BT) pose significant challenges due to the involvement of insect vectors that are free-ranging and strongly influenced by weather and landscape factors. BT is an economically important, trade sensitive disease of ruminants. The risk of an outbreak depends on vector competence (ability of the vector to support replication of the virus and then to transmit it to a suitable host), vector capacity (range of the vector, vector abundance, host preference, vector survival) and the availability of susceptible hosts.

Using BT as a case study, this project will modify an existing FMD simulation model to enable it to be used to study the spread and control of vector-borne diseases. The project will also provide some initial analyses of spatial spread and management approaches for controlling clinical BT outbreaks. Having a good understanding of the rate and extent of spread of vector-borne diseases, as well as the capacity to test control strategies, will help DAWR improve planning, policy development and response for these diseases.

Data and Information

1608D: Incorporating economic components in Australia's FMD modelling capability and evaluating post-outbreak management to support return to trade

Following an outbreak of FMD, surveillance will be required to demonstrate that infection has been eradicated from the population and enable any remaining movement restrictions to be lifted within the country. Proof of freedom will also be needed to satisfy trading partners and regain access to international markets.

Although vaccination is increasingly being recognised as an important tool to assist in containing and eradicating FMD outbreaks, it will make achieving recognition of free status more difficult. Keeping vaccinated animals in the population will delay the period until FMD-free status is regained under the World Organisation for Animal Health (OIE) guidelines and add additional complications to the post-outbreak surveillance program.

There is no agreed approach to post-outbreak management of vaccinated animals in the AUSVETPLAN with the options being to either allow vaccinated animals to remain in the population to live out their normal commercial lives (vaccinate-to-live) or remove all vaccinated animals from the population (vaccinate-and-remove). Under the second option, vaccinated animals could be subject to either slaughter to waste i.e. remove and dispose of vaccinated animals or slaughter and salvage i.e. attempt to sell either raw or processed product from vaccinated animals. For slaughter and salvage there may be some residual value of products that could offset some of the costs.

The project will bring together epidemiological and economic expertise from DAWR, the Australian National University, and CEBRA to formally explore and establish a science-based and cost effective approach to regaining free-status after an FMD outbreak as expeditiously as possible. The project will expand DAWR's modelling capability as well as providing insights into post-outbreak FMD management and contribute to Australia's FMD preparedness.

Project Summaries

Data and Information

1608E: Methodology to guide responses to marine pest incursions under the National Environmental Biosecurity Response Agreement

In the event of a nationally significant pest or disease outbreak in Australia, a Consultative Committee must make a set of recommendations to the National Biosecurity Management Group (NBMG) on the technical feasibility of eradication based on the benefits and cost of such a response. This action occurs under NEBRA. NEBRA includes a National Framework for Biosecurity Benefit: Cost Analysis (the framework). While the framework contains a detailed list of key requirements that a benefit-cost analysis (BCA) must address (see http://www.coag.gov.au/node/74), it does not contain a methodology or specific tools that would provide a uniform approach to performing a BCA.

When a nationally significant marine pest incursion occurs, the responsibility for undertaking the initial BCA falls upon the affected jurisdiction, where personnel experienced in developing BCAs or experienced in marine pest incursions may not be available. Tools that could be rapidly applied under emergency response circumstances are lacking, particularly for assessing non-market impacts and is thus likely to be a significant impediment to performing a timely and cost effective response to a marine pest incursion. This project aims to fill this gap in response capacity by producing a BCA methodology that would guide the evaluation of management options in the context of emergency responses to marine pest incursions.

The most significant benefit of this project will be increased capacity in jurisdictions to complete a BCA with a consistent format and content for a marine pest incursion in emergency response (time critical) circumstances. This, in turn, will enable the NBMG to more rapidly establish and implement a national biosecurity incident emergency response if deemed necessary.

Data and Information

1608F: Biosecurity response decision support framework

MPI has a framework and process for guiding decision making in response to new pest or disease incursions that may pose a risk to the economic, environmental, human health and socio-cultural values of New Zealand, regardless of the affected sector or size of the sector. In addition, a Response Prioritisation Tool is used for determining whether to initiate a response, which also guides investment decision making once a response is initiated. Decision makers use this process and prioritisation tool to support the decision analysis and conclusions about which response option to pursue.

What is currently missing is a consistent and transparent methodology that links the overarching framework, response prioritisation process, support tools and influence of other factors that come into play during biosecurity response decision-making and allocation of response effort.

This project will review the way in which MPI currently assesses pest and disease impacts to both market and non-market values, including MPI's actual investment into new pest and disease incursions across the entire biosecurity response portfolio. It will also investigate how to better link market and non-market values quantitatively or qualitatively for response prioritisation in an equable and transparent manner. An important part of the research will be investigating whether the investment in management of new incursions is commensurate with the risks posed.

The outputs from the project will 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 Government Industry Agreement arrangements.

Continuing Projects

The following project was approved in the 2015-2016 Work Plan, and has been approved to continue in 2016-2017.

1608C: Testing incentive-based drivers for importer compliance (continuation of CEBRA Project 1504C)

To maintain Australia's biosecurity status, DAWR uses various measures to reduce the risks of entry, establishment and spread of exotic pests and diseases to Australia that may threaten human, animal and plant health.

However, government intervention activities increase costs on import-supply chain participants, some of which are passed on to the Australian public through higher costs associated with imported products and, in some cases, limited access to certain goods.

With this in mind, and in accordance with a risk-based approach to biosecurity regulation, DAWR seeks to reduce the regulatory burden on individuals, businesses and community organisations. Recently, inspection rules that reward importers with a good compliance history were implemented. These rules have inherent incentive properties that can be harnessed to further reduce the risk of biosecurity risk material entering Australia.

This project is testing the development of inspection rules that:

- encourage voluntary action by participants to implement biosecurity risk management processes that reduce the likelihood of presence of biosecurity risk material in consignments
- reduce DAWR's intervention level
- reduce the regulatory burden for stakeholders with a strong track record of compliance
- improve DAWR's allocation of resources

This project will implement a field trial designed to test aspects of importer behaviour in response to these changed inspection protocols on two plant-product pathways: 'Peat and Peat Products' and 'Vegetable Seeds for Sowing'.

The expected benefits of this project extension are improved knowledge about implementing compliance-based inspection regimes and the cost savings for import supply-chain participants, including the Australian Government, that result from more effectively targeting inspection efforts.

Deliverables and Milestones Achieved

The following table details the Core Material that were produced in the financial year in review as a result of conducting the Core Activities, which Core Material will be submitted to the Commonwealth for endorsement in accordance with clause 3.9 of the Funding Agreement, and the current status of Core Material.

Table 2: Research Outputs – complete/terminated/in progress/in review

Project	ID	Output	Milestone Date	For Endorsement	Status
Strengthening Surveillance					
1606A	1	Preliminary (historical) data to CEBRA	August 2016	No	Complete
	2	Consultation with internal/external stakeholders regarding possible changes to confidence levels	September 2016	No	Terminated
	3	Observations of current sample sizes used by other countries	October 2016	No	Complete
	4	Conclude analysis of feasible sampling protocols	December 2016	No	Complete
	5	Draft recommendations for internal review	February 2017	No	Complete
	6	Presentation of results to industry groups	March 2017	No	Terminated
	7	Final Report	May 2017	Yes	In progress
1606B	1	DAWR and CEBRA to develop definitions and examples	September 2016	No	Complete
	2	CEBRA to scan available approaches and determine those that are most suitable	January 2017	No	Complete
	3	DAWR to review the suggested approaches prior to the commencement of Phase 2	February 2017	No	Complete
	4	CEBRA and DAWR to develop case studies to test the suggested approaches – Final Report	June 2017	Yes	Complete
1606C	1	Review of methodologies for risk rating importers and suppliers	November 2016	No	Terminated
	2	Workshop to identify appropriate case studies	November 2016	No	Complete
	3	Analyse case studies to estimate the utility of offshore control point information	June 2017	No	Complete
	4	Review data capture policy	June 2017	No	Complete
	5	Final Report	June 2017	Yes	In progress

Deliverables and Milestones Achieved

Project	ID	Output	Milestone Date	For Endorsement	Status
1606D	1	Project plan - preparation and discussions with key participants	July 2106	No	Complete
	2	Documented review of statistical approaches (Stage 1)	Oct/Nov 2016	No	Complete
	3	Development of a purpose-built methodology for statistical analysis to quantify evidence of plant pest absence to a level of confidence (Stage 2)	Jan/Feb 2017	No	Complete
	4	Testing statistical methodology (Stage 3)	March 2017	No	Complete
	5	Linking the methodology to support plant pest area freedom and surveillance strategies (Stage 4)	April 2017	No	Complete
	6	Draft Final Report	May 2017	No	Complete
	7	Final Report	June 2017	Yes	In progress
1606E	1	Formal scoping and project plan	Sep 2016	No	Complete
	2	Review of candidate frameworks and recommendation	Dec 2016	No	Complete
	3	Review and recommendation of candidate biota for case studies	Jan 2017	No	Complete
	4	Two case studies using the candidate framework/s	May 2017	No	In progress
	5	Recommendations concerning data	May 2017	No	In progress
	6	Final report	Jun 2017	Yes	In progress
Building Scientific Capabilities					
1607A	1	Scoping workshop (health and value)	July 2016	No	Complete
	2	Project Report on Scoping Workshop	August 2016	No	Complete
	3	Stocktake and review of relevant past research	October 2016	No	Complete
	4	Articulation, review, development and assessment of methods for measuring the value of the biosecurity system, with interim report	December 2016	No	Complete
	5	Case study completions and interim report	March-May 2017	No	Complete
	6	Draft Final Report	May 2016	No	Complete
	7	Final Report	June 2017	Yes	In progress

Deliverables and Milestones Achieved

Project	ID	Output	Milestone Date	For Endorsement	Status
1607B	1	Scoping workshop (health and value) and outcomes of workshop described in project plan	Jul 2016	No	Complete
	2	Stocktake and review of relevant past research and information resources with examples of program performance evaluations	August 2016	No	Complete
	3	Evaluation framework including criteria, indicators and methods for measuring the health of the biosecurity system, with interim report	December 2016	No	Complete
	4	Case study completions	March-June 2016	No	Terminated
	5	Final Report	June 2017	Yes	In progress
Data and Information					
1608A	1	Project preparation and meetings with key participants	August 2016	No	Complete
	2	Project workshop/meetings with DAWR, ABARES and stakeholders to finalise methods, discuss the best ways to approach the case study and confirm data needs and availability	August 2016	No	Complete
	3	Construction, calibration and testing of the portfolio allocation and spatial component models	August 2016 - March 2017	No	Complete
	4	Workshop presentation of main results, evaluation and refinement	April 2017	No	Complete
	5	Draft Final Report	May 2017	No	Complete
	6	Final Report	June 2017	Yes	In progress
1608B	1	Participant workshop: modelling scope and data needs	August 2016	No	Complete
	2	Modifications to AADIS to incorporate vector transmission	October 2016	No	Complete
	3	Model validation and verification studies	January 2017	No	Complete
	4	Model simulations completed for agreed range of BT outbreak scenarios	April 2017	No	Complete
	5	Data analysis and Draft Report	May 2017	No	Complete
	6	Final Report	June 2017	Yes	In progress
1608C	1	Test and assure platforms and training materials for field pilots with DAWR staff	August 2016	No	Complete
	2	Commence field pilots (after workshop)	August 2016	No	Complete
	3	Interim Report: Analysis of inspection data and process evaluation	March 2017	No	Complete
	4	Interview/survey of importers on actual behaviour change (if any) in response to the protocols	September 2016	No	Complete
	5	Workshop 2: Interim Results	April 2017	No	Complete
	6	End field pilots	November 2017	No	In progress
	7	Final Report: Field Evidence on Compliance Based Protocols and their Relevance to Biosecurity compliance	December 2017	Yes	In progress

Deliverables and Milestones Achieved

Project	ID	Output	Milestone Date	For Endorsement	Status
1608D	1	Workshop to decide on scenarios and confirm management approaches	August 2016	No	Complete
	2	Modifications to AADIS to incorporate post-outbreak management	September 2016	No	Complete
	3	Model simulations for agreed range of outbreak scenarios	October 2016	No	Complete
	4	Economic analysis	March 2017	No	Complete
	5	Draft Report	May 2017	No	Complete
	6	Final Report	June 2017	Yes	Under Review
1608E	1	Completed list of marine pest impacts, completed list of typical management (eradication and containment) costs	May 2017	No	Complete
	2	Methods to evaluate marine pest impacts and management costs	June 2017	No	In progress
	3	Workshop to explain impact and cost evaluation, and decision-making	August 2017	No	In progress
	4	Final Report	September 2017	Yes	In progress
1608F	1	Review of existing decision-making framework and processes	October 2016	No	Complete
	2	Review MPI's investment into new pest and disease incursions	February 2017	No	In progress
	3	Final Report	June 2017	Yes	In progress

Research & Develop Risk Methods

03 Impact and Adoption Activities

Summary of Core Activities

Research allows us to realise opportunities and meet the challenges associated with protecting our favourable biosecurity status and ensuring profitability, productivity, competitiveness and sustainability of Australia's rural industries and ultimately returns to our farmers, fishers and foresters.

The CEBRA research programme plays an important role in supporting our advancement of biosecurity risk management, through the provision of expertise in risk analysis techniques and the development of associated methods, protocols, tools and procedures.

The aim is to ensure the CEBRA research outcomes are effectively integrated into the biosecurity system and to meet the increasing demand for knowledge about strengthening our biosecurity system. Adoption impact has been reported on the following projects.

Data Mining

1301A: Data mining to improve biosecurity risk profiling

- This project is made up of a suite of case studies, which use data held by DAWR along with other government agencies to test and demonstrate the value of data mining for risk profiling.
- The project developed systems and protocols to analyse biosecurity data, with the aim of improving the effectiveness and efficiency with which incoming cargo, mail, people, and vessels are screened.
- The case studies included geospatial and pattern analysis, and data mining methods and determined how to incorporate these techniques in operational practices.
- Overall, the results of the completed case studies was positive. In each case, tools were able to develop statistically reliable models that produced operationally realistic predictions.
- However, access to data along with data quality issues limited CEBRA's ability to complete the analysis required, causing shortcomings in the outcomes achieved for each of the case studies.
- Two of the seven sub-projects were terminated (5 and 7) with agreement of the project sponsor. A summary of the final five with their outcomes:
    - Spatial analysis of international mail interceptions, including address delivery records to relate seizure risk in certain geographical areas with key demographic characteristics of those areas. Statistical analysis and maps of seizure data by census area were developed; avenues for further data analysis and profiling were recommended.
    - Generalised Pattern Analysis for International Passengers, used Department of Immigration and Border Protection (DIBP) traveller data alongside passenger non-compliance information to determine risk factors and the developed models, using these factors, to predict non-compliance. Shortcomings in the data used for analysis were discussed and opportunities for data sharing arrangements with DIBP and exploring the use of this data for profiling were recommended.
    - Detecting anomalous broker activity. No significant patterns were uncovered and, based on this study, there is very little evidence of brokers trying to 'game' the regulatory system.
    - Analysis of vessel inspection data to identify risk factors and predict inspection failure. Risk factors were identified and CEBRA's recommendation to improve data capture is addressed under the Maritime Arrivals Reporting System (MARS) project.

Development of performance indicators for CCV. The case study successfully developed CCV performance measures and CEBRA has made several recommendations for the department to enhance the measurement and reporting of these indicators, including improving access to ICS data. This project may be superseded by project 1501F on Import Clearance Performance Measurement.

Data Mining

1301A: Data mining to improve biosecurity risk profiling

- Challenges included:
    - Access to data. For example, the need to develop a MOU with another agency to access passenger information, resourcing (staff with required security clearance or data analyst skillset).
    - Limited data or poor data quality (e.g. lack of suitable data, unintended bias during data extraction, use of free-text fields).
- There is a need to develop DAWR's data collection and curation systems in relation to interception and operational data and improve access to other agencies data resources.
- The following project linkages may provide opportunities to achieve improved data collection and curation systems and progress any adopted recommendations:
    - Biosecurity Integrated Information System (White Paper Taskforce)
    - Travellers and Vessels 'Profile Automation' project
    - CEBRA project 1504F: Import Clearance Performance Measurement
    - MARS implementation

Where to from here

- CEBRA's final report and recommendations will have a technical and policy review by relevant stakeholders and SMEs in the department.
- The report will also be presented to the Compliance Division Management Committee in June for review.
- Final report and recommendations from each case study will be presented for decision/action by relevant business area within DAWR. Initial assessment of the recommendations indicates responsible areas will include colleagues in the Pathway Compliance Branch, Biosecurity Integrated Information System (White Paper Taskforce) and within Analysis and Intelligence.

Data Mining

1301B: Analytical assessment of endpoint surveys

- Endpoint surveys provide invaluable information about how the department is exercising its responsibilities, both in terms of using available intelligence, and carrying out its interventions.
- Data from endpoint survey samples are used to estimate the number of units in the total exiting population that are still carrying undetected actionable biosecurity material (ABM). These estimates are used to calculate cohort profiles and performance indicators, data products that are used to guide operational decisions at all levels about maximising ABM interception with the resources available.
- This project focused on the statistical and human elements of carrying out and analysing leakage surveys in airports and mail centres.
- CEBRA investigated the design, methods and execution of the endpoint surveys, and the techniques applied to survey data, through interviews with staff at mail facilities and airports, literature reviews, data analysis and simulation experiments.
- The study found that the general design of the survey is sound, but that several issues in its execution compromise the accuracy of the data collected, the credibility of the data products (profiles and KPIs), and the reputation of the survey process itself.
- The main issues in the survey design and execution are:
    - The target population and sampling frame are not clearly defined
    - Sample selections are biased
    - Inspected or partially inspected passenger baggage is not included in survey inspection
    - Inspection quality is inconsistent
    - Data are sometimes fabricated or censored
    - Not all physical processing streams are represented
- The final report makes a number of recommendations, including corrective actions to improve the accuracy and credibility of the survey data and data products.

Adoption of recommendations made by CEBRA

- A policy and technical review of the final report was completed by the Pathway Compliance Branch along with colleagues from ABARES and Biosecurity Policy and Response (completed May 2015).
- Analysis and Intelligence (A&I) met with Directors' from Travellers and Vessels, Cargo and Mail and Inspection Services Group (ISG) to agree on an adoption strategy for the recommendations.
    - Directors agreed the issues raised in CEBRA's report are worth noting and the majority of the recommendations are supported. However, adoption and implementation is currently hindered by the capacity and capability of the responsible business areas while completing higher priority work, such as legislation training relating to the Biosecurity Act 2015.
    - It was agreed that recommendations relating to reviewing and changing instructional material and training could not be addressed until current work on biosecurity legislation, including training and its implementation, are completed.
    - It was agreed a coordinated approach, embedding required changes in existing initiatives and divisional projects, would assist in progressively delivering on adopted recommendations.
- Related initiatives and projects include:
    - Import Clearance Performance Measurement (CEBRA Project 1501F)
    - ISG Competency Assessment project
    - Service Delivery Verification Framework
    - Travellers and Vessels 'Profile Automation' project
- A&I committed to addressing several of the report's recommendations, relating to data products, during the first quarter of 2016. These include improvements to the calculation of key performance indicators and cohort profiles. These changes have been implemented. Passenger and mail profiles have incorporated recommended changes, and the calculation of KPIs have been amended for the March 2016 quarter executive reports. Outstanding recommendations A&I had agreed to adopt, or assist pathway managers with, are dependent on the action taken for other recommendations and will form part of the broader project work outlined above.
- A&I will continue to track progress of recommendations with ISG and the Pathway Compliance Branch and provide updates to the CDMC on a three-monthly basis.

Data Mining

1401C/D: SAC - free-text mining

Define the problem

In the current SAC environment, Biosecurity officers manually assign the tariffs of the escalated entries to AIMS for departmental intervention. The manual process is tedious, time consuming and subject to human error thus biosecurity risks. It was estimated that user-entered level of accuracy was about 55%. Therefore DAWR in collaboration with CEBRA attempted to explore the possibility of automating the process with at least 80% accuracy. This project examined the feasibility of using a computer algorithm for automatic categorisation and assignment of tariffs to escalated SAC consignments.

Methods

Several tools were trialled, but RTextTools package (Random Forests) was found suitable and was employed to categorise the goods descriptions to their nearest probable tariffs. Thousands of SAC goods descriptions were provided to CEBRA. They trialled the algorithm with some level of success. The department provided 4000 'Gold Standard' data (goods descriptions and tariffs) which were 100% accurate because these data were manually checked and corrected by several officers. The algorithm was trained with 'Gold Standard' data before testing the original SAC goods descriptions.

Outcome

The algorithm achieved tariff classification accuracy of 53% against the expected level of 80%, while the user-entered level of accuracy was on average 55%. Distinct from the overall model accuracy, varied performance was observed for individual tariff codes. The three best performing tariff codes, 0902, KHAT and 3507, were correctly classified with accuracy levels of 90% or above. Each of these three tariff codes are focussed around clear key words (tea, khat and enzymes) which primarily feature in these tariffs. The BIOL tariff remains hard to predict, despite being the most common tariff code in the 'Gold Standard' training set it was only correctly predicted at an accuracy rate of 37.5%. This is likely due to the lack of distinct key words that feature in the majority of instances of this tariff. Considering the level of accuracy of the algorithm, the body of the work has been closed now.

Challenges and solutions

While the algorithm may not be immediately useful in the context of the complete automation of assigning tariff codes based on goods descriptions, there still exists the possibility to make use of the learnings from this project in other areas. The existence of free-text fields in the current IT systems has always presented a challenge to meaningful analysis and we may be able to modify the algorithm to allow some progress in this area.

1501F: Import Clearance Performance Measurement

- The purpose of the project is to identify comparable performance indicators that can be used for all the import pathways.
- The project consists of two phases:
  - The first phase had a review of existing performance indicators (BIC, PIC, NCE and hit rate) used for travellers and mail and the development of documents to define the intervention practices of each import pathway.
  - The second phase was the development of recommended performance indicators from Phase 1.
- The existing performance indicators were determined to be best practice and were chosen to be developed for all import pathways in Phase 2.
- Phase 2 is still in progress and when complete will roll into Phase 3, which is a DAWR project to develop the implementation plan. Phase 3 will consist of case studies for each of the pathways to determine how the performance indicators will be implemented i.e. the data requirements, changes to systems, changes to data collection etc.

Where to from here

- CEBRA's final report and recommendations are still being worked on and will have a technical and policy review by relevant stakeholders and SMEs in DAWR.
- Final report and recommendations will be presented for decision/action by the pathway owners within DAWR.
- The pathway owners will be consulted as part of Phase 3 and the work on the case studies for each pathway.

Challenges and solutions

- One of the key challenges has been in defining what compliance is in order to determine what is being measured. Travellers and mail have an existing definition that works for the current performance indicators. However, this may not be suitable for the new performance indicators in order for them to be comparable across the import pathways.
- The temporary solution was for Phase 2 to define the methodology to calculate the performance indicators. The Phase 3 case studies would go into more detail to define compliance and what will be measured by the performance indicators.

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1304C: Market-based incentives for biosecurity compliance

Project description

- This project was used to determine whether systems using CSP sampling methodology, in addition to known risk-return benefits, could serve as an incentive for importers to improve their rate of compliance with the biosecurity requirements. Under this project, a theoretical framework for the design and testing of intervention protocols was developed to encourage import-supply chain participants to act in a manner consistent with the government's biosecurity objectives. The project drew on insight from microeconomic theory and involved data analysis as well as stakeholder interviews to identify key factors that were likely to influence how importers behave in response to changes in system rules.
- This project has led to CEBRA projects 1404C and 1504C evolving, which further test incentive mechanisms identified in this project.

Issues

- The Privacy Act has prevented DAWR from providing import data containing personal information (including some importer and supplier names) to CEBRA researchers.

Uses/Adoption to date

- The concept and methodology developed from this project has been used to inform the design of projects 1404C and 1504C and verify whether the predicted importer behavioural changes to inspection rules are observed in both an experimental laboratory setting and under field conditions.

Planned uses

- Following the completion of projects 1404C and 1504C, it is anticipated that the results will inform refinements to the design and communication of CBIS, and will allow the department to more accurately anticipate risk outcomes when assessing commodity suitability for the CBIS.
- A report on this project has been made publically available and provides an opportunity for external stakeholders to get involved.

Barriers/next steps

- DAWR's current ICT systems that are used to capture and report import data were not designed with analytical capabilities in mind. This restricts the use of data in numerous ways, including limiting the degree to which imported commodities can be identified, manipulation of data and has prevented the accurate recording of inspection failures.
- The current system also recognises commodities by Customs tariff codes which are often too broad to categorise commodities to a suitable level relevant for biosecurity purposes (eg. fresh vs dried dates, tariff recognises 'dates'). This restriction affects the analysis and accuracy of the results on many import pathways and limits DAWR's ability to recognise and easily apply the Compliance-Based Inspection methodology to commodities.

1404C: Testing incentive-based inspection protocols (lab trial)

Project description

- Drawing on behavioural economics, this project explored how compliance based inspection systems may influence regularity compliance. The project used a computer simulated laboratory experiment to test how people would respond to changes in ICT system rules and identify how a systems design can be optimised to encourage people to improve their regulatory compliance with the biosecurity conditions.
- The project involved designing, implementing, and analysing the results from economics experiments that sought to mimic the interactions between DAWR and importers relating to biosecurity inspections.

Issues

- Numerous assumptions were (necessarily) applied to this experiment which may not have reflected the actual import environment. The university students used as test subjects may not have had the appropriate biosecurity background.
- Participants were required to complete a post-experiment questionnaire. Results show that some participants were not clear about difference between the two algorithms tested in the experiment. This would negatively impact accuracy of the finding regarding the two algorithms.

Uses/Adoption to date

- This project found that providing full information about system rules and offering targeted feedback on performance is likely to support the regulatory objective.
- This finding has led to the roll out of 1504C, which is designed to verify the conclusion under a field environment.

Planned uses

- The project built a framework for using a computer simulation laboratory to mimic biosecurity regulatory activities.
- Observations from this project will potentially have broad applications across the entire biosecurity system.

Barriers/next steps

- Nil.

1504C/1608C: Testing incentive-based inspection protocols (field trial)

Project description

- This project aims to test if the import-chain participant's behaviour changes in response to incentives around intervention protocols which were predicted in 1304C (theoretical framework) and observed in 1404C (computer simulation experiment) and gauge whether the behaviour will carry over under a field environment.
- The trial involves applying the Compliance-Based Inspection Scheme (CBIS) on two new plant import pathways, peat and a selection of permitted vegetable seeds for sowing purposes. Importers behavioural responses to the trial will be assessed using both quantitative (data analysis) and qualitative (stakeholder interviews) methods.
- Under the trial, importers will be provided with regular feedback on their imports performance which will assist clients to recognise patterns of their own compliance. This will enable DAWR to test whether information can influence the effectiveness of CBIS operating as an incentive mechanism.

Issues

- The trial cannot be run under the current CBIS operating system in AIMS because neither peat nor permitted vegetable seeds have a unique tariff code, so a new 'commodity code' field is required to identify in-scope entries. Due to the difficulty and timeliness of obtaining the required IT upgrades to support the AIMS q-ruler recognising the 'commodity code' field, a Hyperion dashboard has been developed to apply the CBIS rules for this trial. The work around solution requires an additional manual processing step from document assessment officers which adds time to the documentation assessment process and provides greater scope for human error.

Uses/Adoption to date

- The trial commenced on 29 August 2016 and will run for approximately 15 months.

Planned uses

- Output from the project will be used to improve the effectiveness of CBIS by measuring importers' behaviour patterns and applying potential incentive based strategies when developing, designing, communicating, and improving CBIS projects in the future.
- This project will inform the roll out of incentive based approaches and identify other suitable pathways.

Barriers/next steps

- It is not feasible to continue to use the commodity code and a Hyperion dashboard for operational purposes beyond the trial without further enhancements to AIMS. Plant Import Operations has lodged a request to upgrade the AIMS q-ruler to overcome this problem.

1608C: Incentives for Importer Choices (continuing project)

There are intangible and tangible impacts and some activities could be seen as adoption:

Information sharing and feedback

- More information is now being provided to stakeholders about the CSP-3 sampling algorithm.
- Increased feedback on inspection performance is being made available to importers. The template for feedback used in the trial is now being used on fresh lemons and limes from the US.
- Recognition of the value of feedback also shows itself through the use of feedback to the Mexican NPPO/Competent Authority about the pest loads coming in on asparagus.
- Industry bodies can be an ally to help with communication.

Outcomes

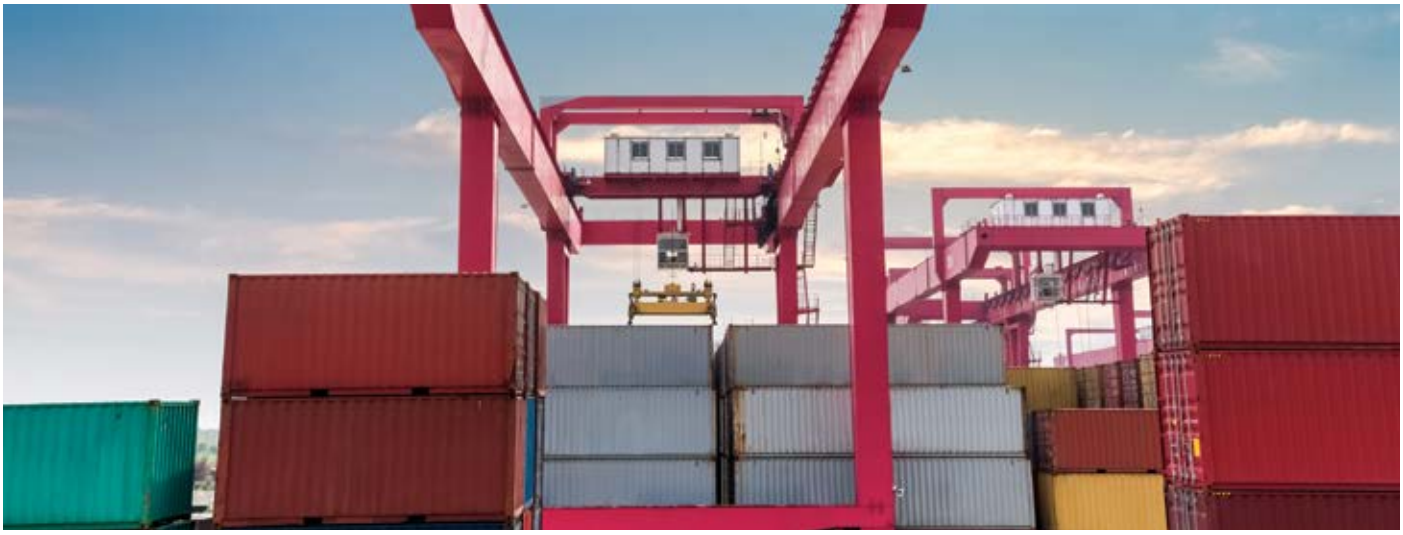
- CSP-1 is being trialled on two plant-based products.
- Two pathways (durians and saffron) have recently been placed on CSP-1.
- 1304C discussed the notion of equivalence in biosecurity standards. In cases where industry based standards already exist, industry bodies or individual businesses in the import supply chain could be encouraged to submit these to DAWR for consideration of equivalence. Leveraging off certification agreements is now being considered and investigated.
- The suite of Carrots and Sticks projects have introduced the idea of interviewing stakeholders as a way of gaining useful information about pathways and stakeholders.
- Staff were also exposed to the use of economic experiments, although these have not been used by any other DAWR staff.
- Use of AQIS commodity code was demonstrated in 1608C and will be used on some of the marine-products pathways as a result of the project.
- In a significant change (almost a cultural change) in thinking about rules and their implementation, we now see other projects leveraging off the Carrots and Sticks work to investigate behaviour of stakeholders in the inspection-rule setting e.g 170602 and 170608.
- Carrots and Sticks is being noticed overseas. For example, NAPPO requested that the Carrots and Sticks work be presented. Clearly we are ahead of the NAPPO countries in explicitly dealing with designing rules to harness incentives inherent in the pathway.

Challenges

- We have learnt about various implementation issues through the field trial process. These include issues with data.

Next Steps

- These outcomes and impacts will be discussed when the Carrots and Sticks projects are presented in a DAWR seminar on 15th September 2017.



1402B: Tools for invasive species distribution modelling for surveillance

Project Description

- The objective of the project was to review approaches to habitat suitability modelling and develop structured guidelines and protocols for identifying the most appropriate tools and approaches for developing models to predict the potential distribution of plant pest species of biosecurity concern. This would help identify 'hotspots' for pest entry and establishment, and inform early detection surveillance activities.
- This project arose from the need to develop a structured approach to spatially mapping high risk areas for entry and establishment of new plant pests as there is no single, best approach for DAWR to identify these areas for making informed decisions to support cost effective, risk-based surveillance.

Method

- The project reviewed the available environmental data and explored the information in the literature for defining proximal variables which are best predictors of potential distribution of an organism. Annual mean temperature, annual precipitation, and soil temperature are the few proximal variables reviewed.
- Based on this review the project explored possible approaches to developing predictive distribution models. The use of climate envelopes was considered as probability based predictions on individual variables were unreliable.
- The project developed statistical methods to identify proximal variables which best predict the distribution of five pests at their native ranges i.e. Fire ant (Solenopsis invicta), Asian gypsy moth (Lymantria dispar), Oriental fruit fly (Bactrocera dorsalis), myrtle rust (Puccinia psidii), and cane toads (Rhinella marina).
- Simulation analysis and real data were used to explore the projection of identified proximal variables, and hence potential pest distribution, into new domains in Australia.

Outcomes

- The project identified a lack of explicit and unambiguous information about proximal variables in the scientific literature. There is no accepted position about which proximal variables will consistently predict pest distribution accurately in new locations.
- It may be possible to identify predictive proximal variables for distribution of species which are well studied by competent physiologists but not for less known species.
- Some variables could be strongly predictive in the native range but weakly predictive when projected to new locations, indicating a fundamental limitation in the ability to accurately perform these projections.
- Application and analysis of the modelling approaches used across the five case studies indicated that no single approach made consistent and reliable predictions. While some analysis choices may be worse than others there was no general automated approach that could be recommended in all circumstances.
- Fire ants —The approaches used were unable to accurately predict the distribution of fire ants in the native range in South America or in the invaded distribution in the south-eastern United States. Projection of their distribution in cool moist mountainous regions of Tasmania was misleading.
- Cane toads —The best fitting cane toad generalised additive model (GAM) performed particularly poorly when projected to Australia.
- Myrtyle rust — Model predictions for the Australian distribution of myrtle rust was not well matched with observed occurrences with omission of a high proportion of known Australian occurrences.
- Fruit fly and gypsy moth —Some models predicted reasonable projections for the Australian distribution of the Oriental fruit fly and gypsy moth as they are aligned with host availability and climate suitability.
- The outcomes highlight the challenges of predicting species distributions to new environments based on limited environmental data. The variables that are widely available to modellers are often coarse. Many models appear to fit due to the spatial nature of environmental variables, but the projections of these are often unreliable.
- Poor predictions may be attributed to poor data quality, biotic interactions in confounding environmental patterns (i.e. presence/absence of predators/competitors) and the different statistical relationships between distribution and environmental variables in the native and invaded range.
- While there are major challenges in assessing the predictive performance of models in new locations, these models are still useful to analyse the distribution of the species in their native range and for some, in new locations.
- A protocol for predicting the potential distribution of plant pest species of biosecurity concern was developed based on the analysis. The

protocol reflects the inherent uncertainty highlighted in the analysis. The protocol empirically identified proximal variables that were strongly predictive.

- The protocol recommends:
    - if detailed, well-supported physiological information exists, it should be used to make projections
    - if detailed physiological information does not exist, expert-based assessment of variables is necessary to identify possible proximal sets of variables by considering the correlative evidence from the native range
    - uncertainty about possible proximal variables should be identified in the analysis and carried forward to the decision phase
    - the observed distribution data in the native range and each set of variables should be used to construct alpha hulls if the number of variables is 3 or less
    - fewer variables will more likely overestimate the potential distribution (predict over larger areas in the invaded range). A large number of variables, particularly if these are chosen based on availability rather than physiology should not be used as they result in over-fitting
    - extrapolation into regions with novel climates, in the sense that the climate does not exist in the native range, should also be considered carefully and climate envelopes should be used rather than probability methods when projecting proximal variables to new locations
- With limited success in attempting to identify and use proximal predictors for the empirical construction of better species distribution models (SDMs), it was suggested better SDMs might be produced using expert knowledge of biophysical constraints on the pest, perhaps derived from controlled studies or extrapolated from meta-studies with related species. Any requirement for expert opinion implies the need for consensus across different experts, for any robust application.

Challenges

- A reliable species distribution model helps DAWR to:
    - estimate the possible extent of an incursion which will help plan incursion responses including cost estimations
    - assist in prioritising where surveillance effort should be focused to maximise the likelihood of early detection.
- Though the project provided valuable insight to the subject, the protocols and proximal variables need to be further defined for adoption of project outcomes.
- Further study needs to be undertaken before deciding if significant improvements to species distribution models used for biosecurity application are possible or not.
- It is necessary to determine ways of incorporating the results of this project into decision-making processes within DAWR. Exploring approaches to statistical parameter estimation for simple models could also be considered.
- The 2016-17 CEBRA project on 'Defensible resource allocation for plant health surveillance' will generate simple geospatial maps on high-risk areas using the model developed in this project to focus surveillance resource on areas that have the highest potential for early detection.

Spatial Analysis

1502E: Risk maps for optimising biosecurity surveillance

Project description

- Develop a spatially explicit Bayesian Network approach to allocate surveillance effort based on risk and a pathway map. While empirical data is available to support an assessment of some risk factors expert elicitation will be required to quantify risks where formal data is not available. The model will be implemented in a geospatial environment. The overall aim will be to identify levels of risk along pathways into any country, including Australia and New Zealand and designated high-risk sites where surveillance is more likely to detect invasive organisms.

Outcome

- The New Zealand forest industry will use the model to plan their annual surveillance programme. Following a recent pilot project, it is planned that the rollout of the full system will commence August 2017.
- MPI will also be using the model to update risk mapping for its High Risk Site Surveillance programme for the 2017-18 season. Season planning starts in May with full rollout of fieldwork in September.
- MPI and the NZ forest industry are very happy with the output of the project and we look forward to any future collaborations.

1305B: Plant-product pathways and the Continuous Sampling Plan (CSP)

Project description

- Following DAWR's adoption of CSP methodology to target border inspections for certain low risk plant product pathways under the Compliance Based Inspection Scheme (CBIS), this project aimed to improve the efficiency and effectiveness of systems, tools and processes to enable effective monitoring of CBIS pathways and to facilitate the expansion of CBIS.
- The project had 5 deliverables including:
    - developing a new code for CBIS simulation
    - exploring whether CSP methodology would be appropriate for managing high risk import pathways
    - developing methods to monitor CBIS performance
    - nominating confidence intervals for CBIS simulation
    - providing advice on data capture for monitoring CBIS performance.

Issues

- The project identified gaps in the way AIMS captures data relating to the CSP rules applied and in the method of monitoring CBIS performance.

Uses/Adoption to date

- Under this project a new R code was developed, which significantly improves ABARES capacity to undertake simulation analysis of the biosecurity risks associated with CBIS commodities. This allows new commodities suitable for CBIS to be rapidly analysed and as a result seven additional commodities have been added to the scheme.

Planned uses

- The new R code will continue to be used to simulate biosecurity risks associated with additional plant, and potentially some non-plant related import pathways.
- The project developed a framework for determining the pattern of failures on high risk plant import pathways, which will be used to analyse and review import conditions.

Barriers/next steps

- A majority of import pathways have no defined pest list so there is an inability to define the level of biosecurity risk posed by a pest group or species on a pathway, making it difficult to analyse and reflect different levels of risk posed by different pests.
- Further insight into inspection failures on high-risk pathways is difficult to determine due to unreliable data and a lack of information being captured at the consignment level. The linkage between AIMS, Incidents data and the historical data recorded for a given commodity is poor and does not provide a clear picture of a commodities import history.

Graduate Students

CEBRA continues to make substantial investments in postgraduate research training to 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: Graduate Students

Student	Title	Supervisor
Current PhD Students		
Victoria Hemming	PhD: Selection of experts for judgement using test questions	Prof Mark Burgman
Stuart Jones	PhD: Numerical methods for biosecurity risk analysis	Prof Mark Burgman
Matthew Malishev	PhD: Feeding ecology and behavior	Prof Mark Burgman
Lucy Rose	PhD: Managing Melbourne water for biodiversity	Prof Mark Burgman
Decky Junaedi	PhD: Trait-based approach of the management of invasive exotic species from botanic gardens in the tropical ecosystem	Prof Mark Burgman
Robert Owen	PhD: The Effect of Varroa on Australian Beekeepers	Prof Tom Kompas
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		
Indriati Bisono	PhD: Modelling spatial extremes	Assoc Prof Andrew Robinson

Institutional Contracts and Consultancies

The work of CEBRA provides our people experience in conducting robust scientific research, analysis, and expert advice on national Biosecurity issues, including importantly their focus on practical, policy-relevant research outcomes. This has resulted in the following institutional contracts and consultancies being awarded.

Table 4: Institutional Contracts and Consultancies

Client	Year	Project	Amount	Investigators
Border Management Division, Department of Immigration and Border Protection	2016-2017	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)	2016-2018	DP160100745 Maximising the benefits of emerging technologies for ecological survey	A$350,600	Prof Mark Burgman Assoc Prof Andrew Robinson Adjunct Prof Andrew (Sandy) Liebhold Dr Joslin Moore
Department of Environment, Water and Planning (DELWP)	2017	Report on electricity and gas network safety performance data integrity and analysis	A$32,742	Assoc Prof Andrew Robinson
Department of Agriculture and Water Resources (DAWR)	2017	QUADS Workshop	A$50,000	Assoc Prof Andrew Robinson
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	US$6,815,969	Prof Mark Burgman Assoc Prof Tim van Gelder Assoc Prof Richard de Rozario Dr Fiona Fidler

Document & Communicate Findings

04 Publications

The challenge of bridging the communication divide between researchers and policy makers is real. At CEBRA we are focused on ensuring that the work we do is understood and able to be implemented in practice. One way we do this is by publishing our work in a range of scientific journals.

CEBRA Publications with ISI Impact Factor and Citations

Table 5: Publications table

	ISI Impact Factor 2016	No. of Citations as at 30/6/17
IN PRESS/EARLY VIEW		
Kompas, T., Van Ha, P., Nguyen, H.T.M., East, I., Roche, S., Garner, G. (2017 in press) 'Optimal Surveillance against Foot-and-Mouth Disease: The Case of Bulk Milk Testing in Australia'. **Australian Journal of Agricultural and Resource Economics.**	1.44	1
Van Ha, P., Kompas, T., Nguyen, H. T. M., & Long, C. H. (2017). Building a better trade model to determine local effects: A regional and intertemporal GTAP model. **Economic Modelling**. In press	1.573	0
2017		
Camac, J.S., Williams, R.J., Wahren, C., Hoffman, A.A & Vesk, P.A. (2017) Climatic warming strengthens a positive feedback between alpine shrubs and fire. **Global Change Biology.** DOI: 10.1111/gcb.13614	9.455	1
Capes, H., Maillardet, R.J., Baker, T.G., Weston, C.J., McGuire, D., Dumbrell, I.G., and Robinson, A.P.. 2017. The Allometric Quarter-Power Scaling Model and Its Applicability to Grand Fir and Eucalyptus Trees. **Journal of Agricultural, Biological, and Environmental Statistics**, early release online. DOI: 10.1007/s13253-017-0292-7	0.99	1
Clarke, S., Hollings, T., Liu, N., Hood, G. & Robinson, A. (2017) Biosecurity risk factors presented by intrnational vessels: a statistical analysis. **Biological Invasions**, June 2017 DOI: 10.1007/s10530-017-1486-1	2.837	0
Decrouez, G., and Robinson, A.P. (2017). Bias-Corrected Estimation in Continuous Sampling Plans. **Risk Analysis**, early release online. DOI: 10.1111/risa.12811	2.857	0
Dodd, A. J., Ainsworth, N., Hauser, C. E., Burgman, M. A., & McCarthy, M. A. Prioritizing plant eradication targets by re-framing the project prioritization protocol (PPP) for use in biosecurity applications. **Biological Invasions**. Mar 2017. Volume 19 (3), pp 859–873.DOI 10.1007/s10530-016-1335-7	2.837	0
Elith, J. & Franklin, J. (2017) Species distribution modeling. Reference Module in Life Sciences. Elsevier.	n/a	n/a
Fraser, F., Soanes, K., Jones, S.A., Jones, C.S. & Malishev, M. (2017) The value of virtual conferencing for ecology and conservation. **Conservation Biology**. 31 (3) pg 540 - 543	5.092	2
Grafton, R.Q., Kompas, T. and Long, N.V. (2017 early view) A Brave New World? Kantian-Nashian Interaction and the Dynamics of Global Climate Change Mitigation. **European Economic Review** http://dx.doi.org/10.1016/j.euroecorev.2017.04.002	1.82	0
Hauser, C.E., Rout, T.M., McCarthy, M.A. & Moore, J.L. (2017) Adaptive management improves decisions about where to search for invasive species. **Biological Conservation** 212: 249-255. https://doi.org/10.1016/j.biocon.2017.04.009	4.546	0
Hester, S.M and Cacho, O.J. (2017). The contribution of community surveillance to invasive species management. **Biological Invasions**, 19(3): 737-748.	2.837	2
Hester, S.M, Hauser, C.E. and Kean, J.M. 'Tools for designing and evaluating post-border surveillance systems', Chapter 2 in Robinson, A. P., Walshe, T., Burgman, M. A. and Nunn M. (eds), *Methods for invasive species risk analysis and management*, Cambridge University Press.	n/a	n/a
Kompas, T., Nhu Che, T., Van Ha, P., Chu,L. (2017), 'Cost–Benefit Analysis for Biosecurity Decisions', in Methods for Invasive Species Risk Analysis and Management, Andrew Robinson, Mark Burgman, Terry Walshe and Mike Nunn (eds.), Cambridge: **Cambridge University Press**	n/a	n/a

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2017		
Landers, S., Hely, A., Harrison, B., Maister, N., Hely, R., Lane, S. E., ... Page, R. S. (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**, 7(5), e014266. https://doi.org/10.1136/bmjopen-2016-014266	2.735	0
Mata, L., Garrad, G. E., Kutt, A., Wintle, B. C., Chee, Y. E., Backstrom, A., Bainbridge, B., Urlus, J., Brown, G., Tolsma, A., Yen, A., New, T. and Bekessy, S. (2017) Eliciting and integrating expert knowledge to assess the viability of the critically endangered golden sun-moth Synemon plana. **Austral Ecology. Volume 42, Issue 3 297-308**	1.832	0
McNeill, M.R., Phillips, C.B., Robinson, A.R., 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** 32: 65-88. https://doi.org/10.3897/neobiota.32.9784	n/a	2
Morán-Ordóñez, A., Lahoz-Monfort, J.J., Elith, J. & Wintle, B.A. (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** Issue online 8 Feb 2017doi:10.1111/geb.12545.	7.53	2
Nguyen, H. T. M., Kompas, T., Breusch, T., & Ward, M. B. (2017). Language, mixed communes and infrastructure: Sources of inequality and ethnic minorities in Vietnam.**World Development**	1.48	6
Owen, R. (2017) Role of Human Action in the Spread of Honey Bee (Hymenoptera: Apidae) Pathogens. **Journal of Economic Entomology**. doi.org/10.1093/jee/tox075	1.824	0
Roberts, D.W., Bahn, V., Ciuti, S., Boyce, M.S., Elith, J., Guillera-Arroita, G., Hauenstein, S., Lahoz-Monfort, J.J., Schroder, B., Thuiller, W., Warton, D., Wintle, B.A., Hartig, F. & Dormann, C.F. (2017) Cross-validation strategies for data with temporal, spatial, hierarchical, or phylogenetic structure. **Ecography**. DOI 10.1111/ecog.02881	5.366	2
Robinson, A., Walshe, T., Burgman, M. & Nunn, M. (2017) Invasive Species: Risk Assessment and Management. *Cambrige University Press*	n/a	0
Rossiter, A., & Hester, S. M. (2017). Designing Biosecurity Inspection Regimes to Account for Stakeholder Incentives: An Inspection Game Approach. **Economic Record**.DOI: 10.1111/1475-4932.12315.	1.177	0
Sperfeld, E., Wagner, N., Halvorson, H.M., Malishev, M. & Raubenheimer, D. (2017) Bridging ecological stoichiometry and nutritional geometry with homeostasis concepts and integrative models of organism nutrition. **Functional Ecology**. 31: 286-296	5.819	4
2016		
Chee, Y. E., Wilkinson, L., Nicholson, A. E., Quintana-Ascencio, P. F., Fauth, J. E., Hall, D., Ponzio, K. J. and Rumpff, L. (2016) Modelling spatial and temporal changes with GIS and Spatial and Dynamic Bayesian Networks. **Environmental Modelling & Software**, 82, pp. 108-120.	4.979	5
Cherry,H., Constantine, A., Primrose ,K., Hauser , C., Tasker, K. (2016) *"It takes a village: detection dogs, partnerships and volunteers aid hawkweed eradication in mainland Australia."* In Proceedings of the 20th Australasian Weeds Conference, eds R. Randall, S. Lloyd and C. Borger. 201. pp.164-170	n/a	2
Constantine, A., Hauser C. E., Primrose, K., Smith, N. (2016) Hawkweed (Hieracium spp.) surveillance: development of a targeted and robust plan for the Victorian Alps **Plant Protection Quarterly** Vol.31(1), pp. 28-32.	0.19	2
Decrouez, G, and Robinson, A.P. (2016). Measuring the inspectorate: point and interval estimates for performance indicators. **Journal of Agricultural, Biological, and Environmental Statistics**. 21: 382 - 401	0.99	0
East, I.J., Martin, P.A.J., Langstaff, R.M., Iglesias, R.M., Sergeant, E.S.G. and Garner, M.G. (2016) Assessing the delay to detection and the size of the outbreak at the time of detection of incursions of foot and mouth disease in Australia. **Preventive Veterinary Medicine** 123: 1 - 11	2.336	3
Elith, J. (2016) Box 2.3: Species Distribution Models. Detecting and responding to alien plant incursions (ed. by J.R. Wilson, F.D. Panetta and C. Lindgren), p. 266. **Cambridge University Press**, UK.	n/a	8
Elith, J. (2016) Chapter 6: Predicting distributions of invasive species. arXiv: http://arxiv.org/abs/1312.0851. Risk-based decisions for biological threats (ed. by T.R. Walshe, A. Robinson, M. Nunn and M.A. Burgman). **Cambridge University Press**.	n/a	17

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2016		
Garner, M.G., East, I.J., Stevenson, M.A., Sanson, R.L., Rawdon, T.G., Bradhurst, R.A., Roche, S.E., Van Ha, P. and Kompas, T., (2016). Early decision indicators for foot-and-mouth disease outbreaks in non-endemic countries. **Frontiers in Veterinary Science**, **3.109**, doi:10.3389/fvets.2016.00109	n/a	0
Garner, M. G., East, I. J., Kompas, T., Van Ha, P., Roche, S. E., and Nguyen, H. T. M (2016), 'Comparison of Alternatives to Passive Surveillance to Detect Foot and Mouth Disease Incursions in Victoria, Australia', **Preventive Veterinary Medicine**, 128, 78–86.	2.336	0
Garrard, G. E., Fidler, F., Wintle, B. C., Chee, Y. E. and Bekessy, S. A. (2016) Beyond advocacy: making space for conservation scientists in public debate. **Conservation Letters**, 9(3), pp. 208-212.	7.316	3
Hanea, A.M., McBride, M.F., Burgman, M.A. & Wintle, B.C. (2016), Classical Meets Modern in the IDEA Protocol for Structured Expert Judgement, **Journal of Risk Research**, Aug 2016: 1-17	1.584	1
Hanea, A.M., McBride, M.F, Burgman, M.A., Wintle, B.C, Fidler, F., Flander, L., Twardy, C.R, Manning, B. & Mascaro, S. (2016), Investigate Discuss Estimate Aggregate for structured expert judgement, **International Journal of Forecasting**	2.837	4
Hauser, C. E., Weiss, J., Guillera-Arroita, G., McCarthy, M. A., Giljohann, K. M., Moore J. L. (2016). Designing detection experiments: three more case studies. **In Proceedings of the 20th Australasian Weeds Conference. pp.171-178**	n/a	2
Hollings, T., M. Jones, N. Mooney, and H. I. McCallum. (2016). Disease-induced decline of an apex predator drives invasive dominated states and threatens biodiversity. **Ecology**. 97(2): 394-405	5.768	6
Jordan, H., Dunt, D., Hollingsworth, B., Firestone, S.M. and Burgman, M. (2016). Costing the morbidity and mortality consequences of zoonoses using health adjusted life years. **Transboundary and Emerging Diseases** Online Sept 2016	3.035	1
Kompas, T., Chu, L. and Nguyen, T. M. (2016) A practical optimal surveillance policy for Invasive Weeds: An application to Hawkweed in Australia. **Ecological Economics** 130: 156-165	4.055	1
Kompas, T., Nhu Che, T. (2016), 'A Structural and Stochastic Optimal Model for Projections of LNG Imports and Exports in Asia-Pacific', **Heliyon,** 2, e00108.	n/a	0
Kompas, T., (2016). Comment 2 on 'Natural resource management'by Pannell, Doole and Cheung. **Australian Journal of Agricultural and Resource Economics**, 60(4), pp.670-671.	1.75	0
Morán-Ordóñez, A., Lahoz-Monfort, J.J., Elith, J. & Wintle, B.A. (2016) Evaluating 318 continental-scale species distribution models over a 60-year prediction horizon: what factors influence the reliability of predictions? **Global Ecology and Biogeography** doi:10.1111/geb.12545.	7.53	2
Parker, T. H., Forstmeier, W., Koricheva, J., Fidler, F., Hadfield, J., Chee, Y. E., Kelly, C., Gurevitch, J. and Nakagawa, S. (2016) Transparency in ecology and evolution: real problems, real solutions. **Trends in Ecology & Evolution**. DOI: http://dx.doi.org/10.1016/j.tree.2016.07.002	18.35	18
Read, C.F., Elith, J. & Vesk, P.A. (2016) Testing a model of biological soil crust succession. **Journal of Vegetation Science**, 27, 176-186.	3.574	4
Roberts, D.W., Bahn, V., Ciuti, S., Boyce, M.S., Elith, J., Guillera-Arroita, G., Hauenstein, S., Lahoz-Monfort, J.J., Schroder, B., Thuiller, W., Warton, D., Wintle, B.A., Hartig, F. & Dormann, C.F. (2016) Cross-validation strategies for data with temporal, spatial, hierarchical, or phylogenetic structure. **Ecography**. DOI 10.1111/ecog.02881	5.366	2
Robinson, A.P., McLarin, M., and Moss, I. (2016). A simple way to incorporate uncertainty and risk into forest harvest scheduling. **Forest Ecology and Management**, 359:11–18.	3.387	2
Rose, L., Heard, G. W., Chee, Y. E. and Wintle, B. (2016) Cost-effective conservation of an endangered frog under uncertainty. **Conservation Biology**, 30(2), pp. 350-361.	5.092	4
Spring, D., Croft, L., & Kompas, T.(2016). Look before you treat: increasing the cost effectiveness of eradication programs with aerial surveillance. **Biological Invasions**, Vol 19 (2) pp 1-15.	2.837	2
Snäll, T., Lehtomäki, J., Arponen, A., Elith, J. & Moilanen, A. (2016) Green Infrastructure Design Based on Spatial Conservation Prioritization and Modeling of Biodiversity Features and Ecosystem Services. **Environmental Management**, 57, 251-256.	2.206	20
Mills, M., Nicol, S., Wells, J,A., Lahoz-Monfort, J.J., Wintle, B., Bode, M., Wardrop, M., Walshe, T., Probert, W.J.M., Runge, M.C., Possingham, H.P. and McDonald Madden, E. (2014) Minimizing the cost of keeping options open for conservation in a changing climate. Conservation Biology. 28: 646 – 653.	4.267	

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2016		
Sperfeld, E., Halvorson, H.M., Malishev, M., Clissold, F. & Wagner, N.D. (2016) Woodstoich III: Integrating tools of Nutritional Geometry and Ecological Stoichiometry to advance element budgeting and the prediction of consumer-driven nutrient recycling. **Oikos** 125: 1539-1553	4.03	4
Van Ha, P., and Kompas, T. (2016) Solving intertemporal CGE models in parallel using a Singly Bordered Block Diagonal ordering technique. **Economic Modelling**	1.573	2
Van Ha, P., Kompas, T., Nguyen, H. T. M., & Long, C. H. (2016). Building a better trade model to determine local effects: A regional and intertemporal GTAP model. **Economic Modelling**. DOI: 10.1016/j.econmod.2016.10.015	1.573	0
2015		
Adams-Hosking, C., McBride, M.F., Baxter, G., Burgman, M., de Villiers, D., Kavanagh, R., Lawler, I., Lunney, D., Melzer, A., Menkhorst, P., Molsher, R., Moore, B.D., Phalen, D., Rhodes, J.R., Todd, C., Whisson, D., McAlpine, C.A. 2015. Use of expert knowledge to elicit population trends for the koala (Phascolarctos cinereus). **Diversity and Distributions** 21, 1-14	5.272	9
Akter, Sonia., Kompas, Tom., Ward, Michael B. (2015) Application of portfolio theory to asset-based biosecurity decision analysis. **Ecological Economics** 117 73-85	4.055	4
Ashdown, M.L, Robinson, A.P., Yatomi-Clarke, S.L., Ashdown, M.L., Allison, A., Abbott, D, Markovic, S.N, Coventry, B.J. (2015) Chemotherapy for Late-Stage Cancer Patients: Meta-Analysis of Complete Response Rates. **F1000Research**, 4:232 (doi: 10.12688/f1000research.6760.1)	1.13	2
Bisono, I.N., and Robinson, A.P. (2015) Spatial Bayesian Model for Maximum Temperature. **International Journal of Applied Mathematics and Statistics** 53 (6), 137–144.	0.18	0
Burgman, M. A. (2015) Governance for effective policy-relevant scientific research: the shared governance model. **Asia and the Pacific Policy Studies**	n/a	2
Burgman, M.A., (2015) Trusting judgements: how to get the best out of experts. Cambridge University Press.	n/a	16
Chee, Y. E., Fidler, F. and Wintle, B. C. (2015) Understanding uptake of decision support models in conservation and natural resource management. in Bunnefeld, N., Nicholson, E. and Milner-Gulland, E. J., (eds.) *Decision-making in Conservation and Natural Resource Management - Uniting Top-down and Bottom-up Approaches*,Cambridge: Cambridge University Press.	n/a	0
Chee, Y. E. (2015) Principles Underpinning Biodiversity Offsets and Guidance on their Use. in van der Ree, R., Smith, D. J. and Grilo, C., (eds.) *Handbook of Road Ecology*,Chichester, West Sussex: John Wiley & Sons, Ltd. pp. 51-59.	n/a	0
Clarke, Sandra, J. and Jones, Stuart, A. (2015) Bayesian estimation for diagnostic testing of Biosecurity Risk Material in the absence of a Gold Standard when test data are incomplete. **Journal of Agricultural, Biological and Environmental Statistics** 20 (3), 389-408	0.99	0
Dodd, A. J., Burgman, M. A., McCarthy, M. A. and Ainsworth, N.(2015). The changing patterns of plant naturalizations in Australia. **Diversity and Distributions** Vol 21 (9) 1038 - 1050	5.272	5
Dodd, A.J., Ainsworth, N., Burgman, M.A. and McCarthy, M.A. (2015) Plant extirpation at the site scale: implications for eradication programmes. **Diversity and Distributions** Vol 21 (2) 151 - 162	5.272	10
Dodd, A. J., McCarthy, M. A., Ainsworth, N., & Burgman, M. A. (2015). Identifying hotspots of alien plant naturalisation in Australia: approaches and predictions. **Biological Invasions,** 1-15.	2.837	1
Fithian, W., Elith, J., Hastie, T. & Keith, D. (2015) Bias Correction in Species Distribution Models: Pooling Survey and Collection Data for Multiple Species. **Methods in Ecology and Evolution** Vol 6 (4) 424-438	8.631	55
Guillera-Arroita, G., Lahoz-Monfort, J.J., Elith, J., Gordon, A., Kujala, H., Lentini, P.E., McCarthy, M.A., Tingley, R. & Wintle, B.A. (2015) Is my species distribution model fit for purpose? Matching data and models to applications. **Global Ecology and Biogeography**. Vol 24 (3) 276-292	7.53	109

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2015		
Hanea, A.M., Morales-Napoles, O. & Ababei, D. (2015) Non-Parametric Bayesian Networks: Improving Theory and Reviewing Applications. **Reliability Engineering & System Safety** Vol 144 265-284	3.461	6
Hester, S., Sergeant, E., Robinson, A.P., and Schultz, G. 2015. Animal, Vegetable, or . . . ? A case study in using animal-health monitoring tools to solve a plant-health surveillance problem. In: Biosecurity Surveillance: Quantitative Approaches, Eds: Frith Jarrad, Samantha Low-Choy, Kerrie Mengersen. CABI, pp 313–333.	n/a	0
Hollings, T., H. McCallum, K. Kreger, N. Mooney, and M. Jones. 2015. Relaxation of risk-sensitive behaviour of prey following disease-induced decline of an apex predator, the Tasmanian devil. Proceedings of the Royal Society B.	n/a	5
Jaskierniak, D., Benyon, R., Kuczera, G., and Robinson, A.P. (2015). A new method for measuring stand sapwood area in forests. **Ecohydrology.** Vol 8 (3) 504-517	2.954	4
Jordan, H., Dunt, D., Hollingsworth, B., Firestone, S.M. and Burgman, M. (2015). Costing the morbidity and mortality consequences of zoonoses using health adjusted life years. **Transboundary and Emerging Diseases** DOI:10.1111/tbed.12305.	3.035	1
Keith, D.A., Rodríguez J.P., Brooks T.M., Burgman M.A., Barrow E.G., Bland L., Comer P.J., Franklin J., Link J., McCarthy M.A., Miller R.M., Murray N.J., Nel J., Nicholson E., Oliviera-Miranda M.A., Regan T.J., Rodríguez-Clark K.M., Rouget M. and Spalding M.D. (2015). The IUCN red list of ecosystems: Motivations, challenges and applications. **Conservation Letters** Vol 8 (3) 214-226	7.316	31
King, S.L., Schick, R.S., Donovan, C., Booth, C.G., Burgman, M., Thomas, L. and Harwood, J. 2015. An interim framework for assessing the population consequences of disturbance. **Methods in Ecology and Evolution** (issued online 30 June 2015).	8.631	29
Kompas, T., Nguyen, H T M. and Ha, P V. (2015) Food Biosecurity: Livestock production and towards a world free of Foot-and-Mouth disease. **Food Security** April 2015, 291-302	2.724	4
Lyon, A., Wintle, B. and Burgman, M. (2015). Collective wisdom: methods of confidence interval aggregation, **Journal of Business Research** 68, 1759 - 1767	4.108	4
Malishev, Mi & Sanson, G.D. (2015) Leaf mechanics and herbivory defence: how tough tissue along the leaf body deters growing insect herbivores. **Austral Ecology**. 40: 300-308	1.832	6
Martin, P.A.J., Langstaff, R.M., Iglesias, R.M., East, I.J., Sergeant, E.S.G., and Garner, M.G. (2015) Assessing the efficacy of general surveillance for detection of incursions of livestock diseases in Australia. **Preventive Veterinary Medicine** 121 (215 - 230).	2.336	8
Matthews, M. and Kompas, T. (2015). Coping with nasty surprises: Improving risk management in the public sector using simplified Bayesian Methods. **Asia and the Pacific Policy Studies** 2 (3) 452 - 456	n/a	3
Mittinty, M., Whittle, P., Burgman, M. and Mengersen, K. (2015). The role of surveillance in evaluating and comparing international quarantine systems. Pp. 137-150. In, Jarrad, F., Low-Choy, S. and Mengersen, K. (eds) *Biosecurity surveillance: Quantitative approaches*. CAB International, Wallingford, UK	n/a	0
Robinson, A.P., Chisholm, M., Mudford, R., Maillardet, R. 2015. Ad hoc solutions to estimating pathway non compliance rates using imperfect and incomplete data. In: Biosecurity Surveillance: Quantitative Approaches, Eds: Frith Jarrad, Samantha Low-Choy, Kerrie Mengersen. CABI, pp 167– 180.	n/a	1
Spring, D. and Kompas, T., (2015). Managing risk and increasing the robustness of invasive species eradication programs. **Asia and the Pacific Policy Studies** 2 (3) 485-493	n/a	1
Sutherland, W.J. and Burgman, M.A. 2015. Use experts wisely. Nature 526, 317-318	43.769	40

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2014		
Burgman, M.A. and Regan, H.M. (2014) Information-gap decision theory fills a gap in ecological applications. **Ecological Applications** 24, 227-228	4.933	4
Burgman, M.A., Regan, H.M., Maguire, L.A., Colyvan, M., Justus, J., Martin, T.G. and Rothley K. (2014) Voting systems for environmental decisions. **Conservation Biology** Vol 28 (2) 322-332	5.092	5
Cook, C.N., Inayatullah, S., Burgman, M.A., Sutherland, W.J. and Wintle, B.A. (2014) Strategic foresight: how planning for the unpredictable can improve environmental decision-making. **Trends in Ecology and Evolution**.	18.35	40
Cox-Witton, K., Reiss, A., Woods, R., Grillo, V., Baker, R.T., Blyde, D.J., Boardman, W., Cutter, S., Lacasse, C., McCracken, H., Pyne, M., Smith, I., Vitali, S., Vogelnest, L., Wedd, D., Phillips, M., Bunn, C. and Post, L. (2014) Emerging Infectious Diseases in Free-Ranging Wildlife-Australian Zoo Based Wildlife Hospitals Contribute to National Surveillance. **PLoS ONE** 9 (5)	3.394	15
Elith, J. and Burgman, M.A. (2014) Reply to Kriticos et al. NeoBiota, 23, 95-99.	n/a	0
Guillera-Arroita, G., Lahoz-Monfort, J.J. & Elith, J. (2014) Maxent is not a presence-absence method: a comment on Thibaud et al. **Methods in Ecology and Evolution**. Vol 5 (11) 1192-1197	8.631	21
Jones, O.D., Maillardet, R.A., and Robinson, A.P. (2014). An Introduction to Scientific Programming and Simulation, Using R, 2nd Edition Chapman & Hall/CRC.	n/a	77
Keith, D.A., Mahony, M., Hines, H., Elith, J., Regan, T.J., Baumgartner, J.B., Hunter, D., Heard, G.W., Mitchell, N.J., Penman, T., Parris, K.M., Tracey, C., Scheele, B., Simpson, C.C., Tingley, R., West, M. and Akcakaya, H.R. (2014). Detecting extinction risk from climate change by IUCN Red List criteria. **Conservation Biology**, 28, 810-819	5.092	33
Keith, D.A., Elith, J. and Simpson, C.C. (2014) Predicting distribution changes of a mire ecosystem under future climates. **Diversity and Distributions**, 20, 440-454	5.272	8
Merow, C., Smith, M.J., Edwards Jr, T.C., Guisan, A., McMahon, S.M., Normand, S., Thuiller, W., Wüest, R., Zimmermann, N.E. & Elith, J. (2014) What do we gain from simplicity versus complexity in species distribution models? **Ecography**. Vol 37 (12) 1267-1281	5.366	76
Mills, M., Nicol, S., Wells, J,A., Lahoz-Monfort, J.J., Wintle, B., Bode, M., Wardrop, M., Walshe, T., Probert, W.J.M., Runge, M.C., Possingham, H.P. and McDonald Madden, E. (2014). Minimizing the cost of keeping options open for conservation in a changing climate. **Conservation Biology**. 28: 646 – 653.	5.092	12
Panetta, D.F. and Cacho, O. (2014) Designing weed containment strategies: An approach based on feasibilities of eradication and containment. **Diversity and Distributions**. 20 (5), 555-566	5.272	9
Read, C.F., Duncan, D.H., Vesk, P.A. & Elith, J. (2014) Biocrust morphogroups provide an effective and rapid assessment tool for drylands. **Journal of Applied Ecology**. Vol 51 (6) 1740-1749	5.989	7
Runge M.C and Walshe T. (2014) Identifying objectives and alternative actions to frame a decision problem. G.R. Guntenspergen, ed. Application of Threshold Concepts in Natural Resource Decision Making. Springer pp. 29-44.	n/a	7
Shtilerman, E., Thompson, C.J., Stone, L., Bode, M. and Burgman, M. (2014) A novel method for estimating the number of species within a region. **Proceedings of the Royal Society, Series B**.	n/a	8
Vietz, G. J., Rutherfurd, I. D., Walsh, C. J., Chee, Y. E. and Hatt, B. E. (2014) The unaccounted costs of conventional urban development: protecting stream systems in an age of urban sprawl. in Vietz, G., Rutherfurd, I. D. and Hughes, R., (eds.) *Proceedings of the 7th Australian Stream Management Conference*, 27-30 July, Townsville, Queensland. pp. 418-424.	n/a	3

	ISI Impact Factor 2016	No. of Citations as at 30/6/17
2013		
Addison, P.F.E., Rumpff, L., Bau, S.S., Carey, J.M., Chee, Y.E., Jarrad, F.C., McBride, M.F. and Burgman, M.A. (2013) Practical solutions for making models indispensable in conservation decision-making. **Diversity and Distributions** 19, 490-502	5.272	60
Burgman, MA, McCarthy, MA, Robinson, A., Hester, SM, McBride, MF, Elith, J and Panetta, FD. (2013) Improving decisions for invasive species management: reformulation and extensions of the Panetta-Lawes eradication graph. **Diversity and Distributions**. 19,603-607	5.272	15
Burgman, M., Roberts, B., Sansford, C., Griffin, R. and Mengersen, K. (2013). The role of pest risk analysis in plant biosecurity. In. Gordon Gordh and S. McKirdy (eds) The Handbook of Plant Biosecurity. Chapter 9, pp. 235-267. Springer, New York.	n/a	4
Burgman, M. A. and Yemshanov, D. (2013) Risks, decisions and biological conservation. **Diversity and Distributions** 19, 485-489	5.272	11
Crase, B., Liedoff, A., Vesk, P.A., Burgman, M., and Wintle, B.A. (2013) Hydroperiod in the main driver of the spatial pattern of dominance in mangrove communities. **Global Ecology and Biogeography** 22, 806-217	7.53	20
Dormann, C.F., Elith, J., Bacher, S., Buchmann, C., Carl, G., Carré, G., Diekötter, T., García Marquéz, J., Gruber, B., Lafourcade, B., Leitão, P.J., Münkemüller, T., McClean, C., Osborne, P., Reineking, B., Schröder, B., Skidmore, A.K., Zurell, D. & Lautenbach, S. (2013) Collinearity: a review of methods to deal with it and a simulation study evaluating their performance. **Ecography, 36**, 27–46.	5.366	1337
Decrouez, G, and Robinson, A.P. (2013) Time-series models for border inspection data. **Risk Analysis** 33, 2142-2153	2.857	1
Drescher, M., Perera, A.H., Johnson, C.J., Buse, L.J., Drew, C.A., and Burgman, M.A. 2013. Towards rigorous use of expert knowledge in ecological research. **Ecosphere** 4, 1-26.	3.074	36
East, I. J., Wicks, R.M., Martin, P.A.J., Sergeant, E.S.G., Randall, L.A and Garner, M.G. (2013) Use of a multi-criteria analysis framework to inform the design of risk based general surveillance systems for animal disease in Australia. **Preventive Veterinary Medicine** 112 (230 - 247).	2.336	13
Elith, J., & Franklin, J. (2013) Species distribution modeling. *Encyclopedia of Biodiversity,* 2nd Edition (ed. S.A. Levin), pp. 692-705. Academic Press, Waltham, MA.	n/a	17
Elith, J. Simpson, J., Hirsch, M. & Burgman, M. A (2013) Taxonomic uncertainty and decision making for biosecurity: spatial models for myrtle/guava rust. **Australasian Plant Pathology**, 42, 43-51	1.283	26
Estevez, R.A., Walshe, T. and Burgman, M. A (2013) Capturing social impacts for decision-making; a Multicriteria Decision Analysis perspective. **Diversity and Distributions** 19,608-616	5.272	22
Guisan, A., Tingley, R., Baumgartner, J.B., Naujokaitis-Lewis, I., Sutcliffe, P.R., Tulloch, A.I.T., Regan, T.J., Brotons, L., McDonald-Madden, E., Mantyka-Pringle, C., Martin, T.G., Rhodes, J.R., Maggini, R., Setterfield, S.A., Elith, J., Schwartz, M.W., Wintle, B.A., Broennimann, O., Austin, M., Ferrier, S., Kearney, M.R., Possingham, H.P. & Buckley, Y.M. (2013) Predicting species distributions for conservation decisions. **Ecology Letters** 16, 1424-1435	13.327	379
Hester, S.M., Cacho, O.J., Panetta, F.D. and Hauser, C.E. (2013) Economic aspects of post-border weed risk management, **Diversity and Distributions**: 19, 580-589	5.272	20
Holliday, J.L., Jones, S.A., Simpson, J.A., Glen, M., Edwards, J., Robinson, A. and Burgman, M.A. (2013) A novel spore collection device for sampling exposure pathways: a case study of Puccinia psidii. **Plant Disease** 97, 828-834.	3.451	3
Keith DA, Rodrıguez JP, Rodrıguez-Clark KM, Nicholson E, Aapala K, Alonson, A, Asmussen A, Bachman S, Basset A, Barrow EG, Benson JS, Bishop MJ, Bonifacio R, Brooks TM, Burgman MA et al. 2013. Scientific Foundations for an IUCN Red List of Ecosystems. **PLoS ONE** 8(5): e62111. doi:10.1371/journal.pone.0062111	3.394	173

	ISI Impact Factor 2016	No. of Citations as at 30/6/17
2013		
Karavarsamis, N., Robinson, A.P., Hepworth, G., Hamilton, A.J., and Heard, G.W. (2013) Comparison of four bootstrap-based interval estimators of species occupancy and detection probabilities. **Australian and New Zealand Journal of Statistics** 55(3):235-252	0.731	4
Lyon, A., Grossel, G., Burgman, M.A. and Nunn, M. (2013) Using intelligence to manage biosecurity risks: a case study for aquatic animal health. **Diversity and Distributions** 19, 640-650	5.272	10
Lyon, A., Mooney, A. and Grossel, G. (2013) Using AquaticHealth.net to Detect Emerging Trends in Aquatic Animal Health. **Agriculture** 3(2), 299-309	n/a	5
Mitchell, M., Gude, J., Anderson, N., Ramsey, J., Thompson, M., Sullivan, M., Edwards, V., Gower, C., Cochrane, J., Irwin, E. and Walshe, T. (2013). Using structured decision making to manage disease risk for Montana wildlife. **Wildlife Society Bulletin**, 37: 107–114	1.048	6
Phillips, S.J. and Elith, J. (2013) On estimating probability of presence from use-availability or presence-background data. **Ecology**. 94: 1409-1419	5.768	57
Potts, J.M., Cox, M.J., Barkley, P., Christian, R., Telford, G. and Burgman, M.A. (2013) Model-based search strategies for plant diseases: a case study using citrus canker (Xanthomonas citri). **Diversity and Distributions** 19, 590-602	5.272	8
Rout, T. and Walshe, T. (2013). Accounting for time preference in management decisions: an application to invasive species. **Journal of Multi-Criteria Decision Analysis**, 20: 197 – 211.	1.14	3
Sinden, J.A., Downey, P., Cacho, O. and Hester, S. (2013). Cost effectiveness in site selection to protect native plant communities from the weed, bitou bush, in Australia, **Journal of Environmental Management**, 128: 1071-1080	4.712	3
Sutherland, W.J., Spiegelhalter, D. and Burgman, M.A. (2013) Twenty tips for interpreting scientific claims. **Nature (Comments)** 503, 335-337	43.769	63
Thompson, C.J., Lee, T.E., Stone, L., McCarthy, M.A., and Burgman, M.A. (2013). Inferring extinction risks from sighting records. **Journal of Theoretical Biology** 338: 16-22.	2.26	12
Wilkinson, L. A. T., Chee, Y. E., Nicholson, A. E. and Quintana-Ascencio, P. (2013) An Object-oriented Spatial and Temporal Bayesian Network for Managing Willows in an American Heritage River Catchment. in Almond, R. and Mengshoel, O., (eds.) 2013 *UAI Application Workshop: Big Data meet Complex Models and Models for Spatial, Temporal and Network Data at the Conference of Uncertainty in Artificial Intelligence, 15 July,Bellevue, Washington, USA, CEUR-WS.org, online http://ceur-ws.org/Vol-1024/paper-10.pdf. pp. 77-86.*	N/A	12

Invasive Species Book launch – (Left to right) **Paul Pheloung, Aaron Dodd, Andrew Robinson, Tom Kompas, Karen Schneider, Matt Koval**

04 Presentations

Strong biosecurity management depends on excellence in biosecurity risk analysis research. It is therefore important to build our networks, champion risk analysis and share the knowledge we create. We are invited to chair, address and facilitate workshops both at national and international conferences. A summary of these representations is as follows:

Table 6: List of Presentations

Dates of Event	Topic / Event	Location	Organisation	Facilitator
2016				
01 July 2016	General Modelling / CEBRA related at Seminar for monthly branch meeting	Melbourne	Statistical Society of Australia	Dr Jane Elith
07 July 2016	The state of conservation science / SCBO Conference	Brisbane	Society for Conservation Biology	Prof Mark Burgman
14 July 2016	Risk Management: how are we prioritising our surveillance to minimise risk?	Melbourne	National Plant Biosecurity RD&E Priorities Forum	Assoc Prof Andrew Robinson
14-15 July 2016	QAECO / CEBRA Retreat	Kinglake	UoM	Prof Mark Burgman
21-22 July 2016	AAS Theo Murphy Think Tank	Canberra	Australian Academy of Science	Prof Mark Burgman, Prof Tom Kompas, Dr Tracey Hollings
26 July 2016	Influencing importer choices and valuing passive surveillance - new insights into pest and disease management	NZ	MPI Operations Branch	Dr Susan Hester
01 August 2016	Talk to biology teachers about ecological modelling - CEBRA linked	Kew, Victoria		Dr Jane Elith
17 August 2016	CEBRA & Expert Elicitation / NZ MPI Surveillance and Incursion Investigation Group	Wellington, NZ	NZ MPI	Assoc Prof Andrew Robinson
22-25 August 2016	Sampling Interception for Risk Identification / International Pest Risk Research Group (IPRRG)	Parma, Italy	European Food Safety Authority	Assoc Prof Andrew Robinson
30 August 2016	CEBRA: Biosecurity Research that Works at the Border of Policy and Practice	UK	DEFRA	Assoc Prof Andrew Robinson
08 September 2016	Consultative Group on Biosecurity Cooperation	Melbourne	DAWR	Assoc Prof Andrew Robinson
27 September 2016	A first continuous Bayesian network model to forecast volcanic eruptions / GNS Science	Wellington, NZ	GNS Science	Dr Anca Hanea
05 October 2016	More Joy of Text	Melbourne	R-Meetup	Assoc Prof Andrew Robinson
07 October 2016	Talk to Research Initiative Members - CEBRA modelling	Melbourne	Computational Biology Institute	Dr Jane Elith
08 November 2016	Comparison between AB and FOL for FMD policy predictions / GEOVET Conference	Chile	GEOVET	Masako Wada
14 November 2016	Pet List Workshop	Melbourne	CEBRA	Assoc Prof Andrew Robinson
22 November 2016	MPI Biosecurity Forum	Auckland, NZ	MPI	Assoc Prof Andrew Robinson
24 November 2016	Quantifying uncertainty with structured expert judgement / SRA ANZ Conference	Adelaide	SRA ANZ	Dr Anca Hanea
29 November - 02 December 2016	To vaccinate or not to vaccinate: using modelling to evaluate FMD control options / EuFMD Workshop	Frascati, Italy	EuFMD within the FAO of the UN	Dr Richard Bradhurst (CEBRA) & Dr Graeme Garner (DAWR)
02 December 2016	Plenary talk as prize-winner of Research Award - ESA 2016 Annual Conference	Fremantle, Western Australia	Ecological Society of Australia	Dr Jane Elith
05-08 December 2016	When does poor governance presage biosecurity risk?	Canberra	Australian Statistical Conference	Dr Stephen Lane

Dates of Event	Topic / Event	Location	Organisation	Facilitator	Type
2017					
09 February 2017	Maximum Economic Yield / Australian Agricultural and Resource Economics Society Annual Meeting		Brisbane	Australian Agricultural and Resource Economics Society	Prof Tom Kompas
10 February 2017	The 'Curse of Dimensionality' Resolved: Trade Effects and Optimal Surveillance for Early Detection in Large-Scale Modelling / Australian Agricultural and Resource Economics Society Annual Meeting		Brisbane	Australian Agricultural and Resource Economics Society	Prof Tom Kompas
09 March 2017	Three Lessons on the Economics of Biosecurity / Food Security, Biosecurity and National Security in the Melanesian Arc		Canberra	Australian Institute of International Affairs	Prof Tom Kompas
14 March 2017	Workshop on Identifying Unexpected Biosecurity Risk		Canberra	CEBRA / DAWR	Martina Hoffman, Assoc Prof Andrew Robinson
22 - 24 March 2017	AADIS jurisdictional training workshop		University of Melbourne	CEBRA / DAWR	Dr Richard Bradhurst (CEBRA), Dr Graeme Garner (DAWR), Dr Clare Death (DAWR) & Prof Mark Stevenson (UoM)
05 April 2017	Presentation on quantifying confidence in pest absence		Canberra	DAWR Plant Division	Dr James Camac, Assoc Prof Andrew Robinson
26 April 2017	Economics for Biosecurity: Land-use Issues and Hawkweed in Victoria / Integrated Forest Ecosystem Research (iFER) Joint Teams Meeting		Melbourne	iFER, The University of Melbourne	Prof Tom Kompas
17 May 2017	Biosecurity Risk, and What To Do With It / Biosecurity and Food Safety Strategic Planning meeting		Sydney	DPI	Assoc Prof Andrew Robinson
22 May 2017	The 'Curse of Dimensionality' Resolved: The Effects of Climate Change and Trade Barriers in Large Dimensional Modelling / 5th International Symposium on Environment and Energy Finance Issues		Paris	5th International Symposium on Environment and Energy Finance Issues	Prof Tom Kompas
25 May 2017	Plant invasions in Australia and decision-theoretic approaches to their management / Science at the Shine Dome		Canberra	Australian Academy of Science	Dr Aaron Dodd
25 May 2017	The 'Curse of Dimensionality' Resolved: Trade Effects and Optimal Surveillance for Early Detection in Large-Scale Modelling / CAP Policy Seminar		London	Imperial College	Prof Tom Kompas
01 June 2017	The 'Curse of Dimensionality' Resolved: The Effects of Climate Change and Trade Barriers in Large Dimensional Modelling / 3rd International Workshop on Financial Markets and Nonlinear Dynamics		Paris	3rd International Workshop on Financial Markets and Nonlinear Dynamics	Prof Tom Kompas
21 June 2017	What about the incentive properties of biosecurity inspection rules?		Armidale, NSW	New England Branch of AARES	Dr Susie Hester
21 June 2017	Three Great Myths in Risk Assessment / Emergency Management Australia		Canberra	Attorney-General's Department	Prof Tom Kompas
28 June 2017	Three Great Myths in Risk Assessment / Clean Energy Regulator		Canberra	Clean Energy Regulator	Prof Tom Kompas
26-30 June 2017	What about the incentive properties of biosecurity inspection rules? / NAPPO		Baltimore, Maryland	International Symposium for Risk Based Sampling - NAPPO	Dr Susie Hester
26-30 June 2017	Translating information into change / NAPPO		Baltimore, Maryland	International Symposium for Risk Based Sampling - NAPPO	Assoc Prof Andrew Robinson

Governance

05 Chair's Report – CEBRA Advisory Board

Ensuring continuity of management and research quality output at CEBRA during a period of major change was the focus of the CEBRA Advisory Board during 2016-2017. It will remain the focus in 2017-2018.

CEBRA is a unique partnership between the Australian Government's Department of Agriculture and Water Resources, New Zealand's Ministry for Primary Industries, and the University of Melbourne directed at biosecurity in both countries. It is viewed widely as a model of collaboration between academia and government to harness the research capability of academia and focus it on topics that are both scientifically challenging and important to the health of Australians and New Zealanders, their way of life and their environment. CEBRA's research is focussed and sharpened by the needs of biosecurity policy makers and aims to address challenges of national and international biosecurity importance. It does this by developing tools, methods, guidelines and protocols to improve biosecurity risk analysis, with the purpose of providing cost-effective solutions and advice for managing biosecurity risk.

During 2016-2017 CEBRA was faced with major change with the inaugural Managing Director, Professor Mark Burgman, announcing his departure to take up a prestigious appointment at Imperial College and the inaugural Advisory Board Chairman, Dr Ron Sandland, indicating his intention to step down from that role. Both had steered CEBRA, created in 2013, and its antecedent ACERA, created in 2006, to become the internationally renowned organisation that is CEBRA today. The chairman of CEBRA's Scientific Advisory Committee, which is central to the quality of research undertaken by CEBRA, Professor Colin Wilks, also advised he was retiring. Change of this magnitude can destabilise an organisation and the Board was determined to embark on a journey of careful succession planning to mitigate this risk.

The new Managing Director is Associate Professor Andrew Robinson who assumed his duties in January. Andrew had been Deputy Managing Director since 2011 and his elevation to Managing Director was a pleasingly easy decision by the Board to ensure fundamental continuity of managerial and research delivery. Professor Ian Robertson, Emeritus Professor of Veterinary Epidemiology at The College of Veterinary Medicine, Murdoch University, has agreed to take on the Scientific Advisory Committee Chairman responsibilities. This is an equally happy outcome as it brings a Western Australian involvement into CEBRA for the first time. Lastly, I was honoured to be approached in late 2016 with the offer to take on the CEBRA Advisory Board Chairmanship, a position that Ron Sandland had managed with distinction, leading to him being awarded a Doctor of Science Honoris Causa by the University in July 2017. I was delighted to accept the role as I was closely involved with the establishment of ACERA and the development of CEBRA through my position in the Department of Agriculture and Water Resources and as a member of the Advisory Board over a number of years.

CEBRA has now finalised its fourth funding agreement, aimed at continuing its role between the governments and the University, until 2021. This acknowledgement by the governments that CEBRA is valued is very pleasing. The challenge before the Board now is to ensure that, notwithstanding the changes that have occurred, CEBRA manages this responsibility without interruption to the quality of its work or governance. I am confident that we are up to the challenge and on behalf of my colleagues on the CEBRA Advisory Board, I commit to this objective.

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

CEBRA Advisory Board Members

Name	Position	Organisation
Dr Colin Grant	Chair	Independent
Mr Peter Gooday	Board Member	Department of Agriculture and Water and Resources, ABARES
Dr Marion Healy	Board Member	Department of Agriculture and Water Resources, Plant Division
Assoc Prof Roger Paskin	Board Member	Primary Industries and Regions South Australia (PIRSA)
Prof Colin Wilks	Board Member (SAC Chair)	University of Melbourne, Veterinary Science
Prof Pauline Ladiges AO FAA	Board Member (Host)	University of Melbourne, BioSciences
Prof Peter Taylor	Board Member (Host)	University of Melbourne, School of Mathematics and Statistics
Ms Christine Reed	Board Member	Ministry for Primary Industries, NZ
Prof Helen Sullivan	Board Member (Host)	Australian National University, Crawford School of Public Policy
Assoc Prof Andrew Robinson	Board Member (Ex Officio)	University of Melbourne, CEBRA
Prof Tom Kompas	Board Member (Ex Officio)	University of Melbourne, 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; and
  - 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 Colin Wilks
- 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 Committee List for 2016-2017 financial year

NAME	ORGANISATION
Dr Arthur Campbell	Yale University
Dr Hoa Nguyen	Australian National University
Dr Hugh Millar	Hugh Millar & Associates Pty Ltd
Dr Tony Britt	former Department of Primary Industries
Dr Siobhan Mor	The University of Sydney
Dr Hoang Long Chu	Australian National University
Dr John Weiss	Plant Biosecurity Cooperative Research Centre
Dr Nick Golding	The University of Melbourne
Dr John Baumgartner	The University of Melbourne
Dr Reid Tingley	The University of Melbourne
Dr Cindy Hauser	The University of Melbourne
Dr Rob Cannon	former Department of Agriculture and Water Resources
Prof Oscar Cacho	University of New England
Dr David Cook	Department of Agriculture and Food
Dr Libby Rumpff	The University of Melbourne
Maria Salvatico	Department of Economic Development, Jobs Transport and Resources
Dr Sandy Clarke	The University of Melbourne
Dr Keith Hayes	Commonwealth Scientific and Industrial Research Organisation
Dr Joslin Moore	The University of Melbourne
Dr Simon Barry	Commonwealth Scientific and Industrial Research Organisation
Assoc Prof Ben White	The University of Western Australia
Dr Terry Walshe	Australian Institute of Marine Science
Prof Michael Ward	The University of Sydney
Dr Sarah Rosanowski	The Royal Veterinary College
Dr Brendan Cowled	Ausvet
Dr Anca Hanea	The University of Melbourne
Dr Caroline Dubé	Canadian Food Inspection Agency
Dr Simon Firestone	The University of Melbourne
Dr Peter Caley	Commonwealth Scientific and Industrial Research Organisation
Dr Kimberley Millers	Oregon State University
Assoc Prof Ellen Ariel	James Cook University

Key Performance Indicators

CEBRA's objectives and outcomes against KPIs are summarised in the following table. In all 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	On-Going	⊙	2017-18 project proposals have been approved
		At least 90% of Output (milestones, reports, systems, software, guidelines etc.) completed satisfactorily per year	Director, Business Manager	On-Going	⊙	The satisfactory completion of outputs continues to track above 90%.
		At least 80% outputs completed on time per year	Director	On-Going	⊙	The on time completion of outputs continues to track above 80%.
		At least 90% of projects to be delivered on budget	Director, Business Manager	On-Going	⊙	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	On-Going	⊙	CEBRA's H index is 20 CEBRA/ACERA's combined H index is 57
		Number of Publications per year by CEBRA staff	Director	On-Going	⊙	CEBRA staff have published several journal articles badged as CEBRA work. Details are provided in Table 5
1.3	Biosecurity risk analysis capacity in Australia and New Zealand is enhanced	Number of research higher degree students enrolled	Director	On-Going	⊙	CEBRA is currently supporting twelve higher degree students
		Number of research higher degree students graduated	Director	On-Going	⊙	None graduated in this 12 month period
		Number of post-doctoral research fellows employed	Director	On-Going	⊙	Edith Arndt, Richard Bradhurst, James Camac, Aaron Dodd, Tracey Hollings, Steve Lane

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 (BRSC) to discuss context and details of research projects	Director	BRSC meetings held on: 11 March 2016 10 June 2016 14 Oct 2016 24 March 2017 23 June 2017	⊙	The Centre's Executive Management has been represented at each BRSC 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	On-going	⊙	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	On-Going	⊙	Collaboration agreements have been executed with: • Anais Gibert • Centre for Market Design • Imperial College London • Scion Research • Universal Biosecurity Limited
1.5	Peer review of all draft project plans	Scientific Advisory Committee successfully reviews and oversees revision of all project reports	Director, SAC Chair	On-Going	✪	The SAC reviewed all submitted business cases and provided 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	On-Going	⊙	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				A new CEBRA Facebook page and Twitter account have been created. CEBRA website has been 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 6

Key Performance Indicator		Measure	Officer	Delivery Date	Rating	Progress/Outcome
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	On-Going	⊙	CEBRA staff have made at least twelve presentations badged as CEBRA work, detailed information is provided in Table 6
		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 6
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	On-Going	⊙	CEBRA staff have made at least three plenary presentations; detailed information is provided in Table 6
		At least 1 International Visitor per year				CEBRA has hosted: • Dr Prue Addison, University of Oxford • Dr Obisesan Olalekan, University of Ibadan • Barney Caton from the United States Department of Agriculture (USDA) • Representatives from the Thailand Agricultural Research Development Agency (ARDA)
		At least 1 visit to international laboratories by CEBRA personnel per year				Dr Anca Hanea made the following international visits: • Sept 2016 – GNS Science, NZ • Nov 2016 – TU Delft, The Netherlands • Feb 2017 – Leiden University and TU Delft, The Netherlands • July 2017 – Lucia Blaga University, Sibiu, Romania

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 & 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	On-Going	⊙	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, BRSC	On-Going	⊙	The following reports were submitted for endorsement: • 1304C Final Report • 1401C/D Supplementary Report • 1402B Final Report • 1305B Final Report • 1501F Final Report • 1404D Final Report • 1502C Final Report • 1503B Final Report • 1501C Final Report
						Endorsement letter received 14/11/16 for 1304C, 1401C/D & 1402B Endorsement letter received 3/4/17 for 1404D

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 & Chair	○ Over performance ⊙ On target ☒ Target at risk ◊ Target not achieved ✪ Completed	⊙ On target

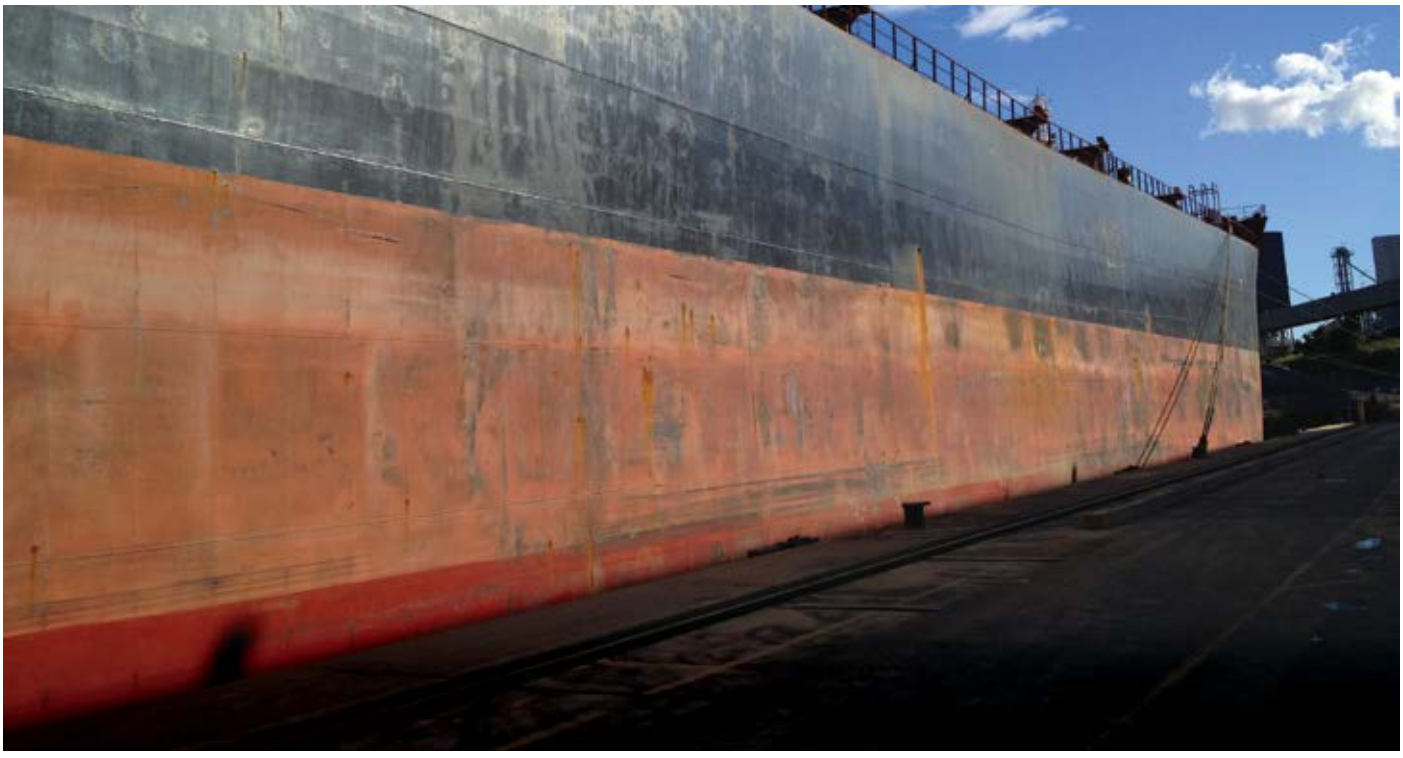
	Key Performance Indicator	Measures	Officer	Delivery Date	Rating	Progress/Outcome
4.1	Budget and workplan developed and approved annually	Submit to DAWR and MPI a budget and workplan for research projects each financial year	Business Manager	14 July 2016	✪	The budget and workplan was submitted to DAWR and MPI on 14 July 2016.
		Review budget and workplan and approve (subject to amendments)	DAWR/MPI	31 July 2016	✪	DAWR and MPI approved the budget and workplan on 18 August 2016.
4.2	Payment of Funding in support of CEBRA	DAWR and MPI to pay CEBRA Funding Payments twice annually	DAWR/MPI	31 January 2017 31 July 2017	⊙	Invoice No: 734353 was issued to MPI on 3/1/17 and paid on 27/1/17. Invoice No: 734354 issued to DAWR on 3/1/17 and was paid on 20/1/17.
		The University of Melbourne contributes $537,900 in funds and $500,000 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 2016	✪	The University's DVCR and Faculty of Science contribution was received in Jan 2017. The School of BioSciences contribution was received in March 2017.
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 July 2016 30 November 2016 31 March 2017	✪	PR # 9 was submitted to DAWR /MPI on 28 July 2016 PR #10 was submitted to DAWR/MPI on 30 Nov 2016 PR #11 was submitted to DAWR/MPI on 31 March 2017
		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 2017 July 2016	✪	FR # 6 was submitted to DAWR / MPI on 14 July 2016 FR # 7 was submitted to DAWR / MPI 13 Jan 2017

Key Performance Indicator		Measures	Officer	Delivery Date	Rating	Rating
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 2016 Auditor's Report: 31 August 2016	✪	The annual report was submitted to DAWR/ MPI on 5 October 2016 and the Auditor's Report was submitted to DAWR/MPI on 31 Aug 2016
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 2017	⊙	On track for submission by 30 Sept, 2017
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	19 August 2016 25 Nov 2016 24 Feb 2017 9 June 2017	✪	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 2018	⊙	Board meeting #20 scheduled to be held in Wellington NZ on 9 May 2018
		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 annual review of Advisory Board performance with a view to achieving best practice in quality of advice and organisational management	Annual Review Questionnaire completed by all Board Members and discussed at appropriate Board meeting	Board Chair	May – August	✪	Annual review was completed and presented at CAB Mtg # 16 held on 9 June 2017

Financial Statement

06 Financial Report Summary

CEBRA FINANCIAL STATEMENT 2016-2017	
INCOME	
Balance Brought Forward	$ 258,521
Department of Agriculture and Water Resources	$ 1,793,000
Ministry for Primary Industries	$ 290,400
Host Contribution	$ 493,075
Interest	$ 11,871
SUB-TOTAL	$ 2,588,346
OPERATING FUNDS (REVENUE + BALANCE CARRIED FORWARD)	**$ 2,846,867**
LESS EXPENDITURE	
Salaries	$ 340,236
Operations	$ 31,430
Business Development	$ 170,623
Research Contracts	$ 2,200,922
SUB-TOTAL	**$ 2,743,211**
BALANCE	**$ 103,656**



CEBRA In-Kind Statement

	%	$
Infrastructure Costs - Staff (On Campus Laboratory) $86,490/FTER per annum (Grant funded)		
Prof M. Burgman	24%	$ 20,758
Assoc Prof A. Robinson	100%	$ 86,490
Prof T. Kompas	50%	$ 43,245
Ms J. Holliday	8%	$ 6,487
Dr T. Hollings	28%	$ 24,506
Dr S. Lane	100%	$ 86,490
Dr E. Arndt	15%	$ 12,974
Dr J. Camac	88%	$ 75,679
Dr R. Bradhurst	100%	$ 86,490
Dr A. Dodd	65%	$ 55,858
Dr D. Spring	56%	$ 48,434
Assoc Prof K. Schneider	25%	$ 21,623
Dr A. Hanea	85%	$ 73,084
Dr C. Hauser	29%	$ 25,082
Dr F. Jarrad	17%	$ 14,703
Ms M. Hoffman	47%	$ 40,362
Ms H. Fraser	35%	$ 30,272
Ms C. Watts	57%	$ 49,299
Ms E. Kecurious	60%	$ 51,894
Ms A. Moran	44%	$ 37,623
Infrastructure Costs - RHD Student (On Campus Laboratory) $39,000/FTER per annum		
L. Rose	50%	$19,500
V. Hemming	50%	$19,500
D. Junaedi	100%	$39,000
R. Owen	100%	$39,000
Total		**$1,008,351**

Auditors Report

oakton
A DIMENSION DATA COMPANY

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 2016 to 30 June 2017.

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 $2,743,211 expenditure on the Project for the period 1 July 2016 to 30 June 2017; and
- the contributions of the University were $493,075 in cash and $1,008,352 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.

Lisa Tripodi
Partner

Date: 10 October 2017

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Outlook

07 Future Outlook

Our thinking will continue to be challenged as movement of people and goods continues to grow, and Governments continue to look for smarter, evidence-based ways of protecting our precious resources with greater efficiency. CEBRA is presented with an incredible opportunity to build on its very strong base.

We have received funding for another four years of service, providing us certainty until 2021 and allowing us greater impact and positive influence, both here and internationally.

Our Research priorities for 2017 -18 continue to be focussed by three themes:

- **Strengthening Surveillance** – surveillance and analysis reduces the risk of new entry of pests, diseases and weeds and to better target the risks that matter most.
- **Building Scientific Capabilities** – science remains effective and cutting-edge in an increasingly complex environment by building capacity and developing professional networks and collaborations.
- **Data and Information** – optimise the use of data and information facilitates better biosecurity risk analysis.

Strengthening Surveillance

Project ID: #2 170602	Increasing confidence in pre-border risk management
Project ID: #4 170604	Australian Zones and Compartments: new client service models for the agricultural export trade
Project ID: #6 170606	Developing models for the spread and management of National Priority Plant Pests
Project ID: #7 170607	Developing scientifically robust risk maps for priority plant pests
Project ID: #8 170608	CBIS/CSP sensitivity analysis
Project ID: #15 170615	Assessing ant pathways to better inform site selection for ant surveillance
Project ID: #18 170618	Optimising New Zealand's marine biosecurity surveillance programme
Project ID: #21 170621	Proportional value of interventions across pathways and layers of the biosecurity system (extension of 1606E)

Building Scientific Capabilities

Project ID: #13 170713	Value of Australia's biosecurity system (extension of 1607A)
Project ID: #14 170714	Health of Australia's biosecurity system (extension of 1607B)

Data and Information

Project ID: #5 170805	Optimisation of national resources for animal disease surveillance
Project ID: #20 170820	Biosecurity response decision support framework (extension of 1608F)

CEBRA continues to play a vital role in assisting the Australian and New Zealand governments to remain at the forefront of practical biosecurity risk analysis by the provision of collaborative, relevant, and practical research outcomes.

Historically, biosecurity was seen as the responsibility of only the federal government. Biosecurity is now recognised as demanding the support and active engagement of the federal and state governments, the scientific community, industry, trading partners, and the population at large. This change places new demands on biosecurity risk management, and creates fresh opportunities for CEBRA to develop cross-sector engagement and cooperation.

CEBRA Biosecurity Research Projects
July 2017 - June 2018

Themes

Strengthening Surveillance $740,000

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

Last updated
31 July 2017

Building Scientific Capability $500,000

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

FUNDING
2017-18: $1,365,000

Data and Information $115,000

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

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

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Australian Government
Department of Agriculture and Water Resources

THE UNIVERSITY OF MELBOURNE

Ministry for Primary Industries
Manatū Ahu Matua

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