cebra

Centre of Excellence for
Biosecurity Risk Analysis

2015/16 CEBRA Annual Report

Australian Government
Department of Agriculture
and Water Resources

THE UNIVERSITY OF
MELBOURNE

Ministry for Primary Industries
Manatū Ahu Matua

report

Centre of Excellence for Biosecurity Risk Analysis

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01 Director's Introduction

It is my privilege to introduce the 2015-16 Centre of Excellence for Biosecurity Risk Analysis (CEBRA) Annual Report.

It's been another busy and successful year with CEBRA's people and colleagues achieving both at home and internationally. A few of our people have been acknowledged for their great work. Our own environmental scientist Associate Professor Jane Elith was awarded the Australian Academy of Science 2016 Fenner medal. The purpose of this award is to recognise distinguished research in biology by researchers up to ten years post-PhD. Earlier in the year Jane was awarded the 2015 Frank Fenner Prize for Life Scientist of the Year, one of six awards in the annual Prime Minister's Prize for Science. This topped off a year where she won another five awards for her published work.

- Two *Recognition of Achievement for a Research Paper* awards in 2015 as first author on papers that have been highly cited over the past 5 years, in the journals *Methods in Ecology and Evolution* and *Journal of Animal Ecology,*
- As one of a team receiving the *Thomson Reuters Citation Award for significant contribution to science change research*, and
- *Thomson Reuters Highly Cited Researcher 2014* and *2015* -top 1% of papers internationally in Ecology and Environment, earning the papers the mark of exceptional impact.

Jane, who is an ARC Future Fellow, is one of the ten most highly cited environmental scientists in the world. She and Dr Simon Barry from the CSIRO and their colleagues orchestrated the delivery of two important CEBRA reports this year on spatial models appropriate for terrestrial and marine environments.

On a personal note I would like to thank CEBRA's Deputy Director, Associate Professor Andrew Robinson who provided the Centre strong leadership and support especially during the current period while I am Head of the School of Biosciences and Director of CEBRA.

Andrew was awarded the University's inaugural Excellence in Engagement award in the category of Public Value. The award acknowledges the significant impact and pivotal role Andrew has made in engaging with the Australian Government's Department of Agriculture, Water and Resources (DAWR) and New Zealand's Ministry for Primary Industries (MPI) to address challenges of national and international biosecurity importance.

Professor Tom Kompas was elected to the Academy of Social Sciences in Australia. The Academy promotes excellence in Social Sciences in Australia and in their contribution to public policy. Tom has dedicated much of his time to public policy in Australia and it is wonderful to see this formally recognised. Tom also commenced full time at the University of Melbourne in August this year and is developing a new program in environmental economics for the Faculty of Science.

Three of our research fellows, Prue Addison, Bonnie Wintle and Marissa McBride have taken up positions in the world's three best universities. Dr Prue Addison has won a Senior Postdoctoral Knowledge Exchange Fellowship in Conservation Science at the University of Oxford under the supervision of Professor E.J Milner-Gulland. Dr Bonnie Wintle has a research fellowship at the Centre for the Study of Existential Risk at the University of Cambridge where she works on the science of evaluating extreme risks associated with new technologies. Dr Marissa McBride now works at Harvard University as Postdoctoral Fellow at Harvard Forest.

Their experience with CEBRA conducting robust scientific research, analysis and expert advice on national Biosecurity issues, including importantly their focus on practical, policy-relevant research outcomes, has provided them with enviable experience, making them highly attractive researchers internationally.

The inaugural CEBRA Policy Exchange Fellowship was awarded to Philip Tennant from DAWR. The fellowship promotes the sharing and flow of knowledge and expertise between CEBRA and its stakeholders. Phil worked in the CEBRA research community on knowledge exchange opportunities that arose from CEBRA funded projects.

Doctors Susie Hester and Anca Hanea, Professors Tom Kompas, Andrew Robinson and myself have facilitated and presented at many national and international conferences. One of particular note was a conference at the British Ecological Society Symposium at the Cambridge Conservative Initiative meeting on the interface between policy and science. The conference looked at how to make science work for government. I believe that the governance systems that support the relationships between CEBRA, DAWR and MPI are world-leading and quite unique.

Our close relationship with government provides an opportunity to work on topics that are both scientifically challenging and important to the health of Australians and New Zealanders, their way of life and their environment. Our research is focussed and sharpened by the needs of our policy makers. This year has seen some 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 1401D: AIMS and SAC text mining
- Project 1402A: Development of a Marine Spatial Analysis Model for improved risk assessment
- Project 1304A: Cost-effective surveillance of Foot and Mouth Disease
- Project 1405C: Torres Strait risk and resource allocation project

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 dedication.

Professor Mark Burgman FAA
Director, CEBRA

Core Activities 02

02 Summary of Core Activities

The Core Activities that the Centre undertook during the Financial Year 2015/2016 comprise the following projects approved by the Biosecurity Research Steering Committee.

Table 1 : Core Activities for 2015/2016

Project	Title	2015-2016 Budget
	Data Mining	
1501C	Improving Ballast Water Risk Tables	$70,000
1501E	Compliance and risk based sampling for horticulture exports	$25,000
1501F	Import Clearance Performance Measurement	$110,000
	Spatial Analysis	
1502C	Estimation of national-level farm demographic data	$162,720
1502D	Criteria in prioritising plant pests along the biosecurity continuum	$60,000
1502E	Risk maps for optimising biosecurity surveillance	$130,000
	Intelligence	
1503A	Intelligence gathering and analysis	$220,000
1503B	Intelligence tools for regulated goods traded via e-commerce	$40,000
	Benefit Cost	
1504C-SP	Testing incentive-based inspection protocols	$115,000
1504D	Using decision support tools in emergency animal disease planning and response	$90,000
	Pathways	
1505A	Ornamental fish import surveillance systems	$100,000
	Total:	**$1,122,720**

Themes

Projects

Data Mining $668,000

Project ID: 1301A ♦AR
Project Title: Data Mining to Improve Biosecurity Risk Profiling
Division: Compliance
2013-14: $180,000
2014-15: $78,000
R01/D55

Project ID: 1301B ♦AR
Project Title: Analytical Assessment of Leakage Surveys
Division: Compliance
2013-14: $50,000
2014-15: $25,000
R02/D56

Project ID: 1501C (1301C) ➔ AR
Project Title: Improving Ballast Water Risk Tables
Division: Biosecurity Animal
Sponsor: Andrew Cupit
Project Leader: Peter Stoutjesdijk
2013-14: $90,000
2015-16: $70,000
R03/D57

Project ID: 1401D AR
Scoping study: AIMS and SAC Text Mining
Division: Compliance
2014-15: $40,000
R11/D65

Project ID: 1501E AR
Project idea: Compliance and risk based sampling for horticulture exports
Division: Biosecurity Plant
Sponsor: Louise van Meurs
Project Leader: Adam Dawes & Russel Cant
2015-16: $25,000 *TBA*

Project ID: 1501F ➔ AR
Project idea: Import Clearance Performance Measurement
Division: Compliance Division
Sponsor: Raelene Vivian
Project Leader: Wayne Terpstra
2015-16: $110,000 *TBA*

Spatial Analysis $882,440

Project IDs: 1402A (1302A) MB
Project Title: Development of a Marine Spatial Analysis Model for Improved Biofouling Risk Assessment (1402A)
Division: Biosecurity Animal
2013-14: $101,000
2014-15: $120,000
R04/D58

Project ID: 1402B ♦ MB
Project Title: Tools and approaches for invasive species distribution modelling for surveillance
Division: Biosecurity Plant
2014-15: $150,000
R13/D67

Project ID: 1502C (1402C) ❖ MB
NZ MPI Project Title: Estimation of National-Level Farm Demographic Data for Preparedness of Highly-Infectious Livestock Disease Epidemics
Division: NZ MPI
Sponsor: Christine Reed
Project Leaders: Mary Van Andel
2014-15: $158,720
2015-16: $162,720
077127-R14/D68

Project ID: 1502D SH
Project Title: Determining the relative sensitivity and contribution of criteria in prioritising plant pests along the biosecurity continuum
Division: Biosecurity Plant
Sponsor: Sally Troy
Project Leaders: Susie Collins & Ranjith Subasinghe
2015-16: $60,000

Project ID: 1502E TK
Project Title: Risk maps for optimising biosecurity surveillance
Division: NZ MPI
Sponsor: Steve Hathaway
Project Leaders: Paul Stevens
2015-16: $130,000 *077127-TBA*

Intelligence $671,000

Project ID:s 1503A (1303A, 1403A) ➔ ♦ MB
Project Title: Intelligence Gathering and Analysis: International Biosecurity Intelligence System - IBIS
Division: Biosecurity Animal, Biosecurity Plant
2013-14: $216,000
2014-15: $195,000
2015-16: $220,000
R05/D59

Project ID: 1503B ♦ MB
Project Title: Intelligence tools for regulated goods traded via e-commerce
Divisions: Compliance Division and NZ MPI
Sponsor: Steve Hathaway
Project Leaders: Carolyn Bleach & Matthew Chrisholm
2015-16: $40,000 *TBA*

FUNDING
2013-14: $1,074,000
2013-15: ($104,000) returned
2014-15: $1,378,631
2015-16: $1,122,720

Key
MB – Mark Burgman
AR – Andrew Robinson
SH – Susie Hester
TK – Tom Kompas
❖ – NZ MPI project
♦ – Collaborative with NZ MPI
➔ – Extension of an ACERA project

Benefit Cost $690,162

Project ID: 1404A (1304A) ♦TK
Project Title: Cost Effective Surveillance of Foot-and-Mouth Disease
Division: Biosecurity Animal
2013-14: $91,000
2014-15: $91,000
R06/D60

Project ID: 1304B ♦ MB
Project Title: Handling Uncertainty in the Risk-Return Resource Allocation (RRRA) Model
Division: Service delivery
2013-14: $50,000
R07/D61

Project IDs: 1504C (1304C, 1404C) ♦ SH
Project Title: Testing Incentive-Based Inspection Protocols
Division: Biosecurity Plant
Sponsor: Louis Ransom
Project Leader: Felicity Woodhams
2013-14: $65,000
2014-15: $76,000
2015-16: $115,000
R08/D62

Project ID: 1504D (1404D) ♦ TK
Project Title: Using Decision Support Tools in Emergency Animal Disease Planning and Response: Foot-and Mouth Disease
Division: Biosecurity Animal
Sponsor: Tim Chapman
Project Leader: Graeme Gamer
MPI Collaborator: Andre van Halderen
2014-15: $112,162
2015;16: $90,000
R15/D69

Pathways $559,749

Project IDs: 1505A (1305A, 1405A_ ➔ ♦ AR
Project Title: Ornamental Fish Import Reform – Health Monitoring Program
Division: Biosecurity Animal
Sponsor: Andrew Cupit
Project Leader: Yuko Hood
2013-14: $50,000
2014-15: $50,000
2015-16: $100,000
R09/D63

Project ID: 1305B ➔AR
Project Title: Plant-Product Pathways and the Continuous Sampling Plan
Division: Biosecurity Plant
2013-14: $77,000
2014-15: $77,000
R10/D64

Project ID: 1405C TK & SH
Project Title: Torres Strait Risk and Resource Allocation Project
Division: Compliance
2014-15: $165,749
R16/D70

Project ID: 1405D AR
Project Title: Illegal Logging Sampling Strategy
Division: Agricultural Adaptation & Forestry
2014-15: $20,000
R17/D71

Project Summaries

Data Mining

1501C: Improving Ballast Water Risk Tables

Previous ACERA and CEBRA work identified several shortcomings in the modelling approach used to develop Ballast Water Risk Tables. The risk tables rely on current temperature data. The risk tables currently used are generated using a restricted temperature dataset. Research was conducted to identify sources of sea surface temperature data, and assess them to identify the best source for the needs of the Ballast Water Risk Analysis (BWRA). There will be further work required to incorporate sea-surface temperature data into the BWRA.

Further, the risk of translocation does not presently incorporate the number of transits between ports (based on shipping movement data). Vessel transit data can be sourced from a number of sources, including; the Australian Maritime Safety Authority, Lloyds, Port Authorities and the Bureau of Infrastructure, Transport and Regional Economics. These data sources underpin an assessment of vessel traffic to and from ports to identify if the approach can effectively assess the cumulative risk of establishment for each port, and subsequently identify areas where departmental resources should be targeted for compliance activities. The Marine Pest Unit (MPU) has obtained Lloyds shipping data up to the end of 2014. The Lloyds data are being used for this project.

Finally, the tables also rely on up-to-date species presence and range data, which is provided by the States and Northern Territory through port monitoring surveys. As well as understanding cumulative risk for ports and taking into account current pest presence data, this research should be able to provide information to industry (and others) about which port surveys, if carried out and resulting pest species freedom, would provide the most financial benefit to the shipping industry.

Data Mining

1501E: Compliance and risk based sampling for horticulture exports

The Horticultural Export Program (HEP) undertakes inspection of plant products before they are exported. Inspections are carried out to a standard specified by the importing country, such as 600 units, a random sample of which size provides 95% confidence that the contamination rate is below 0.5% if no defectives are discovered. The standard specification is problematic when consignments comprise many lines of different products.

HEP provided CEBRA with historical inspection data, that CEBRA analysed using several approaches. CEBRA made recommendations regarding suitable mechanisms for inspection of small or multi-product consignments, and for the intervention management of low-risk pathways.

Data Mining

1501F: Import Clearance Performance Measurement

The Compliance Division of the Department of Agriculture and Water Resources (DAWR) is developing a suite of performance indicators and the necessary infrastructure to collect the needed data, and has asked for CEBRA support. The support comprised two phases. Phase one involved two main tasks. The first was a review of current performance indicators. This review assessed whether current indicators were suitable for all import pathways at conveying performance to policy areas and for senior management. This review required input from senior executives who regularly use these performance indicators, the managers of pathways that do not currently have performance indicators, and biosecurity policy areas. It also sought feedback from the managers of travelers and mail that have implemented the existing performance indicators. The terminology of compliant and non-compliant was reviewed. The review also considered alternatives to existing indicators. This task involved both the department and CEBRA working together to survey stakeholders and producing a paper outlining the review's findings.
The second task entailed the review and documentation of existing intervention practices for each regulated pathway. Declaration requirements, intervention rates, and other regulatory practices vary within and between pathways; therefore most pathways were divided into sub-pathways that were analysed separately. This task was primarily undertaken by the department, with CEBRA advising on the most appropriate way to describe pathways to support the development of performance indicators in phase two. Phase two used the results of phase one to develop performance measures for each pathway. This work delivered a report recommending performance indicators for each pathway, including quantitative descriptions of leakage surveys (if applicable), data and data collection requirements. Phase two was predominately undertaken by CEBRA, with the department providing advice to ensure that performance measures are practical and can be implemented.

Spatial Analysis

1502C: Estimation of national-level farm demographic data for preparedness of highly infectious livestock disease epidemics (includes student involvement)

Epidemic spread models depend sensitively on initial conditions, including the distribution of livestock among farms. Project 1402C developed a suite of statistical models that estimate the number of animals on farms in New Zealand from remotely sensed data at a scale that is relevant to support emergency response planning. These models have identified areas where data are sparse and where uncertainties are relatively high. The economic impacts of these inaccuracies have not been modelled, and there is no way for assessing priorities for reducing these uncertainties.

Project 1502C filled this knowledge gap. We employed sensitivity analysis to answer this question in the New Zealand context and used the results for economic modelling. We considered four main categories of inaccuracies and a range of scenarios, including spatial inaccuracy, missing data, incomplete form information and uncertainty in animal number estimates. This project quantified the impact of demographic and spatial data inaccuracy by using both epidemic and economic modelling, both at the farm and the macroeconomic level. The results will be used to set priorities to acquire additional data and to improve model fit, so that economic costs of disease incursion can be minimised efficiently.

Spatial Analysis

1502D: Criteria in prioritising plant pests along the biosecurity continuum

More than five hundred plant pests are classified by Australian plant industries as priority pests. Efficiently allocating increasingly scarce surveillance resources to managing such a large number of pests presents a significant challenge for the Australian government because no national framework or mechanism currently exists for prioritisation or for guiding government investment in their management. This project is designed to address the prioritisation of plant pests for surveillance in Australia.

Pest prioritisation requires the careful integration of information on the likelihood of pest entry, establishment and spread, an estimation of the impact associated with the pest if established, and capacity to detect and eradicate the pest. This project reviewed and assessed methods for prioritisation in invasive species and environmental management that have been recommended or used elsewhere; identify the approach best suited to the Australian plant-pest prioritisation context; and developed a plan for identifying the most effective way of rolling out the assessment process in Australia. Outputs from this project will assist in the future development of a computer-based mathematical model that will clarify the ranking of high priority plant pests based on priority criteria and pest-specific information.

Spatial Analysis

1502E: Risk maps for optimising biosecurity surveillance

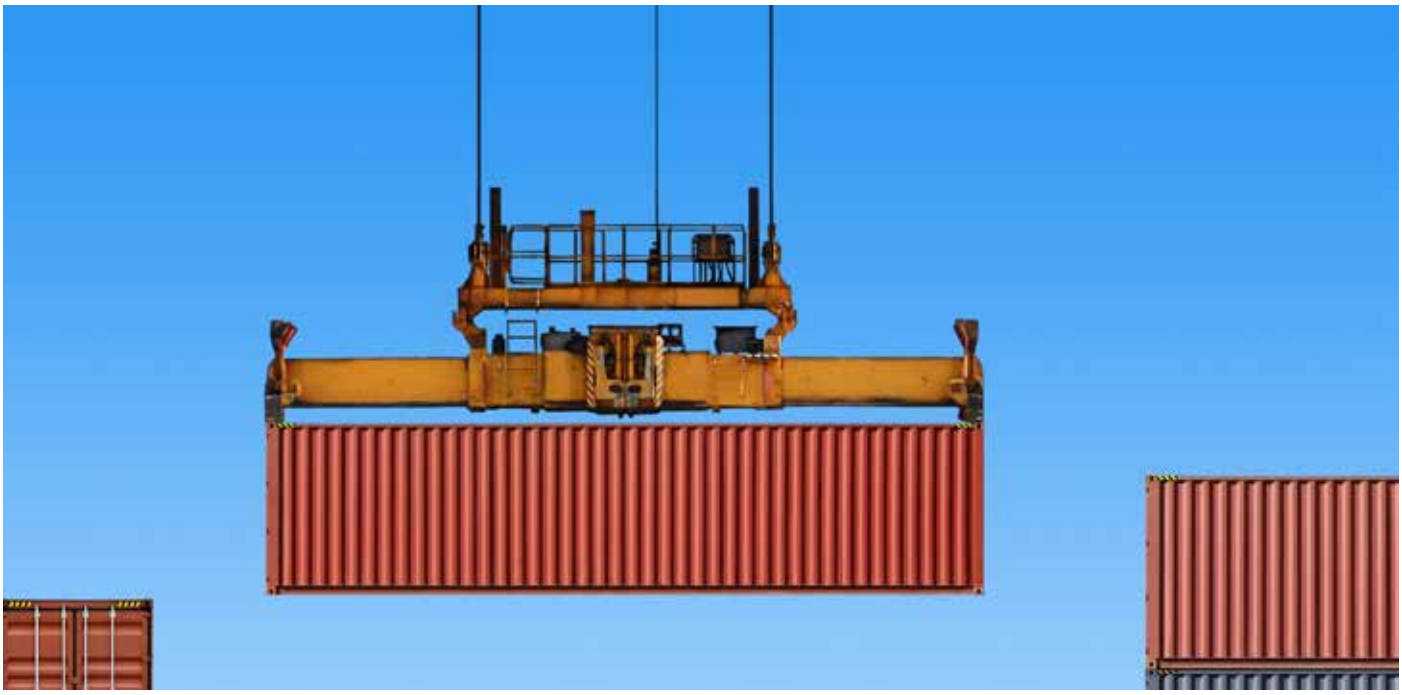
We developed a spatially explicit Bayesian Network approach to allocate surveillance effort based on risk and a pathway risk map. Empirical data is available to support an assessment of some risk factors. However, expert elicitation will be required to quantify risks where formal data is not available. The model will be implemented in a geospatial environment. The overall aim is to identify levels of risk along pathways into any country, including Australia and New Zealand, and designate potential high-risk sites where surveillance is more likely to detect invasive organisms. Recommendations for how the Bayesian Network can be implemented in surveillance planning and instructions on how the tool can be set up for easy implementation by users was also explored.

Intelligence

1503A: Intelligence gathering and analysis

International Biosecurity Intelligence System (IBIS) is a web search tool that provides real-time intelligence on emerging pests, diseases and pathogens. The project provides platforms for gathering aquatic and animal disease intelligence. In 2014-15, with the growing user base, the suite of structural deficiencies were uncovered that limited the performance of the system and constrained the development of new capabilities. These inherent problems were confirmed by an independent software design review.

The next stage of research and development focussed on improved architecture for the IBIS site. The architecture was redesigned so that the existing deficiencies are accounted for, providing the environment necessary to implement the next set of developments and improvements in the user experience. Once the site architecture is redesigned, the project developer will focus on specific elements including search term site ontological architecture, a new Graphic User Interface, 'groups' or community functionality, improved automated multiple language translation support, a flexible visualisation analysis dashboard, an issues analysis dashboard and improved user documentation.



Intelligence

1503B: Intelligence tools for regulated goods traded via e-commerce

Internet commerce facilitates long distance dispersal of alien species (risk goods), but the effects of this trade are neither well understood nor documented. The magnitude of the threat is not known, and tools for managing the risk are undeveloped. Initial research was required to determine whether software already exists that can be used, with or without modification, to readily identify biosecurity risks associated with internet commerce. Such software can help to better understand the nature and magnitude of the risks, and help to determine the appropriate regulatory response to the risks.

The project was a desktop exercise involving reviews of available literature and data and discussions with staff in other jurisdictions. Existing software was evaluated against a set of functionality requirements that were more completely specified at the outset of the project. These requirements were informed by key Ministry for Primary Industry (MPI) stakeholders from Surveillance & Incursion Investigation Teams, Biosecurity Response, Business Technology and Information Services, Integrated Targeting and Operations Centre, Policy and Trade, and Border Clearance Services. We concentrated our efforts on assessing the software used by regulatory agencies in various jurisdictions. These agencies may be biosecurity regulators, or regulators of other types of risk arising from international movements of goods or persons.

Benefit Cost

1504C-SP: Testing incentive-based inspection protocols

The project is innovative from DAWR's perspective, as the trial is investigating whether the AQIS Commodity Code (ACC) can be used to separate different products (and therefore biosecurity risks) under the same tariff code. The department is also trialing new ways of communicating with industry stakeholders, drawing upon insights from CEBRA Project 1304C. The expected benefits of this project 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. The findings will also inform adoption to other import pathways across the department.

Benefit Cost

1504D: Using decision support tools in emergency animal disease planning and response

This project continued the progress in CEBRA project 1405D. Modelling studies both in Australia and overseas have shown that vaccination can be very effective in reducing the size and duration of a Foot and Mouth Disease (FMD) outbreak. Vaccination is most effective in reducing the duration and size of an outbreak when used early and is less effective the longer you delay. However, a decision to vaccinate early in the outbreak may result in using vaccination in situations where it is not actually required, with consequent implications for post-outbreak surveillance, the management of vaccinated animals and the ability to regain FMD-free status and access to markets. Overall, the choice of control measure to adopt in an FMD outbreak will thus depend on the variable and potentially conflicting objectives of the control program. As an important component of disease planning and preparedness for the department, the project reported on key information that could be used in an FMD outbreak to infer the potential scale of an outbreak and information to support disease management decision-making.

Pathways

1505A: Ornamental fish import surveillance systems

Trade in live animals facilitates spread of infectious diseases. Ornamental finfish are of particular biosecurity concern worldwide because they carry viruses in three genera of the family Iridoviridae (referred to generally as iridoviruses). The current requirements for importation of ornamental fish to Australia include pre-border health certification and a mandatory on-arrival quarantine period of one to three weeks (depending on the species) in registered quarantine-approved premises (QAPs). Quarantined fish are observed for signs of disease, but are not directly tested. Diseased fish can be asymptomatic and so may not show visible signs of disease.

The Department has proposed changes to the way it manages the disease risks associated with imported ornamental fish. The proposed changes include the introduction of on-arrival health surveillance that will allow the department to monitor the performance of overseas authorities and exporters in meeting the health requirements for ornamental fish exported to Australia. This ongoing project (ACERA 1206G, CEBRA 1305A, and CEBRA 1405A) focuses on developing and trialling a sampling framework for the proposed surveillance program.

This project comprised analysis of the third phase of the surveillance program trial, which ran from May to February 2016, and development and implementation of a syndromic surveillance monitoring system, initially in a prototype spreadsheet-like software tool, and subsequently embedded within the department's systems.

Continuing Projects

The following projects were approved in the 2014/2015 workplan and continued into 2015/2016. A summary of work undertaken to date and priorities for this year are as follows:

1301A: Data mining to improve biosecurity risk profiling

The Department has adopted a risk-based approach to managing the biosecurity risk of various pathways. During Increased Quarantine Intervention (IQI), introduced in 2001, inspection for a number of pathways was increased to 100%. A risk-based approach to management is based on a statistical analysis of inspection outcomes, and enables the commitment of inspection resources to higher-risk pathways and activities.

CEBRA project 1301A comprises a suite of seven sub-projects, each of which focuses on a separate compliance undertaking and uses a different analytical tool. The sub-projects are as follows:

1. Geocoding international mail interceptions applies spatial analysis to the delivery addresses and categories of mail articles that are intercepted carrying high-risk biosecurity material
2. Generalised pattern analysis for international passengers applies data mining tools to a passenger interception database that has been augmented by data from the Departments of Immigration and Customs
3. Detecting anomalous broker activity uses combinations of Customs and Agriculture data to profile import brokers
4. Risk factor extraction with Vessel Monitoring System (VMS) uses data mining techniques to profile international vessels
5. Estimating compliance with inadequate data (transfer learning) assess the degree to which information from well measured pathways can be 'shared' with less known pathways
6. Performance indicators for Cargo Compliance Verification(CCV) develops statistical tools that can be used to report the CCV undertaking
7. Predicting hitchhiker pest activity combines interception information and the biology of invasive pests to try to refine intervention efforts.

This project was completed in 2015/16.

1404C-SP: Testing compliance-based inspection protocols

This project consisted of undertaking a series of economic experiments in a computer laboratory, in order to understand interactions between the department and importers relating to biosecurity inspections. These experiments built on economic theory relating to importers' incentives in the biosecurity inspection system documented in CEBRA Project 1304C. These theoretical frameworks have also been informed by discussions with stakeholders. The experiments, undertaken at Monash University, examined differences in importer choices about supplier behaviour for two different inspection rules – the CSP-1 and CSP-3; for different levels of information about these inspection rules; and in a setting where the importer could choose the rule that applied to them from a small set of rules.

The experiments did not find consistent systematic differences in the supplier choices of subjects between directly comparable CSP-1 and CSP-3 treatments, although subjects who reported to understand the inspection rules better tended to choose suppliers with lower biosecurity risk material approach rates. Other experimental results suggest that providing more information to importers about the inspection rule parameters and the consequences of failing inspection could support them choosing lower risk suppliers. The findings in the simple rule-choice experiment were surprising and suggest that offering a choice of rule, based on changing combinations of parameters alone would be ill advised. Rather, it would be better to opt for intervention options that are based on import-supply chain participants providing evidence of undertaking activities that reduce the likelihood of biosecurity risk material being found in imported consignments. Findings from this project have been incorporated into CEBRA Project 1504C where several inspection protocols are modified and implemented as part of a field trial.

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

Studies of Continuous Sampling Plan (CSP) strategies carried out by ACERA, ABARES and the Plant Division of the DAWR have shown that CSP combined with stratification by factors such as importers, suppliers, and countries can increase the detection rate relative to random sampling with the same effort for some pathways of import activity. This project is designed to extend the usability of CSP technology into further pathways by various means.

This ongoing project involves recoding of the CSP software to increase its speed of execution and improve its concordance with pathway risk management, an examination of the natures of the fails detected, and development of more reliable ways of analysing the data that arise from CSP sampling to underpin better management of the biosecurity risk both within and between pathways. Considerable effort has been invested in harmonising the simulation experiments with the operational pathway management practices. Further work is underway on analysis of data arising from CSP experiments.

This project was completed in 2015-16.

Deliverables and Milestones Achieved

The following table details the Core Material 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
1501C	1	Report on data sources for SST	Oct-15	No	Complete
	2	Updated BWRA Model	Jul-16	No	In progress
	3	Port relative risk assessed	Jul-16	No	In progress
	4	Final Report	Jul-16	Yes	In progress
1501E	1	Preliminary data to CEBRA	Jul-15	No	Complete
	2	Observations of current sampling practices	Sep-15	No	Complete
	3	Conclude analysis of sampling practices	Nov-15	No	Complete
	4	Conclude analysis of compliance data	Dec-15	No	Complete
	5	Draft recommendations for internal review	Jan-16	No	Complete
	6	Presentation to Horticulture Exports Industry consultative Committee (HEICC) for external review	Mar-16	No	Complete
	7	Final report delivered to Project Sponsor	Apr-16	Yes	In review
1501F	1	Paper articulating the review of existing performance indicators endorsed by the project sponsor	Nov-15	No	Complete
	2	Documentation of current intervention practices for each pathway endorsed by the project sponsor	Nov-15	No	Complete
	3	Recommended performance indicators report endorsed by project sponsor	Apr-16	Yes	In review
	4	Presentation of recommended performance indicators to the department, including representatives of the senior executive, policy and operational areas.	Jun-16	No	Complete
1502C	1	Literature Review	Sep-15	No	Complete
	2	Report on Bayesian modelling demographic models	Nov-15	No	Complete
	3	Economic Modelling	Feb-16	No	Complete
	4	Report on machine learning demographic models	Apr-16	No	Complete
	5	Final Report	Jun-16	Yes	In review

Deliverables and Milestones Achieved

Project	ID	Output	Milestone Date	For Endorsement	Status
1502D	1	Project work-plan finalising task list, allocated staff and time lines	Jul-15	No	Complete
	2	Workshop 1 to review, confirm or refine SNPHS criteria and sub-criteria and to determine weightings of criteria	Feb-16	No	In progress
	3	Draft procedures and guidelines development for consultation	Jan-16	No	In progress
	4	Workshop 2 if needed, to refine weightings of criteria	Feb-15	No	In progress
	5	Draft final report containing revised prioritisation process, guidelines for undertaking prioritisation and components for computer-based model	May-16	Yes	In progress
1502E	1	Project workshop and work-plan	Sep-15	No	Complete
	2	Draft structure for model	Dec-15	No	Complete
	3	Parameterised model in geospatial environment	Mar-16	No	Complete
	4	Risk Map for Entry and Establishment	May-16	No	Complete
	5	Draft Final Report	May-16	No	Complete
	6	Final Report	Jul-16	Yes	In progress
1503A	1a	Rebuilding the site architecture Rebuilding the site architecture	Nov-15	No	Complete
	1b	Reconstruction of search term site ontological architecture, activation of groups functionality and new GUI	Mar-16	No	Complete
	1c	Report outlining progress and outcomes	May-16	Yes	Terminated
	2	Continued implementation and testing of automated multiple language translation support	Dec-15	No	Terminated
	3	Development and implementation of analysis dashboard tools	Jun-16	No	Terminated
	4	Continued improvement in the capacity to receive and scrape valuable biosecurity information	Jun-16	No	Terminated
	5	Active engagement of the external IBIS community	Jun-16	No	Terminated
	6	Training material and work-flow manuals	Jun-16	Yes	Terminated
1503B	1	Initial workshop of MPI, DAWR and CEBRA personnel to confirm approach and scope	Aug-15	No	Complete
	2	Finalise DAWR's and MPI's functionality requirements for candidate software	Oct-15	No	Complete
	3	Draft report to MPI/DAWR	Mar-16	No	Complete
	4	Final Report	Jun-16	Yes	In review

Deliverables and Milestones Achieved

Project	ID	Output	Milestone Date	For Endorsement	Status
1504C	1	Develop field test platforms and training materials	Jan-16	No	Complete
	2	Communicate with system stakeholders about the pilot (include developing communication material) – Department and project team	Feb-16	No	Complete
	3	Workshop 1: with DAWR staff to test and assure platforms and training materials for field pilots	Aug-16	No	Complete
	4	Conduct training for DAWR staff and field officers on processes and systems for the field pilot if required	Jul-16	No	Complete
	5	Commence field pilots	Aug-16	No	In progress
	6	Interim Report: Analysis of inspection data and process evaluation	Jan-17	Yes	In progress
	7	Interview/survey of importers on actual behaviour change (if any) in response to the protocols	Oct-16 and May-17	No	In progress
	8	Workshop 2: Interim Results	Apr-17	No	In progress
	9	End field pilots	Nov-17	No	In progress
	10	Final Report: Field Evidence on Compliance Based Protocols and their Relevance to Biosecurity compliance	Dec-17	Yes	In progress
1504D	1	Re-evaluate early indicators assessed to date and discuss additional indicators and scenarios to include in analysis.	Sep-15	No	Complete
	2	Simulation runs of the Australian and NZ models for the assessment of early indicators of outbreak size	Oct-15	No	Complete
	3	Statistical analysis of early indicators for outbreak predictions and use of multivariate techniques to determine the optimal FMD control measures	Jan-16	No	Complete
	4	Phase 3: Optimisation techniques	Feb-16	No	Complete
	5	Collate results and draft report	Apr-16	No	Complete
	6	Workshop – meeting with project participants and relevant stakeholders to present findings	May-16	No	Complete
	7	Final report	Aug-16	Yes	In progress
1505A	1	Identify protocols/analysis that can be used to prioritise signs of emerging disease through an elicitation workshop	Aug-15	No	Complete
	2	Spreadsheet tool/script for analysis of data from phases 1-3 inspection and testing data	Dec-16	Yes	In progress
	3	Update spreadsheet tool/script that includes monitoring for emergent risks and flexibility for expansion i.e. syndromic surveillance	Dec-16	Yes	In progress

Research & Develop Risk Methods

03

03 Adoption activities

Summary of Core Activities

Data Mining

1501C: Improving Ballast Water Risk Tables

1301C/1401C/1501C – To estimate and manage the likelihood of transferring marine pests within Australia, CSIRO and the Department of Agriculture and Water Resources (DAWR) developed the Australian ballast water risk assessment (BWRA).

Previous ACERA (1104E) and CEBRA (1301C, 1501C) projects involved collaboration between CSIRO, ACERA/CEBRA researchers, The Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) and the Marine Pest Unit (Animal Biosecurity Division- DAWR) have refined the detailed analytical methods that underpin the BWRA and facilitated adoption within DAWR. ABARES now has this analytical capability and has produced the last two sets of ballast water risk tables. The BWRA will underpin domestic ballast water management when implemented under the Biosecurity Act 2015.

Spatial Analysis

1502C: Estimation of national-level farm demographic data for preparedness of highly infectious livestock disease epidemics (includes student involvement)

The model results, code and data have been provided to the Ministry for Primary Industries (MPI) and are available to DAWR. The work led to a new project that extends the results to embed them in economic models for emergency response in New Zealand.

Intelligence

1503A: Intelligence gathering and analysis

DAWR elected in 2016 to take over the maintenance and development roles for the software. The developers improved the performance of the original platform, to the stage that it is performing acceptably and relatively reliably.DAWR have maintained the original platform and are exploring the implementation of the new architecture. Essentially, the work has been adopted and internalised by DAWR.

Intelligence

1503B: Intelligence tools for regulated goods traded via e-commerce

The report identifies a range of tools that may be adopted for routine intelligence scanning. These are currently being considered for adoption by DAWR and MPI.

Benefit Cost

1504D: Using decision support tools in emergency animal disease planning and response

The project has established key information that could be used in an FMD outbreak to infer the potential scale of an outbreak and information to support disease management decision-making. It has also determined the optimal size of the vaccination zone given a potential outbreak.

Benefit Cost

1504C-SP: Testing incentive-based inspection protocols

The project is innovative from DAWR's perspective, as the trial is investigating whether the AQIS Commodity Code (ACC) can be used to separate different products (and therefore biosecurity risks) under the same tariff code. The department is also trialing new ways of communicating with industry stakeholders, drawing upon insights from CEBRA Project 1304C. The expected benefits of this project 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. The findings will also inform adoption to other import pathways across the department.

Continuing Projects

Pathways

1404C-SP: Testing compliance-based inspection protocols

Findings from this project have been incorporated into CEBRA Project 1504C where several inspection protocols are modified and implemented as part of a field trial.

Pathways

1404D: Using decision support tools in emergency animal disease planning and response

This project was carried over into 1504D (with the description of the project indicated there) and was completed in 2015/16.

Pathways

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

1001B(J)/1101C/1206F/1305B – DAWR's Compliance-Based Inspection Scheme (CBIS) was implemented in July 2013 as the direct result of a CEBRA risk return project that developed a risk-based intervention model for imported plant products. The original CEBRA project provided the department with a statistical modelling tool that enables analysis of the quarantine risk level of imported commodities based on historic import data and interception records. This tool was imbedded into DAWR's electronic import system (AIMS) to reward importers who demonstrate consistent compliance with Australia's biosecurity requirements with a reduction in the number of inspections at the border. These importers benefit from reduced inspection costs and faster clearance of their goods.

The CBIS approach has continued to go from strength to strength, expanding from the original single trial import pathway of green coffee beans, to now include 19 plant products. In the 2015-16 financial year CBIS was used to process 9854 import entries, resulting in 3748 saved inspections for the department, and approximately $359,840 to industry from reduced inspection costs. The department continues to explore opportunities to expand the use of CBIS and risk-based intervention for our stakeholders.

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 in Australia.

Table 3: Graduate Students

Student	Title	Supervisor
Graduate 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
Indriati Bisono	PhD: Modelling spatial extremes	A/Prof Andrew Robinson
Thiripura Vino	PhD: Spatio-Temporal Modelling of Group A Streptococcal Infection in Northern Australia	A/Prof Andrew Robinson
Nayomi Attanyake	PhD: Efficient estimation of hazard cut-points for risk-based fleet management	A/Prof Andrew Robinson
Gayan Dharmarathne	PhD: Exploring the Statistical Aspects of Expert Elicited Experiments	A/Prof Andrew Robinson
Completed Graduate Students		
Aaron Dodd	PhD: Predicting invasion success	Prof Mark Burgman
John Hicks	MPhil: Robust optimal decision making in traditional Aboriginal culture	Prof Mark Burgman
MSc:	MSc: Performance of CSP algorithms under incomplete inspection	A/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
Australian Research Council	2014/2016	LP 130100435 Red listing ecosystems – testing the new global standard for conservation	$389,065	Prof Mark Burgman Prof David Keith Prof Richard Kingsford A/Prof Jon Rodriguez Dr Tony Auld Dr Rebecca Lester Dr Emily Nicholson Dr Philip Pisanu Dr Tracey Regan
Australian Pesticides and Veterinary Medicines Authority	2014/2015	Risk screening tool	$241,500	Prof Mark Burgman
Department of Infrastructure and Regional Development	2015	Report on Utility of ETD Deployment Arrangements	$77,990	A/Prof Andrew Robinson
CRC Plant Biosecurity, University of Canberra	2016	Maximising the Net Benefits of Barrow Island BioSecurity	$221,596	Prof Tom Kompas A/Prof Andrew Robinson

Document & Communicate Findings

04

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.

Table 5: Publications table

	ISI Impact Factor 2015	No. of Citations as at 30/6/16
IN PRESS/EARLY VIEW		
Burgman, M. A. (2015) Governance for effective policy-relevant scientific research: the shared governance model. Asia and the Pacific Policy Studies (in press)	n/a	1
Chee, Y. E., Fidler, F. and Wintle, B. C. (In Press) 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	-
Decrouez, G, and Robinson, A.P. (2015) Measuring the inspectorate: point and interval estimates for performance indicators. Journal of Agricultural, Biological, and Environmental Statistics.	n/a	-
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	2.182	1
Elith, J. (2014 accepted) Chapter 6: predicting distributions of invasive species. Available now from arXiv: http://arxiv.org/abs/1312.0851.Risk-based decisions for biological threats. T.R. Walshe, A. Robinson, M. Nunn and M.A Burgman. Cambridge University Press	n/a	6
Hanea, A.M., McBride, M.F, Burgman, M.A., Wintle, B.C, Fidler, F., Flander, L., Twardy, C.R, Manning, B. & Mascaro, S. (2015) Investigate Discuss Estimate Aggregate for structured expert judgement, International Journal of Forecasting (in press)	n/a	-
Hanea, A.M., McBride, M.F., Burgman, M.A. & Wintle, B.C. (2015) Classical Meets Modern in the IDEA Protocol for Structured Expert Judgement, Journal of Risk Research, (in press)	na	-
Hollings, T., M. Jones, N. Mooney, and H. I. McCallum. (2015) Disease-induced decline of an apex predator drives invasive dominated states and threatens biodiversity. Ecology. (in press)	4.733	1
Jordan, H., Dunt, D., Hollingsworth, B., Firestone, S.M. and Burgman, M. (2014 early view) Costing the morbidity and mortality consequences of zoonoses using health adjusted life years. Transboundary and Emerging Diseases	2.714	-
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 (in press).	6.344	7
Kompas, T., Chu, L. and Nguyen, T. M. (2016 in press.) A practical optimal surveillance policy for Invasive Weeds: An application to Hawkweed in Australia. Ecological Economics	3.227	-
Lyon, A., Wintle, B. and Burgman, M. (2015 early view) Collective wisdom: methods of confidence interval aggregation, Journal of Business Research (in press)	n/a	-
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. (In Press) Eliciting and integrating expert knowledge to assess the viability of the critically endangered golden sun-moth Synemon plana. Austral Ecology	2.14	-
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.	2.826	-

	ISI Impact Factor 2015	No. of Citations as at 30/6/16
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.	5.2	-
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.	2.182	-
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.	6.02	1
Kompas, T., and 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	-
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	10.47	-
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.	n/a	-
Van Ha, P., and Kompas, T. (2016) Solving intertemporal CGE models in parallel using a Singly Bordered Block Diagonal ordering technique. Economic Modelling	1.024	1
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	4.566	-
Akter, S., Kompas, T., Ward, M B. (2015) Application of portfolio theory to asset-based biosecurity decision analysis. Ecological Economics 117 73-85	3.227	1
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)	n/a	-
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.	n/a	-
Burgman, M.A., (2015) Trusting judgements: how to get the best out of experts. Cambridge University Press.	n/a	1
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	-
Clarke, S, J. and Jones, S 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	n/a	-
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	4.566	2
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	4.566	6
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.	2.855	-
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	6.344	22

	ISI Impact Factor 2015	No. of Citations as at 30/6/16
2015		
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	5.84	36
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	2.498	2
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	-
Hollings, T., McCallum H., Kreger K., Mooney N. , and Jones M.. (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	-
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	2.138	2
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.	2.714	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	7.126	6
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	1.557	3
Lyon, A., Wintle, B. and Burgman, M. (2015) Collective wisdom: methods of confidence interval aggregation, Journal of Business Research 68, 1759 - 1767	n/a	3
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.	2.182	2
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	-
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	-
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	-
Sutherland, W.J. and Burgman, M.A. (2015) Use experts wisely. Nature 526, 317-318	38.138	12

	ISI Impact Factor 2015	No. of Citations as at 30/6/16
2014		
Burgman, M.A. and Regan, H.M. (2014) Information-gap decision theory fills a gap in ecological applications. Ecological Applications 24, 227-228	4.252	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	4.267	4
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.	n/a	19
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 Wildlike-Australian Zoo Based Wildlife Hospitals Contribute to National Surveillance. Plos One 9 (5)	3.057	11
Elith, J. and Burgman, M.A. (2014) Reply to Kriticos et al. NeoBiota, 23, 95-99.	n/a	-
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	6.344	13
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	66
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	4.267	25
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	4.566	3
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	5.355	29
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	7
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	4.566	5
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	5.196	3
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	4
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	7
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	-

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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	4.566	32
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	4.566	11
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	1
Burgman, M. A. and Yemshanov, D. (2013) Risks, decisions and biological conservation. Diversity and Distributions 19, 485-489	4.566	7
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	5.84	16
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.	5.355	767
Decrouez, G, and Robinson, A.P. (2013) Time-series models for border inspection data. Risk Analysis 33, 2142-2153	2.225	-
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.	2.287	16
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.	2.182	9
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	8
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	1.026	18
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	4.566	13
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	10.772	204
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	4.566	16
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.	3.192	1
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	3.057	103
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	n/a	4

	ISI Impact Factor 2015	No. of Citations as at 30/6/16
2013		
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	4.566	8
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	4
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	0.781	5
Phillips, S.J. and Elith, J. (2013) On estimating probability of presence from use-availability or presence-background data. Ecology. 94: 1409-1419	4.733	38
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	4.566	7
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.	n/a	1
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	3.131	3
Sutherland, W.J., Spiegelhalter, D. and Burgman, M.A. (2013) Twenty tips for interpreting scientific claims. Nature (Comments) 503, 335-337	41.456	44
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	2.049	10
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	-

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	Type
2015					
01 July 2015	Problems and solutions in expert judgement of biosecurity risk Centre for Biodiversity and Biosecurity 10th Anniversary Celebration	Auckland, New Zealand	University of Auckland	Prof Mark Burgman	Plenary
09-11 July 2015	Equivalence Testing for Model Validation - Are You a Lumper or Are You a Splitter? / How to Build Trust in Computer Simulations Towards a General Epistemology of Validation	Hannover, Germany	VolkswagenStiftung	A/Prof. Andrew Robinson	International Conferences
17 July 2015	Intelligence and uncertainty in risk analysis / Risk Science Network, Risk Governance Symposium	Canberra	National Library of Australia	Prof Mark Burgman	Invited Presentations
20-24 September 2015	The potential for compliance-based inspection protocols in Australia's biosecurity system	Hawaii Island, USA	EMAPi 2015 (Ecology and Management of Alien Plant Invasions)	Dr Susan Hester	International Conferences
19-23 October 2015	Introducing compliance-based inspection protocols to Australia's biosecurity system	Armidale NSW	ANZSEE 2015 (The Australia New Zealand Society for Ecological Economics)	Dr Susan Hester	National Conferences
29 October 2015	Risk based surveillance and intelligence for biosecurity/ North American Plant Protection Meeting	Memphis, USA	North American Plant Protection Organisation (NAPPO)	Prof Mark Burgman	International Conferences
13 November 2015	The science of expert judgement / Conservation Ecology Seminar	Canberra	University of Canberra	Prof Mark Burgman	Seminar
17-18 November 2015	R Workshop	Geelong	Barwon Health	A/Prof. Andrew Robinson	Workshop
8-12 December 2015	Pest Risk Analysis in Australia / Building a Regional System for Pest and Diseases Risk Analysis	Antigua, Guatemala	OIRSA	A/Prof Andrew Robinson	Workshop
03 December 2015	Equity in Ecology / Ecological Society of Australia Annual Conference	Adelaide	Ecological Society of Australia	Prof Mark Burgman	Key Note
Dec-15	A portfolio approach to allocating resources for biosecurity/ Economics Society of Australia Annual Dinner	Canberra	Economics Society of Australia	Prof. Tom Kompas	Invited Presentations

Dates of Event	Topic / Event	Location	Organisation	Facilitator	Type
2016					
19-21 January 2016	9th International Conference on Marine Bioinvasions (ICMB)	Sydney	International Society for the Study of Marine Bioinvasions	Prof Mark Burgman	Plenary
02 February 2016	Incorporating importer behaviour into the design of border inspection rules	Canberra	GetWise seminar to the Department of Agricultural and Water Resources	Dr Susan Hester	Invited Presentations
03 February 2016	Introducing compliance-based inspection protocols to Australia's biosecurity system	Canberra	AARES 2016	Dr Susan Hester	National Conferences
03 February 2016	Optimal local surveillance measures for an exotic pest in heterogeneous spaces over time	Canberra	AARES 2016	Prof Tom Kompas	National Conferences
03 February 2016	Chair/organiser of Special Session "Advances in Biosecurity"	Canberra	AARES 2016	Dr Susan Hester	National Conferences
05 February 2016	Budgeting and portfolio allocation for biosecurity measures	Canberra	AARES 2016	Prof Tom Kompas	National Conferences
05 February 2016	Invited Chair of contributed paper session on "Biosecurity"	Canberra	AARES 2016	Dr Susan Hester	National Conferences
03 March 2016	CEBRA: A Case Study in Bilateral Academic/ Government Collaboration	Canberra	Aus-NZ Plant Health Forum	A/ Prof. Andrew Robinson	National Conferences
06 April 2016	Pollinator abundance decision support system quantification/ University of Warwick	Warwick, UK	University of Warwick	Dr Anca Hanea	Workshop
07 April 2016	Structured Expert Judgement/Decision Research at Warwick (DR@W)	Warwick, UK	University of Warwick	Dr Anca Hanea	Invited Presentations
12 April 2016	An IDEA on how to get the best out of experts/ Workshop on Food Safety and Food Security	Dubrovnik, Croatia	COST Network	Dr Anca Hanea	International Conferences
12 April 2016	An IDEA for Pollinator Abundance Decision Support/Workshop on Food Safety and Food Security	Dubrovnik,Croatia	COST Network	Dr Anca Hanea	International Conferences
13 April 2016	Making science work for government / British Ecological Society Symposium	Cambridge, UK	Cambridge Conservation Initiative	Prof Mark Burgman	International Conferences
21 April 2016	The Science of Expert Judgement / Department of Zoology Seminar	Oxford, UK	Oxford University	Prof Mark Burgman	Seminar
26 April 2016	The Science of Expert Judgement / Department of Biological Science Seminar	Durham, UK	Durham University	Prof Mark Burgman	Seminar
12 May 2016	Data! Data! Data!	Melbourne	2016 Quarantine Regulator's Meeting	A/Prof. Andrew Robinson	National Conferences
19 May 2016	About CEBRA B3 Conference 2016	Wellington, NZ	B3 (Better Border Biosecurity)	A/Prof. Andrew Robinson	International Conferences
25 May 2016	Incorporating measures of economic, environmental and community impact into the ranking of national priority plant pests – a spreadsheet-based tool	Melbourne	National Plant Health Surveillance Workshop	Dr Susan Hester	Invited Presentations
26 May 2016	CEBRA and animal disease risk. / Australian Veterinary Association Conference	Adelaide	Australian Veterinary Association	Prof Mark Burgman	National Conferences
6-10 June 2016	Third International Workshop on Weeds and Invasive Plants	Alberta, Canada	ANdiNA	A/Prof. Andrew Robinson	Invited Presentation

Governance

05

05 Chair's Report – CEBRA Advisory Board

The achievements of the past year provide many reasons for optimism about CEBRA's future. CEBRA's research is innovative, effective and practical, and is at the forefront of risk research. The research program is driven by the challenges faced by governments to achieve the most effective and efficient investment in biosecurity risk management.

The CEBRA advisory board gives the CEBRA leadership group strategic advice on all aspects of the Centre's work. The board is highly engaged in these strategic issues and provides an independent perspective, always focused on the optimal development of the Centre.

One of our challenges is to balance the somewhat different needs of the partners. In the case of governments , the requirement is for positive impact on biosecurity practice. The University's major requirement is demonstrated research excellence. CEBRA provides, I believe, a world leading example of the benefits of government and university collaboration where policy outcomes, service delivery practicalities, risk management principles and quality research coalesce to address the biosecurity challenges facing Australia and New Zealand governments, business and community.

Our Advisory Board reviews its performance annually. Pleasingly, our most recent survey indicated that the Advisory Board is able to consider the most important issues affecting CEBRA and that the Board's contributions are valued by CEBRA's leadership team.

Another challenge facing CEBRA as with all organisations is succession planning. The quality of Professor Mark Burgman's leadership has been a major driver of CEBRA's success. The board has taken an active role in this area so we can identify and develop internal people to fill key leadership positions. The opportunity for Associate Professor Andrew Robinson to take a stronger leadership role while Professor Mark Burgman tackles both the role of Head of the School of Biosciences and Director CEBRA has been fortuitous and bodes well for the future success of CEBRA.

On behalf of my colleagues on the CEBRA Advisory Board we feel privileged to be providing strategic advice to guide CEBRA's engaging and high quality research and innovative practices that aim to make an early and important difference to Biosecurity risk.

Dr Ron Sandland AM FTSE
Chair, CEBRA Advisory Board

CEBRA Advisory Board Members

Name	Position	Organisation
Dr Ron Sandland AM FTSE	Chair	Independent
Ms Karen Schneider	Board Member (Commonwealth)	Department of Agriculture and Water Resources , ABARES
Dr Marion Healy	Board Member (Commonwealth)	Department of Agriculture and Water Resources, Plant Division
Dr 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 Aleks Owczarek	Board Member (Host)	University of Melbourne, Mathematics and Statistics
Ms Christine Reed	Board Member	Ministry for Primary Industries NZ
Prof Helen Sullivan	Board Member (Host)	University of Melbourne, MSoG
Prof Mark Burgman	Board Member (Ex Officio)	University of Melbourne, CEBRA
A/Prof Andrew Robinson	Board Member (Ex Officio)	University of Melbourne, CEBRA
Prof Tom Kompas	Board Member (Ex Officio)	University of Melbourne, CEBRA

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 Members

(* indicates reviewers used in the last 12 months)

NAME	ORGANISATION
A/Prof Ben White	University of Western Australia
Dr Brendan Cowled	AusVet*
Dr Caroline Dube	Canadian Food Inspection Agency*
Dr Carolyn Gates	Massey University
Dr Chris Jewell	Lancaster University
Dr Anca Hanea	The University of Melbourne*
Dr Fiona Fidler	The University of Melbourne
Dr Jane Elith	The University of Melbourne*
Dr Keith Hayes	CSIRO
Dr Naomi Cogger	Massey University
Dr Simon Barry	CSIRO*
Dr Simon Firestone	The University of Melbourne*
Dr Terry Walshe	The University of Melbourne*
Dr Graeme Clark	University of New South Wales
Dr Grant Rawlin	The Department of Economic Development, Jobs, Transport and Resources
A/Prof Jenny-Ann Toribio	The University of Sydney*
Dr Jo Luck	Plant Biosecurity Cooperative Research Centre*
Dr Mark Stanaway	Queensland University of Technology
Prof Mark Stevenson	The University of Melbourne
Mr Rob Cannon	Independent Consultant*
Dr Oliver Floerl	Cawthron Institute*
Prof Oscar Cacho	University of New England*
Prof Michael Ward	The University of Sydney*
Dr Sam Beckett	SDB Bio*
Dr Sarah Rosanowski	The Royal Veterinary College, University of London*
Dr Steven Mascaro	Bayesian Intelligence Pty Ltd
Dr Sandy Clarke	Statistical Consulting Centre, The University of Melbourne*
Dr Cindy Hauser	University of Melbourne*
Dr Bill Roberts	Independent Consultant*
A/Prof Graham Hepworth	Statistical Consulting Centre, The University of Melbourne
Dr Richard De Rozario	Independent Consultant*
Dr Cory Marker	US Department of Agriculture
A/Prof Lana Friesen	University of Queensland*
Prof Uwe Dulleck	Queensland University of Technology*

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 – Governance				
Strategic Objective	**Key Performance Indicator**	**Measures**	**Officer**	**Progress/Outcome**
CEBRA governance to offer quality actionable advice to the CEBRA Director and the Management Executive on the quality of research outputs, the direction of research, Government priorities, strategic business development and the quality and utility of research outputs.	The Advisory Board provides input to the Centre and Biosecurity Research Steering Committee (BRSC) on broad direction setting for risk analysis research through Advisory Board meetings 4 times per year	• 4 meetings per year, minimum attendance of 80% (max of two members missing) of members • Breadth, balance and experience of members of the Advisory Board	Director, Board Chair	The key issues addressed this year included: • Communication strategy • Consulting Business/ CEER development • Strategic initiatives • Review of the 2016/2017 research portfolio • Succession planning
	Scientific Advisory Committee – approve all draft project plans and provide an assessment on all final reports	Committee successfully reviews and oversees revision of all project reports	Director, SAC Chair	The SAC reviewed all submitted business cases and provided constructive feedback to proponents to improve proposals.
	Director attends BRSC meetings to provide context and details of the research projects undertaken by CEBRA and engages with Department of Agriculture and Water Resources (DAWR) and Ministry for Primary Industries (MPI).	3-4 meetings per year	Director	The Centre's Executive Management have been represented at each BRSC meeting to report on Centre activities and to foster engagement with funding bodies
	Evaluation of Board Performance process 1. Annual Review Questionnaire completed by all Board Members 2. Chair to discuss individual perceptions of the quality of advice with Managing Director and Board Members 3. Session to evaluate performance – explicit agenda item following questionnaire to evaluate performance	Once per year	Board Chair	Annual review was completed and presented at CAB Mtg # 12

Activity – Business Operations and Communication				
Strategic Objective	**Key Performance Indicator**	**Measures**	**Officer**	**Progress/Outcome**
Manage the Centre and ensure that the Core Activities are undertaken in accordance with objectives and key performance indicators and relevant industry standards and best practice guidelines.	CEBRA plays key role with BRSC in project planning and delivery	Meets with collaborators, project proponents and attend workshops	Director / DAWR / MPI	CEBRA's core research team continue to meet with collaborators and project proponents to ensure successful project delivery
	Budget and workplan developed and approved	Submit to DAWR and MPI a budget for the expenditure of the funding and workplan for research projects each financial year	Business Manager	The budget and workplan was submitted to DAWR and MPI on July 14, 2016
		Review budget and workplan and approve (subject to amendments)	DAWR/MPI	DAWR and MPI approved the budget and workplan on August 18, 2015.
		Once per Year Advise Centre of any KPIs to be included or core activities to be treated as specified core activities in the workplan	DAWR/MPI	No additional KPIs have been included in the workplan.
	Payment of Funding	DAWR and MPI to pay the Centre Funding Payments by six monthly instalments	DAWR/MPI	MPI paid invoice 705146 on July 30, 2015 and invoice 714694 on February 15, 2016. DAWR paid invoice 704644 on July 31, 2015 and invoice 714784 on February 2, 2016.
	Provision of quarterly Progress Report (PR) on Centre activities	Centre supplies DAWR and MPI with progress reports as set out in Schedule 3 of the Funding Agreement	Business Manager	• PR # 7 was submitted to DAWR/MPI on November 25, 2015 • PR # 8 was submitted to DAWR/MPI on March 16, 2016 • PR # 9 was submitted to DAWR /MPI on July 28, 2016
	Provision of Financial Report for the previous six months setting out the funding expended or committed	Centre supplies 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	• FR # 5 was submitted to DAWR/MPI on January 12, 2016 • FR # 6 was submitted to DAWR / MPI on July 14, 2016
	Provision of Annual Report for each financial year	Host supplies DAWR and MPI with an annual report for the preceding financial year as set out in Schedule 4 of the Funding Agreement	Business Manager	The annual report is on track for submission to DAWR/ MPI on September 30, 2016
	Auditor's Report confirming the Recipient has managed the Funding and kept accounts and records in respect of this Deed	Host supplies DAWR and MPI with an auditor's report for the preceding financial year as set out in Schedule 4 of the Funding Agreement	Business Manager	The auditor's report is on track for submission to DAWR/MPI on Aug 31, 2016
	Provision of Final Report on Centre activities at the completion of the term	Host supplies 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	Not required in the reporting period
	Recipient Contribution	The Recipient will contribute cash contributions of $537,900 and in-kind contributions of $500,000 per annum being support for Centre Staff including space for the Centre, IT system and support, financial systems, operational support, contract management and purchasing	Business Manager	The recipient contribution was received in full in May 2016.
	Level and quality of operational support and infrastructure provided to the Centre	The Centre will be supported by an Administrator and Business Manager, who will subject to the UoM performance development framework (PDF).	Business Manager, Director	The business manager and administrator continue to offer operational support to the Centre in line with UoM policies and procedures.

Activity - Communications				
Strategic Objective	**Key Performance Indicator**	**Measures**	**Officer**	**Progress/Outcome**
Document and communicate research findings to governments and others engaged in biosecurity decision making; Work to promote excellence in risk analysis;	Effective media communication	At least 2 informative media stories per year	Director, Business Manager, Communications PR	Jenny Barbour has developed a Communications Strategy in 2015, and will take carriage of implementation during 2016/2017.
	Influence over national and international developments	At least 12 national presentations by Centre participants (badged as CEBRA work) per year	Director	CEBRA staff have made at least twelve presentations badged as CEBRA work, detailed information is provided in Table 6 – List of Presentations.
		At least 2 international presentations by Centre participants (badged as CEBRA work) per year	Director	CEBRA staff have made at least six international presentations badged as CEBRA work, detailed information is provided in Table 6 – List of Presentations.
	Recognition	At least 3 invitations to chair, host conferences, participate in key advisory forums, or similar	Director	CEBRA staff have made at least three plenary presentations, detailed information is provided in Table 6 – List of Presentations.
	Collaborations: Development of research opportunities and the funding base	At least 3 substantial collaborations with research organisations per year	Director	Collaboration agreements have been executed with: • Monash University • Matthew Chisholm • University of NSW
		At least 1 new work with Government agencies other than the funding agency per year	Director	CEBRA staff completed work on developing a screening tool for Australian Pesticides and Veterinary Medicines Authority (APVMA) CEBRA staff have completed work with the CRC Plant Biosecurity on the Barrow Island biosecurity
	International links and networks	At least 1 International Visitor per year	Director	CEBRA hosted Resit Akcalkaya from Stonybrook University, Yakov Benheim from Technion Israel Institute of Technology, Obisesan Olalekam from the University of Ibadan, Marona Rovira Capdevila and Audrey Lustig from Lincoln University, New Zealand.
		At least 1 visit to international laboratories by Centre personnel per year	Director	• A/Prof Andrew Robinson visited Francoise Petter, the acting Director of the EPPO secretariat in Paris. They discussed several CEBRA and EPPO projects. http://www.eppo.int • A/Prof Andrew Robinson visited Ilia State University, Toilisi (Georgia) and had several discussions with researchers about invasive species. • A/Prof Andrew Robinson visited the Minnesota Invasive Terrestrial Plants and Pests Center and talked with the director Rob Venette and Heather Koop, the associate director. They discussed various aspects of CEBRA's operating model, which is the basis of MITPPC's design. http://www.mitppc.umn.edu
	Generate an effective flow of information and publicity about the objectives and results of the Centre	Effective use of website, blogs and social media to increase brand awareness	Director / Business Manager	A new website for CEBRA has been developed and secure access has been provided for external parties. A CEBRA Facebook page and Twitter account have been created. The website will be refreshed in 2016.

Activity – Research				
Strategic Objective	**Key Performance Indicator**	**Measures**	**Officer**	**Progress/Outcome**
Research and develop new and existing methods relevant to biosecurity risk; Engage the range of disciplinary skills relevant to the analysis of biosecurity risk, to ensure Australian and New Zealand governments remain at the forefront of practical risk assessment; Collaborate and engage with end users to improve adoption of methods and increase the impact of research findings;	Project Approvals	At least 90% of Project Proposals submitted for approval are approved, pending budget allocations	Director, Biosecurity Research Team, SAC	The eleven project proposals submitted to the steering committee in the 2015/2016 workplan were approved.
	Project Milestones and completions	At least 90% of Output (milestones, reports, systems, software. Guidelines etc) completed satisfactorily per year	Director, Business Manager	The satisfactory completion of outputs continues to track above 90%.
		At least 80% outputs completed on time per year	Director	The on time completion of outputs continues to track above 80%.
		At least 3 Working groups conducted and summaries completed per year	Director	CEBRA staff have completed at least three workshops in the reporting period. Detailed information is provided in Table 5 – List of Publications.
	Project Management	At least 90% of projects to be on time, delivered against milestones and on budget	Director, Business Manager	Projects continue to track on or below budget.
	Adoption - Use of Centre materials in routine Government activities	CEBRA to provide a summary of completed research findings/ outputs to the BRSC and CAB each quarter.	Director, Business Manager	Director provides summary of completed research findings at each BRSC meeting.
		Each CEBRA project has a clearly articulated and measurable adoption/extension strategy in place (one page).	Biosecurity Research Section (DAWR) and MPI	Each business case in the workplan has a clearly articulated Adoption / Uptake section
		Provision of progress report towards adoption, checking alignment with the original adoption strategy, providing clear rationale for any move from the original adoption strategy to be reported to the CAB and BRSC.	Biosecurity Research Section (DAWR) and MPI	Biosecurity Research Section confirms progress towards adoption reporting is on track
		Provide an update against the adoption strategy given the outcomes of the research project with an indication of DAWR and MPI intention and pathway to adoption.	CEBRA, MPI and DAWR Project Leaders	DAWR completed an adoption snapshot paper that will be maintained biannually within the department
	Endorsement	At least 90% Project outputs submitted for endorsement per year	Director	The following reports were submitted for endorsement: • 1301A Final Report • 1301B Final Report • 1304A Final Report • 1402A Final Report • 1402B Final Report • 1401D Project Closure Report • 1405C Final Report • 1405D Final Report
		At least 90% Submitted project outputs endorsed by Government per year	Director, BRSC	The above reports were endorsed by the BRSC.

Activity – Research				
Strategic Objective	**Key Performance Indicator**	**Measures**	**Officer**	**Progress/Outcome**
Research and develop new and existing methods relevant to biosecurity risk; Engage the range of disciplinary skills relevant to the analysis of biosecurity risk, to ensure Australian and New Zealand governments remain at the forefront of practical risk assessment; Collaborate and engage with end users to improve adoption of methods and increase the impact of research findings;	Contribute positively to the University's ERA by achieving quality research outputs based on standard measures	Organisational H-Index	Director	CEBRA's H index is 16 CEBRA/ACERA's combined H index is 50.
		Number of Publications per year by Centre staff	Director	CEBRA staff have published several journal articles badged as CEBRA work. Details are provided in Table 5 – List of Publications.
		Other Research Income	Director	CEBRA staff are undertaking additional research contracts for other agencies. Details are provided in Table 4 Institutional Contracts and Consultancies
	Build biosecurity risk analysis capacity in Australia and New Zealand	Number of research higher degree students enrolled	Director	CEBRA is currently supporting ten higher degree students.
		Number of research higher degree students graduated	Director	Aaron Dodd completed PhD. Peixin Yuan completed MSc. John Hicks completed MPhil.
		Number of post-doctoral research fellows employed	Director	Jane Elith, Terry Walshe, Bonnie Wintle, Frith Jarrad, Jan Carey & Anca Hanea provided in-kind support to the Centre.

2016 QAECO and CEBRA retreat - Kinglake Ranges Wilderness Camp

Financial Statement

06

06 Financial Report Summary

CEBRA FINANCIAL STATEMENT 2015/2016	2015/2016
INCOME	
Balance Brought Forward	$ 233,180
Department of Agriculture and Water Resources	$ 1,793,000
Ministry for Primary Industries	$ 275,969
Host Contribution	$ 537,900
Interest	$ 11,457
SUB-TOTAL	$ 2,618,326
OPERATING FUNDS (REVENUE + BALANCE CARRIED FORWARD)	**$ 2,851,506**
LESS EXPENDITURE	
Salaries	$ 341,117
Operations	$ 33,203
Business Development	$ 198,839
Research Contracts	$ 2,019,825
SUB-TOTAL	$ 2,592,984
BALANCE	**$ 258,521**

CEBRA In-Kind Statement

	%	$
Payroll Costs for Research Staff (Melb Uni funded)		
A/Prof B. Wintle	10%	$18,120
A/Prof J. Elith	25%	$26,220
Dr J. Carey	25%	$16,177
Prof M. McCarthy	10%	$21,835
Dr F. Jarrad	10%	$48,227
Dr L. Rumpff	10%	$7,945
Sub-Total		**$138,524**
Infastructure Costs – Staff (On Campus Laboratory) $86,490 / FTER per annum (Grant funded)		
Prof M. Burgman	100%	$86,490
A/Prof A. Robinson	100%	$86,490
Prof T. Kompas	100%	$86,490
Ms J. Holliday	50%	$43,245
Dr T. Hollings	100%	$86,490
Dr S. Lane	100%	$36,037
Dr E. Arndt	80%	$28,830
(Melb Uni funded)		
A/Prof B. Wintle	10%	$8,649
A/Prof J. Elith	25%	$21,623
Dr J. Carey	25%	$21,623
Prof M. McCarthy	10%	$8,649
Dr F. Jarrad	10%	$8,649
Dr L. Rumpff	10%	$8,649
Sub-Total		**$531,914**
Infastructure Costs – RHD STudents (On Campus Laboratory) $39,000 / FTER per annum		
M. Malishev	100%	$39,000
L. Rose	60%	$23,400
S. Bau	100%	$39,000
V. Hemming	100%	$39,000
D. Junaedi	100%	$39,000
Sub-Total		**$179,400**
TOTAL		**$849,838**

Auditors Report

Consulting Technology

oakton
A DIMENSION DATA COMPANY

INDEPENDENT AUDIT REPORT

TO COMMONWEALTH OF AUSTRALIA – DEPARTMENT OF AGRICULTURE, FISHERIES AND FORESTRY 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 2015 to 30 June 2016.

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 $2,592,984 expenditure on the Project; and
- the contributions of the University is $537,900 in cash and $849,838 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: 30 August 2016

Oakton Services Pty Ltd ABN 31 100 103 268
Melbourne *Head office* Level 8 271 Collins Street Melbourne VIC 3000 Australia t +61 3 9617 0200 f +61 3 9621 1951
Sydney Level 3 65 Berry Street North Sydney NSW 2060 Australia t +61 2 9923 9800 f +61 2 9929 6731
Canberra Unit 2 45 Wentworth Avenue Kingston ACT 2604 Australia t +61 2 6230 1997 f +61 2 6230 1919
Brisbane Level 5 200 Mary Street Brisbane QLD 4000 Australia t +61 7 3136 2900 f +61 7 3136 2999
Perth Level 14 Governor Stirling Tower 197 St Georges Terrace Perth WA 6000 Australia t +61 8 6188 7680 f +61 8 6188 7607
Hyderabad Krishe-e 8-2-293 Plot 499 Road 36 Jubilee Hills 500033 Hyderabad India t +91 40 23552694 VoIP: +61 3 9617 0294 **www.oakton.com.au**

Outlook

07

07 The year ahead

We thrive on the opportunity to work on topics that are scientifically challenging and practically relevant. We will continue to be challenged over the next year as the volume of passengers, mail, and global trade in imports continues to grow and changing climate brings new threats and different ways for disease, pests and weeds to spread.

With these challenges in mind and after very fruitful discussions and workshops with our colleagues at the Australian government Department of Agriculture and Water Resources (DAWR) and New Zealand government's Ministry for Primary Industries (MPI), next year's 2016/17 themes and projects have been agreed and approved.

We used the Australian Government's Agriculture Competitiveness White Paper to position and guide our themes and projects. The White Paper outlines the initiatives and commitments by the Australian Government for agriculture.

Our Research priorities for 2016/17 are 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 biosecurity environment by building our capacity and developing professional networks and collaborations.
- **Data and Information –** optimal use of data and information to facilitate better biosecurity risk management

Strengthening Surveillance

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

Project 1606B Operational imports analysis on compliance

Project 1606C Risk mapping import pathway for risk-return opportunities

Project 1606D Quantifying evidence of a plant pest's status of absence

Project 1606E Use of interception data to inform biosecurity system effectiveness. Proportional value of interventions across pathways and layers of the biosecurity system

Building Scientific Capabilities

Project 1607A Value of the biosecurity system

Project 1607B Measuring the health of the biosecurity system

Data and Information

Project 1608A Defensible resource allocation for plant health surveillance based on risk

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

Project 1608C (1504C) Testing incentive-based drivers for importer compliance

Project 1608D Incorporating real-time economic components in Australia's FMD modelling

Project 1608E Development of benefit-cost tools for use during a response to a marine pest incursion

Project 1608F Biosecurity response decision support framework

Next year CEBRA will continue to assist Australia and New Zealand governments to remain at the forefront of practical biosecurity risk assessment by providing collaborative, relevant and practical research outcomes. Of the projects above, those devoted to determining the value and health of Australia's biosecurity system will be among the most important, and are likely to stretch over more than one year.

To meet the growing demand for risk thinking and analysis, the School of Biosciences has launched a new research consultancy and high level training group, the Centre for Environmental and Economic Research (CEER). Professor Tom Kompas is its Director. While separate to the work of CEBRA it will provide Biosciences and CEBRA with access to relevant research strengths and support. CEER will work with government, business and other research groups on environmental and economic research, with a focus on risk assessment and management.

The coming year will provide new opportunities to further develop innovative and tangible outcomes for the challenges facing Australia and New Zealand governments, allowing industries and communities they support to prosper.

Confirmed Research Projects for 2016 /17

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 status of absence
Division: Biosecurity Plant
2016-17: $64,000

Project ID: 1606E ❖ AR
Project Title: Use of interception data to inform biosecurity system effectiveness. Proportional value of interventions across pathways and layers of the biosecurity system.
Division: NZ MPI
2016-17: $81,000

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

Building Scientific Capability $370,000

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

Project ID: 1607B ♦ EA
Project Title: Measuring the health of the biosecurity system
Division: Biosecurity Policy & Implementation
2016-17: $100,000

FUNDING
2016-17: $1,174,000

Data and Information $454,000

Project ID: 1608A TK
Project Title: Defensible resource allocation for plant health surveillance based on risk
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 real-time economic components in Australia's FMD modelling
Division: Biosecurity Animal
2016-17: $94,000

Project ID: 1608E SH
Project Title: Development of benefit-cost tools for use during a response to a marine pest incursion
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

WEB

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

EMAIL

cebra-info@unimelb.edu.au

PHONE

+61 (0)3 8344 4405

FAX

+61 (0)3 9348 1620

POST

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

Australian Government
Department of Agriculture and Water Resources

THE UNIVERSITY OF MELBOURNE

Ministry for Primary Industries
Manatū Ahu Matua

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