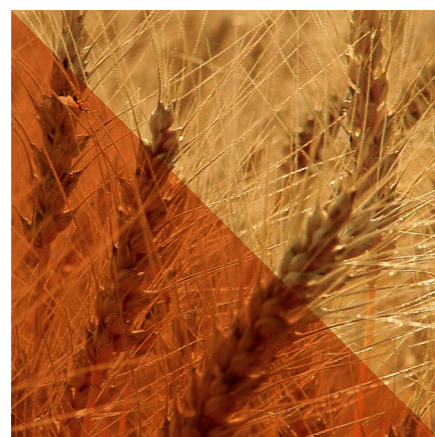
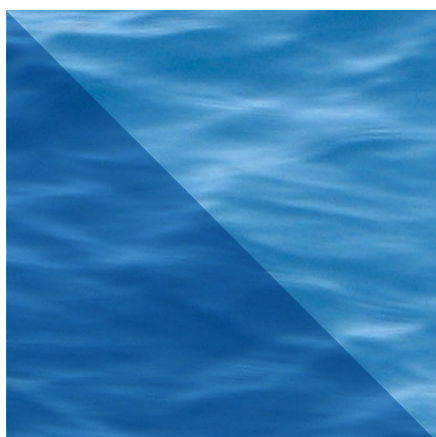


2014/15 CEBRA ANNUAL REPORT



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01 DIRECTOR'S INTRODUCTION

It gives me great pleasure to present the second Annual Report of the Centre of Excellence for Biosecurity Risk Analysis (CEBRA). Since its establishment in 2013, CEBRA has been busy implementing a significant research agenda.



Professor Mark Burgman, Director.

Over the last 12 months, many CEBRA projects have been completed, we have continued to build an exciting research agenda, our international relationships have continued to evolve, and importantly, we are seeing some important commercial applications of our research and models.

It has been a busy year and there have been many highlights.

In August, CEBRA was again very pleased to be a partner for the Society of Risk Analysis – Australia and New Zealand (SRA-ANZ) conference, held at Massey University. Several CEBRA staff and affiliates presented at the conference.

The conference theme was 'Risk beyond the numbers'. CEBRA's Deputy Director, Andrew Robinson, presented his paper "When Does Poor Governance Presage Biosecurity Risks". This focused on the

importance of appropriately designed feedback data in guiding biosecurity investments. Peter Sandman was the keynote speaker and his workshop following the conference was a sell-out.

My presentation, "Tips for Policy Makers to Interpret Scientific Advice", focused on the importance of bridging the communication-divide between researchers and policy makers.

This is a theme that we continue to bring to the work of CEBRA and the way we communicate to our key stakeholder groups. We must always keep focus on ensuring that the work we do is understood and able to be implemented in practice. How we communicate is critical to this and the CEBRA communications workshop in May 2015, attended by staff and Board members, was a key step in helping shape our communications strategy.

On the international front, CEBRA continues to strengthen its linkages with New Zealand's Ministry for Primary Industries (MPI) and Massey University. Project 1402C on the 'Estimation of farm-level livestock using remotely sensed imagery' is an excellent example of this collaboration. This project will improve our understanding of national herd disease levels and inter-farm transmissions and will have important real world applications in New Zealand and Australia. Scoping Study 1405E on the 'Use of Unmanned Aerial Vehicles

(UAV) for Biosecurity Surveillance, Incursion and Response' provided further opportunities to liaise with our MPI colleagues in understanding how to efficiently and cost-effectively include UAVs into existing plant-and-animal-health management programs. Our New Zealand counterparts have collaborated on several other CEBRA research projects throughout the year.

Further abroad I represented CEBRA in Rome at the Food and Agriculture Organization of the United Nations (FAO): Commission on Phytosanitary Measures, Tenth Session. Following that, I spent 10 days in Washington at the Society of Conservation Biology Retreat and visiting United States Department of Agriculture (USDA) colleagues to discuss risk based inspection systems. Finally, I went to Japan where I was joined by Anca Hanea and Cindy Hauser. Together we presented to the University of Tokyo. I also attended a three-day workshop in Kyoto on expert judgement and uncertainty estimation at the Kyoto University.

This year also saw the outbreak of Ebola in West Africa. With cases subsequently reported in the United States, the issue served to highlight the critical importance of understanding our risk exposure, disease pathways and effective response measures. It was good to see Australia's border protection stand up to this threat.

Our valued researchers have also enjoyed some much-deserved recognition throughout the year.

- Deputy Director Andrew Robinson was promoted to Reader and Associate Professor in the School of Mathematics and Statistics at The University of Melbourne in December.
- CEBRA's Jane Elith along with Melbourne University's Mike Kearney received "Recognition of Achievement for a Research Paper" awards – presented to the corresponding author of the most highly cited paper in the British Ecological Society journals for the past 5 years.

In the last 12 months we have had the following reports endorsed by the Biosecurity Research Steering Committee:

- CEBRA project 1304B: Handling uncertainty in the RRRRA model
- ACERA project 1106D: Evaluating the Qualitative Risk Model

- CEBRA project 1302A: Evaluation of arrival pathways and species distribution models
- CEBRA project 1301A: Data mining to improve biosecurity risk profiling. Report on the first cohort of case studies
- CEBRA Project 1301C: Improving ballast water risk tables
- CEBRA Project 1305A: Ornamental fish import surveillance systems interim report
- CEBRA Project 1405D: Illegal logging sampling strategy.

Through implementing this research agenda, our focus remains firmly on delivering against the Centres objective to deliver practical solutions and advice for assessing and managing Australia's and New Zealand's biosecurity risks.

On this point, it is fantastic to see CEBRA being engaged on a number of new external contracts. These engagements are a chance to implement

CEBRA's research tools and findings, demonstrate them in an operational and commercial context, and underpin their broader deployment.

This year CEBRA has delivered 19 peer-reviewed publications and 7 technical reports. I encourage you to review the project summaries in this Annual Report and to refer to CEBRA's website for updates throughout the year.

It has been a fantastic year for CEBRA and I would like to thank all the staff and researchers that have made it a success.

Together we can look back and be proud of how the work of CEBRA is helping to protect the economy and environment of Australia and New Zealand and look forward to another full year ahead.

Prof Mark Burgman FAA
Director, CEBRA

CEBRA's New External Contracts

The following is a selection of new work commenced by CEBRA for other agencies in high-level risk, biosecurity, economic and environmental research:

AUSTRALIAN PESTICIDES AND VETERINARY MEDICINES AUTHORITY (APVMA)

CEBRA is working with AMPVA to develop a risk screening tool. If the system works as envisioned, then it may substantially improve the efficiency of the risk assessment process, providing pathways for safe, rapid assessment of low risk proposals.

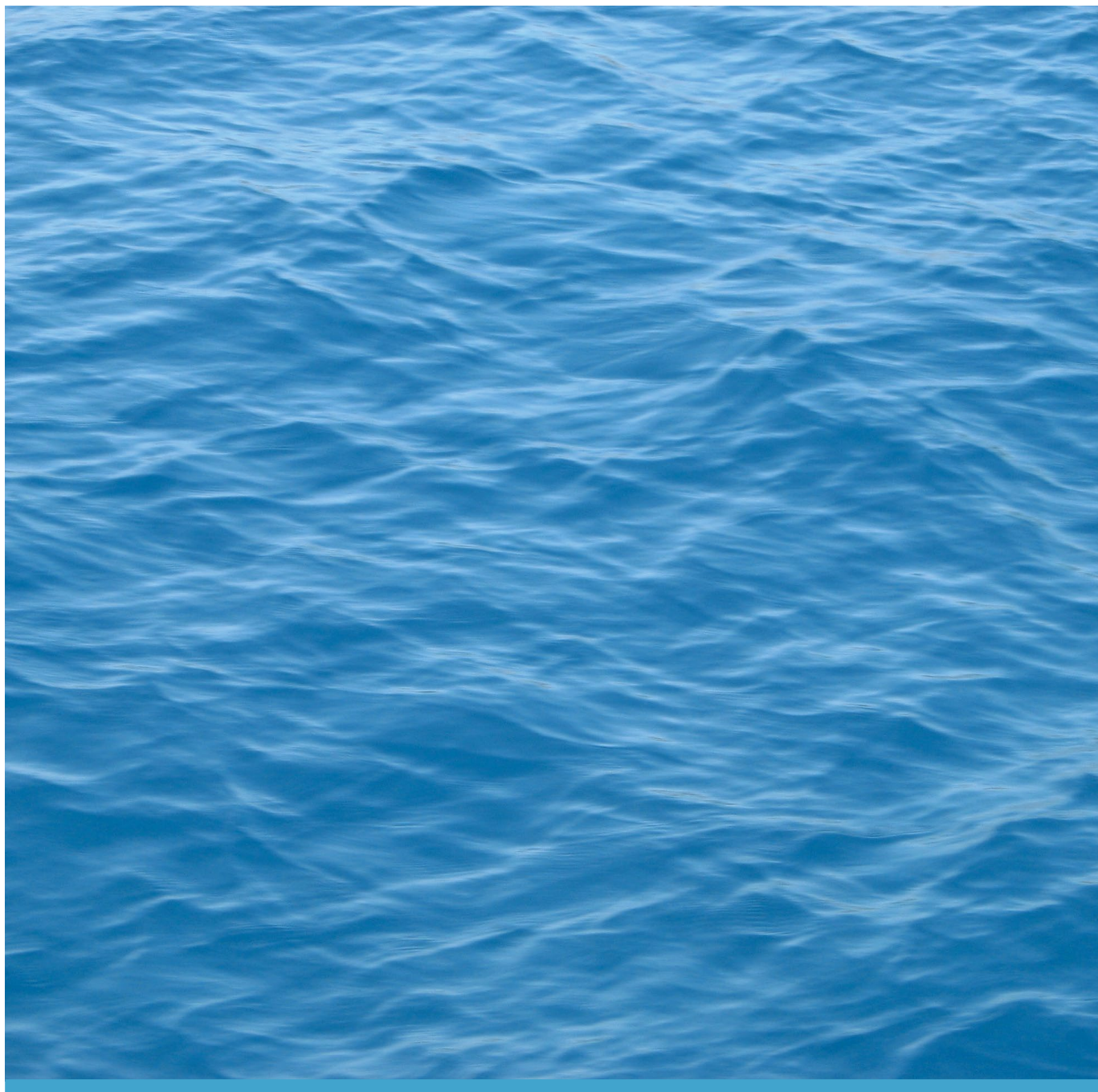
CHEVRON

CEBRA has begun to develop expert judgment elicitation protocols for Chevron's Barrow Island project. The project involves a complex and detailed inspection and surveillance system for biosecurity risks. With the coming changes from construction to operation, the focus of surveillance will shift to anticipate the new risk profile. CEBRA is assisting Chevron and the Queensland Institute of Technology to engage with experts to estimate the new risks.

RED LIST OF ECOSYSTEMS

CEBRA is involved in a new ARC Grant to develop and test rules for assessing the conservation status of ecosystems internationally. CEBRA's contribution will be to provide advice on how experts can best estimate the parameters that will contribute to the assessments.

02 CORE ACTIVITIES



Summary of Core Activities

The Core Activities that the Centre undertook during the Financial Year 2014/2015 comprise the following projects approved by the Biosecurity Research Steering Committee on 12 June 2014:

TABLE 1 CORE ACTIVITIES FOR 2014/15

PROJECT	TITLE	2014-2015 BUDGET
DATA MINING		
1301A	Data mining to improve biosecurity risk profiling	\$78,000
1301B	Analytical assessment of leakage surveys	\$25,000
1401D/E	Data profiling for border compliance and Entry process outcomes in AIMS	\$40,000
SPATIAL ANALYSIS		
1402A	Development of a marine spatial analysis model for improved biofouling risk assessment	\$120,000
1402B	Tools and approaches for invasive species distribution modelling for surveillance	\$150,000
1402C	Estimation of national-level farm demographic data for preparedness of highly infectious livestock disease epidemics	\$158,720
INTELLIGENCE		
1403A	Intelligence gathering and analysis	\$195,000
BENEFIT COST		
1304A	Cost effective surveillance of foot-and-mouth disease	\$91,000
1404C-SP	Testing incentive-based inspection protocols	\$76,000
1404D	Using decision support tools in emergency animal disease planning and response	\$112,162
PATHWAYS		
1405A	Ornamental fish import surveillance systems	\$50,000
1305B	Plant-product pathways and the Continuous Sampling Plan	\$77,000
1405C	Torres Strait risk and resource allocation project	\$165,749
1405D	Illegal logging sampling strategy	\$20,000
1405E	Use of unmanned aerial vehicles for biosecurity surveillance, incursions and response (scoping study)	\$20,000
TOTAL		\$1,378,631

2014/15 CEBRA Biosecurity Research Projects

DATA MINING

AR

Project ID 1301A

Title Data mining to improve biosecurity risk profiling

Leader Greg Hood

MPI Collaborator Christine Reed

Sponsor Raelene Vivian

Budget (14/15) \$78,000

AR

Project ID 1301B

Title Analytical assessment of leakage surveys

Leader Alan Kuffner

MPI Collaborator Sean Callis

Sponsor Raelene Vivian

Budget (14/15) \$25,000

AR

Project ID 1401D/E

Scoping Study Data profiling for border compliance and Entry process outcomes in AIMS

Leader Lloud Grant

Sponsor Raelene Vivian

Budget (14/15) \$40,000

SPATIAL ANALYSIS

MB

Project ID 1402A

Title Development of a Marine Spatial Analysis Model for Improved Biofouling Risk Assessment

Leader Paula Brown

Sponsor Tim Chapman

Budget (14/15) \$120,000

MB

Project ID 1402B

Title Tools and approaches for invasive species distribution modelling for surveillance

Project Leaders Enrico Perotti, Ranjith Subasinghe & Bart Rossel

Sponsors Steve Hathaway, Louise van Meurs, Vanessa Findlay and Sally Troy

Budget (14/15) \$150,000

MB

Project ID 1402C

Title Estimation of national-level farm demographic data for preparedness of highly-infectious livestock disease epidemics

NZ MPI Leader Daan Vink and Mary van An del

NZ MPI Sponsor Christine Reed

Budget (14/15) \$158,720

INTELLIGENCE

MB

Project ID 1403A

Title Intelligence gathering and analysis: International Biosecurity Intelligence System – IBIS

Project Leaders Geoff Grosse l, Sam Hamilton & Neil Grant

MPI Collaborators Christine Reed and Haritina Mogosanu

Sponsor Andrew Cupit

Budget (14/15) \$195,000

BENEFIT COST

TK

Project ID 1304A

Title Cost effective surveillance of foot-and-mouth disease

Leader Graeme Garner

MPI Collaborator Christine Reed

Sponsor Tim Chapman

Budget (14/15) \$91,000

SH

Project ID 1404C

Title Testing incentive-based inspection protocols

Leader Christina Aston and Jessica Sibley

Sponsor Anthony Wicks

Budget (14/15) \$76,000

TK

Project ID 1404D

Title Using decision support tools in emergency animal disease planning and response: Foot-and-mouth disease

Leader Graeme Garner

Sponsor Tim Chapman

MPI Collaborator Dr Andre van Halderen

Budget (14/15) \$112,162

PATHWAYS

AR

Project ID 1405A

Title Ornamental fish import reform – surveillance program

Project Leader Ramesh Perera

MPI Collaborator Brian Jones

Sponsor Andrew Cupit

Budget (14/15) \$50,000

AR

Project ID 1305B

Title Plant-product pathways and the continuous sampling plan

Leaders Christina Aston and Jessica Sibley

Sponsor Louise Van Meurs

Budget (14/15) \$77,000

TK & SH

Project ID 1405C

Title Torres Strait Risk and Resource Allocation Project

Leader Murray Korff

Sponsor Jonathan Benyei

Budget (14/15) \$165,749

AR

Project ID 1405D

Title Illegal logging sampling strategy

Leader Teresa McMaugh

Sponsor Cassandra Kennedy

Budget (14/15) \$20,000

SH

Project ID 1405E

Scoping Study Use of unmanned aerial vehicles for biosecurity surveillance, incursions & response

NZ MPI Sponsor Christine Reed

Budget (14/15) \$20,000

KEY

CEBRA Project Managers:

MB

Mark Burgman

AR

Andrew Robinson

SH

Susie Hester

TK

Tom Kompas

Project Summaries

DATA MINING

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 Management System (VMS) uses data mining techniques to profile international vessels



5. Estimating compliance with inadequate data (transfer learning) to 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.

These sub-projects have been prioritised, and the analytical work and reporting for sub-projects 1, 3, 4, and 6 have been completed. Sub-projects 2 and 7 are still underway, sub-project 5 has been downgraded by the Department, and further data collection is continuing – namely the sourcing of extra information from Customs – for an augmented re-analysis of sub-project 2.

1301B: Analytical assessment of leakage surveys

The Department screens and inspects international passenger and mail pathways. For the last ten years the Department has assessed its intervention and screening effort in these pathways by means of endpoint surveys. The endpoint surveys involve inspecting a sample of passengers or mail after all other intervention. This two-year project involves a review of how the endpoint surveys are carried out, along with recommendations as to how it could be improved. The final report combines the outcomes of detailed interviews with regional officers and an extensive simulation experiment.

1401D/E: AIMS and SAC Text Mining

Imported cargo consignments ('entries') are declared to Australian Customs and Border Protection Services (AC&BPS) either as a Full Import Declaration (FID) or a Self-Assessed Clearance (SAC). FIDs are required when the declared value of the goods is \$1000 or more, and SACs when less than \$1000. SAC data integrity is not an AC&BPS priority, so most SAC data supplied by brokers/importers is invalidated free text. Department staff manually assess all SACs referred from Integrated Cargo System to decide whether further action is required.

Department staff manually process all upgraded SACs and directly referred FIDs in AIMS (Agriculture Import Management System). Much of the information critical to supporting risk-based intervention, such as the reason for direction failure, is recorded in free text fields in AIMS. Project 1401D/E is a scoping study that will explore the potential of text mining to (i) improve profiling on SACs by extracting information from the large amount of free text held in the SAC database and (ii) identify common phrases and terms recorded by officers in the free text fields to inform an electronic systems change request to add meaningful phrases in drop lists and restrict/limit the use of free text recording in AIMS.



The Department's risk-based approach on cargo pathways is being hindered by the inability to extract usable information from the free text fields in AIMS and SAC. The free text data are a potential goldmine of untapped information that would be useful for constructing profiles that better target inspectorate activity, and for providing feedback to brokers and importers on how they can better comply with regulations. This project will identify techniques that can unlock these untapped sources of information.

The Department's risk-based approach on cargo pathways is being hindered by the inability to extract usable information from the free text fields in AIMS and SAC

SPATIAL ANALYSIS

1302A: Evaluation of Arrival Pathways and Species Distribution Models

The primary objective of this project was to evaluate spatial tools and methodologies that can inform high-risk pathways and priority locations for the potential establishment of species of concern (SOC). The Department's current risk assessment tools for the marine environment do not have the capacity to characterise high risk pathways based on the current distribution and ecological tolerances of biofouling species of concern, or ports visited by international vessels arriving in Australia. In terrestrial environments there is no single, broadly-accepted, easy to implement methodology to pinpoint high priority locations for potential SOC establishment.

A range of Department and academic experts participated in several workshops and identified a range of available methodologies to be assessed, the criteria they were to be assessed against, and example scenarios in both marine and terrestrial contexts for the methodologies to be applied to. Criteria for assessment were broadly based on the defensibility of the methodologies and the human and organisational factors that needed to be considered for successful implementation. This project concluded with recommendations for further developing models that suit the data and regulatory constraints of the Department's and MPI's contexts. The results of this work were used to design the follow-up projects, to run in 2014-15, to develop new, spatially explicit modelling tools that are suited to a range of biosecurity contexts, and suitable for marine and terrestrial contexts.



1402B: Tools and Approaches for Invasive Species Distribution Modelling for Surveillance

Jane Elith, Simon Barry and Michael Kearney worked together to develop an approach that integrates explicit ecological models with the statistical models used routinely for terrestrial habitat suitability modelling. They held a workshop on October 3, 2014 and developed a research agenda and allocated tasks for delivery of the research objectives outlined in the plan. The project team met in January and again in March 2015, to outline progress and discuss next steps. They have completed a review of analytical methods, and created a set of new proximate variables that will better predict the potential distribution of species in novel environments. The new approach was applied to several case studies, including cane toads, fruit fly and Myrtle rust.

The 1402C research group have developed a suite of models to predict animal numbers on individual farms.

1402C: Estimation of National-Level Farm Demographic Data for Preparedness of Highly-Infectious Livestock Disease Epidemics

The team of Tracey Hollings, Mary van Anel, Daan Vink, Chris Jewell, Andrew Robinson and Mark Burgman has met many times in Australia and New Zealand. Mary van Anel has completed a review of available data. Tracey Hollings reviewed GIS-based approaches to predicting animal numbers. Daan Vink developed a strategy to generate data that can be used as a gold standard to test regression models. The meeting on October 21, 2014 in Wellington finalised the analytical approaches, potential explanatory variables, variable selection procedures, and methods for testing the models. The group have developed a suite of models to predict animal numbers on individual farms. The models are complete and the interim report has been submitted to the Steering Committee.

INTELLIGENCE

1303A: Intelligence Gathering and Analysis

In 2012-13, the project team developed a new web site, AquaticHealth.net, an open-source aquatic biosecurity intelligence gathering and analysis application. The system collected information in much the same way as other similar systems (e.g. HealthMap, BioCaster). However, the information collected undergoes minimal automated analysis, and analysis is largely left to AquaticHealth.net's users. The result was an automated system of intelligence gathering, combined with a manual system of intelligence analysis.

This approach relies on a large number of users, and so AquaticHealth.net relies on an open-intelligence analysis method; any user can publish their own analyses for all to see and analyse further. By combining automated data collection and human analysis, AquaticHealth.net provides fast and accurate forecasts, accompanied with nuanced explanations.

The project now incorporates aquatic health (www.aquatichealth.net), plant health (www.planthealth.org), and animal health (www.animalhealth.org), of which the aquatic site is the most operationally advanced. In the final stages of this project, the aquatic and terrestrial animal and plant intelligence gathering and analysis tools were integrated on one site (named the International Biosecurity Intelligence System or IBIS). Integration on a single platform improves intelligence sharing, achieves synergies in research and IT building efficiency and simplifies ongoing site maintenance. The site development included many changes to the graphic interfaces and data summary pages, to enhance performance and understanding. The



research group also developed manuals to support users, and implemented searches of materials in languages other than English.

The new provider, Technocrat, was appointed in July 2014. Initially, they have been working on stabilising the site and its server, and identifying and fixing the most pressing software problems. The site was reviewed in March 2015 and Technocrat provided two reports to the Department in May 2015. They indicated a need to transfer the site to a new architecture, to provide the flexibility and computing power necessary to deal with the growing user base. They also described a range of new user features that would encourage more feedback from the participants. These recommendations were reviewed by an independent expert (Steven Mascaro of Bayesian Intelligence). He verified the need for the suggested actions and costs, and Technocrat agreed to undertake the translation of the site to the new architecture.

BENEFIT COST

1304A: Cost Effective Surveillance of Foot-and-Mouth Disease

Looking for disease early in an outbreak is problematic. When prevalence is low, you need wide coverage of the population and high sampling rates. As you can't know when foot-and-mouth disease (FMD) might be introduced, programs need to be ongoing. In this study, active surveillance of healthy animals at sale-yards did not improve detection times over the current passive system, whilst requiring large numbers of animals to be tested. Testing of large numbers of animals would also inevitably result in false positive results that would cause logistical problems for sale-yard operators and animal health authorities (as well as potential trade ramifications). Bulk-milk testing (BMT), while showing considerable promise as a diagnostic tool, was also not economical as a primary active detection strategy. This could change if the likelihood of an FMD incursion is considered to be greater than a one-in-50-year event or if the cost of BMT could be reduced to around \$2 per test. However, BMT was found to be highly suited to active surveillance after an FMD incursion, both to shorten the size and duration of an outbreak, and for post-outbreak 'proof-of-freedom' testing. The report concluded that enhancing the current passive system offers the best opportunity for improving times to detection of FMD in Australia. This will have particular benefits in reducing the likelihood of having a large outbreak. While maintaining a high level of awareness of FMD and promoting the need for disease reporting by all producers is essential, if resources are limited, targeting education programs to those sectors that are considered to be at greatest risk of being a source of introduction or where current disease reporting and investigation is low is likely to be a more effective use of resources.



1304C-SP: Market-Based Incentives for Biosecurity Compliance

The response of import-chain participants to compliance-based inspection protocols, such as the CSP-3 approach, was explored in this project. Six plant product pathways were selected as case studies for this analysis: cut flowers; green coffee beans; vegetable seeds for sowing; plant-based stockfeed; peat and peat products; and dried vegetables. Interviews with agents in the supply chain (customs brokers and importers) for each pathway allowed an understanding of the scope of import-chain participants to respond to changed inspection regimes. Analysis of the interviews, along with theoretical modelling and analysis of the Department's AIMS and Incident databases were used to select two pathways for further analysis: the sphagnum peat moss pathway and a subset of the vegetable seeds for sowing pathway. For both pathways it is recommended that a 'menu of regulatory contracts', with refined pathway definitions, be applied.

The next step ... is to test and refine proposed inspection protocols using simulated scenarios in a computer based experimental economics laboratory

1404C-SP: Testing Incentive-Based Inspection Protocols

The response of import-chain participants to incentive-based inspection protocols, including the current CSP-3 approach for selected plant-product pathways, was explored in CEBRA Project 1304C. Outputs from that project advise on potential ways to design such protocols, and lay the groundwork for a proof-of-concept trial for adaptive sampling protocols. The next step in determining how to apply compliance-based protocols is to test and refine proposed inspection protocols, using simulated scenarios in a computer based experimental economics laboratory as required. This testing and refinement is the focus of 1404C. Testing is required to examine whether the behaviour predicted by the theoretical framework and verified by interviews with stakeholders, carries over in practical application.

1404D: Using Decision Support Tools in Emerging Animal Disease Planning and Response: Foot-and-Mouth Disease

The project progressed over the 2014-15 period with the following milestones completed: (1) Project preparation and work plan established; (2) A scoping workshop was held from 3-5 September, 2014 to meet with key stakeholders and project participants; (3) Model set up and cross validation (Phase 1) – this included cross Tasman communication to align FMD simulation models, agreement on scenarios and parameters to use in the models, and version updates and trouble shooting of the new national Australian model AADIS; (4) Simulation runs of Australian and NZ models and analysis of results to complete Phase 1; (5) Simulation runs of Australian and NZ models and multivariate analysis of early disease indicators (Phase 2); and (6) Completion of an interim report of activities and findings to date. In view of some technical delays, the project team revised the work plan and reduced the scope of the project, with the following changes made: (1) Limited number of scenarios assessed in both countries, reducing the validation component of the study to the 'silent spread phase' in both countries and the 'control phase' in Australia. This is due to technical difficulties experienced with the new Australian modelling platform in implementing control measures in the NZ setting, and reducing the number of strategies assessed for early disease indicators; and (2) Delaying Phase 3 (completion of simulations and economic optimization) to 2015-16.



PATHWAYS

1405A: 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

The Department has proposed changes to the way it manages the disease risks associated with imported ornamental fish

of overseas authorities and exporters in meeting the health requirements for ornamental fish exported to Australia. This ongoing project focuses on developing and trialling a sampling framework for the proposed surveillance program.

Phase two of the sampling framework is underway in the South East Regional Office. A workshop held on August 7, 2014 identified the structure of questions and the focus of expert elicitation for both inspection and laboratory observations. The outcomes of this workshop were used to design a questionnaire that has been distributed among relevant experts more broadly. The elicitation process is underway, led by CEBRA's Jan Carey and the Department's Yuko Hood.

1305B: Plant-Product Pathways and the Continuous Sampling Plan

Studies of CSP (continuous sampling plan) strategies carried out by ACERA, ABARES and the Plant Division of the Department 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 nature 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 harmonizing the simulation experiments with the operational pathway management practices. Further work is underway on analysis of data arising from CSP experiments.

1405C: Torres Strait Risk and Resource Allocation Project

The Torres Strait Islands (TSI) are a primary pathway for the entry and establishment of exotic pests and diseases. This project identified 10 major pathways, with a focus on movements of people and small boats and environmental pathways, between the islands and to the mainland of Australia. The project constructed a Bayesian network model to characterise all of the relevant pathways. Expert elicitation was used to generate key parameter values. The project also generated portfolio allocation and consequence measures. The focus was on Papaya Fruit Fly (PFF), Citrus Canker (CC) and rabies. Applying a spatial-economic model and using Monte Carlo stimulations, estimated results indicate the average (nominal) potential cost per year in Queensland caused by a PFF incursion and spread is \$16.1 million. The total net present value of the potential cost of PFF (over 25 years) is estimated to be from \$214.3 million to \$250.0 million, with an average of \$231.9 million. On average, the potential cost of a CC spread and establishment is estimated to be \$6.9 million and \$5.5 million per year for Queensland and New South Wales, respectively. The potential cost of CC is most important for the Burnett Mary region (Queensland) and the Riverina (New South Wales). For rabies, the report focused on a rabid dogs analysis, providing preliminary estimates of mass dog vaccination costs due to a rabies outbreak along with other potential costs of a rabies endemic. The cost of mass dog vaccinations is estimated to be \$5.9 million, \$8.5 million, \$7.7 million and \$5.8 million for



Queensland, New South Wales, Victoria and South Australia, respectively. For the case of a rabies outbreak (without an eradication strategy), the average cost of Post Exposure Treatment (PET) per year is estimated to be \$3.8 million, \$6.0 million, \$4.7 million and \$1.3 for Queensland, New South Wales, Victoria and South Australia, respectively. Losses to livestock range from \$45,000 to \$200,000 per year, and vary by State. All results show that the TSI pathway shows a risk of significant economic damages, underscoring the ongoing need for effective surveillance and quarantine activities in this region.

The Torres Strait Islands are a primary pathway for the entry and establishment of exotic pests and diseases. This project identified 10 major pathways, with a focus on movements of people and small boats and environmental pathways, between the islands and to the mainland of Australia.



1405D: Illegal Logging Sampling Strategy

The Illegal Logging Prohibition Act 2012 and the Illegal Logging Prohibition Amendment Regulation 2013 introduce new due diligence requirements for importers of regulated timber products and processors of domestic raw logs from November 30, 2014.

The Department of Agriculture is developing a phased approach to assessing compliance to the new requirements. In the first phase, the Department will work in partnership with industry with a focus on raising awareness, educating and encouraging voluntary compliance, before moving to a second phase that may comprise more comprehensive compliance assurance controls.

This project addresses the Department's lack of information on the community that it will be regulating. The primary objectives of measurement are to understand the environment of the regulated community and collect information about gaps in compliance. The project developed sampling plans and provided advice on the practical and statistical elements of measurement.

1405E: Use of Unmanned Aerial Vehicles for Biosecurity Surveillance, Incursions and Response – Scoping Study

The performance, capability and payload options for Unmanned Aerial Vehicles (UAV's) in plant biosecurity are reasonably well understood, the challenge is now in understanding how to efficiently and cost-effectively include UAVs into existing plant – and animal – health management programs. Benefits of UAVs in biosecurity include that there is little or no environmental impact as a result of data collection, and that they provide a solution to data collection in inaccessible landscapes. Further, the range of UAV platforms and sensor combinations available should allow for selection of a UAV that allows data collection at a cost that is competitive with other surveillance methods.

A potential CEBRA project has been suggested. The project involves the development of a mathematical model that would be used to investigate the general problem of managing an incursion by allocating a limited budget to surveillance (either on-ground or remote using UAVs) and treatment activities. In general terms, on-ground

surveillance is a high-sensitivity and high-cost option, whereas remote surveillance tends to have lower cost and sensitivity, so it is able to cover large areas at relatively low cost. The relative cost and effectiveness of the two methods will determine their optimal combination for preventing entry or spread of any given pest.

In general terms, on-ground surveillance is a high-sensitivity and high-cost option, whereas remote surveillance tends to have lower cost and sensitivity, so it is able to cover large areas at relatively low cost

The general model could then be applied to specific problems of interest to Australia and New Zealand, such as:

- the economics of early detection of myrtle rust (or other wind-borne pathogens) using mobile spore traps fitted to UAVs;
- using UAVs in the management of orange hawkweed in Victoria and New South Wales, with a particular focus on delimitation; and
- assessing the sensitivity of the infrared thermography sensor that would be required to warrant investment in the use of thermal imaging to detect FMD or speed up the delimitation of an incursion during a response programme.

Deliverables and Milestones Achieved

The following table details the Core Material that was 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

PROJECT ID	OUTPUT ID	OUTPUT	MILESTONE DATE	FOR ENDORSEMENT	STATUS
1301A	1	Review of data sources	Jan-14	Yes	Complete
	2	Report of first suite of project	Sep-14	Yes	Complete
	3	Report of second suite of projects	Jun-15	Yes	In Progress
1301B	1a	Detailed plan for site visits	Nov-13	No	Complete
	2a	Conduct site visits	Jan-14	Yes	Complete
	3a	Conduct literature review	Jun-14	No	Complete
	4a	Complete draft report of findings	Sep-14	Yes	Complete
	5	Finalise report incorporating feedback from stakeholders, and submit to Steering Committee for endorsement	Jan-15	No	In Review
	6	Discussions with key stakeholders on the preferred solutions to identified issues	Apr-15	Yes	In Progress
	7	Complete draft procedural documentation to address the issues as agreed	Jun-15	No	In Progress
1401D/E	1	Final Report	Jan-14	Yes	In Review
1402A	1	Data availability for operational risk assessment and identification of experts	Sep-14	No	Complete
	2	Review of relevant literature completed and elicitation material developed for approval by CEBRA/DA	Nov-14	No	Complete
	3	Expert Elicitation completed	Mar-15	No	Complete
	4	Predictive modelling approach developed and tested	Apr-15	No	Complete
	5	Final report detailing risk tool	Jun-15	Yes	In Review
1402B	1	Project workshop and work-plan finalising task list, allocated staff and timelines	Jul-14	No	Complete
	2	Draft spatial procedures and guidelines development for consultation	Nov-14	No	Complete
	3	Case studies (NZ Forests, Northern Australia)	Mar-15	No	In Progress
	4	Final Report	May-15	Yes	In Progress

TABLE 2 RESEARCH OUTPUTS CONT.

PROJECT ID	OUTPUT ID	OUTPUT	MILESTONE DATE	FOR ENDORSEMENT	STATUS
1402C	1	Literature Review / Situational Analysis	Jul-14	No	Complete
	2	Interim Report	Jan-15	No	Complete
	3	Final Report	May-15	No	Complete
	4	Dissemination and Training	Jun-15	No	Complete
1403A	1	Implement and test multiple language translation support	Dec-15	No	Complete
	2	Enhance performance	Dec-15	No	Terminated
	3	Integrate biological taxonomy	Dec-15	No	Complete
	4	Implement revised search term structures	Dec-15	No	Terminated
	5	Implement word network analysis	Dec-14	No	Complete
	6	Develop user documentation (work-flow manuals) and provide intelligence and foresight training to departmental analysts	Dec-15	Yes	Complete
	7	Improve capacity to receive and scrape valuable biosecurity information normally unobtainable through searching	Dec-14	No	Complete
1304A	1	Establish a Project Steering Committee	Jul-13	No	Complete
	2	Establish an End-Users Group (including representatives from DA and AHA) and meetings with the Project Team throughout the term of the project	On-going	No	Complete
	3	Develop and conduct a scoping workshop for the project, establishing project design, collaboration and additional reporting mechanisms.	Aug-13	No	Complete
	4	Draft Report for candidate surveillance measures and workshop	Apr-14	No	Complete
	5	Presentation of the results to stakeholders and at international and domestic conferences and workshops	Sep-14 Dec-14	No	Complete
	6	Final presentation to DA and Policy Briefing	Jun-15	Yes	Complete
	7	Final report	Jun-15	No	In Review
1404C	1	Formal project start	Jan-15	No	Complete
	2	Workshop on economic experiments and evaluation framework for laboratory tests	Mar-15	No	In Progress
	3	Progress report on experimental design for field pilot	Jun-15	Yes	In Progress

PROJECT ID	OUTPUT ID	OUTPUT	MILESTONE DATE	FOR ENDORSEMENT	STATUS
1404D	1	Project preparation	Aug-14	No	Complete
	2	Scoping workshop – meetings with key stakeholders and project participants	Aug-14	No	Complete
	3	Simulation runs of the Australian and NZ models and assessing the effectiveness of various control measures	Dec-14	No	In Progress
	4	Evaluation and analysis of the optimal FMD control measures	Dec-14	No	In Progress
	5	Optimisation techniques	Apr-15	No	In Progress
	6	Presentation of the results to stake holders	Jun-15	No	In Progress
	7	Final report and presentation	Jun-15	Yes	In Progress
1405A	1	Evaluate trial phase 2 at intervals throughout the operation and at the completion	Aug-14	No	Complete
	2	Spreadsheet tool/script for analysis of phase 2 inspection and testing data	Aug-14	No	Complete
	3	Identify protocols/analysis that can be used to prioritise signs of emerging disease	Dec-14	No	Terminated
	4	Updated spreadsheet tool/script that includes monitoring for emergent risks and flexibility for expansion	Mar-15	Yes	Terminated
	5	Design and recommendations for the full fish health monitoring system	Jun-15	Yes	In progress
1305B	1	Re-code the simulation tool	Dec-13	No	Complete
	2	Report on failure types	Jun-14	No	In Progress
	3	CSP utility measure methodology	Dec-14	Yes	Terminated
	4	Data mining and profiling report	Jun-15	No	In Progress
	5	Block bootstrapping assessment	Dec-14	Yes	In Progress
	6	Develop reporting tools on performance metrics	Jun-15	Yes	In Progress
1405C	1	Form Project Steering Group and initiate a specific project strategy/adoption plan	On-Going	No	Complete
	2	Establish relative risk measures for candidate pathways and begin to determine potential consequences of key incursions; data requirements and data capture models	Sep-14	No	Complete
	3	Construction of resource allocation models and measures of best-practice and/or local optimal surveillance measures	Mar-15	No	Complete
	4	Draft report and stakeholder workshop	Mar-15	No	Complete
	5	Final Report	Jun-15	Yes	In Review

TABLE 2 RESEARCH OUTPUTS CONT.

PROJECT ID	OUTPUT ID	OUTPUT	MILESTONE DATE	FOR ENDORSEMENT	STATUS
1405D	1	Requirements gathering	Jul-14	No	Complete
	2	Stage one <ul style="list-style-type: none"> Defensible and statistically sound advice on the sampling regime, including advice on the sample size of operators per year and on the sample design Defensible and statistically sound advice on how to stratify the sample, for example by industry sector, regulated product group, import volume or value, industry demographic and/or business size, taking into account both domestic processors and importers. advice on the sampling frequency for importers and processors 	Jul-14	No	Complete
	3	Stage two <ul style="list-style-type: none"> Build compliance data and provide data to CEBRA Analysis of compliance data by CEBRA Advice on interpretation and conclusions provided by CEBRA to the Department 	Jun-15	No	Complete
	4	Monitor and control <ul style="list-style-type: none"> Project deliverables attain acceptance by the CEBRA Science Research Committee Project deliverables attain acceptance by the Biosecurity Research Steering Committee Periodic ongoing updates to the Illegal Logging Project Board 	Jun-15	Yes	Complete
1405E	1	Project closure report	Mar-15	No	Complete

03 RESEARCH & DEVELOP RISK METHODS



Adoption Activity

1301C: Improving Ballast Water Risk Tables

Cargo-carrying vessels use the uptake and discharge of ballast water to enable safe and reliable travel. Ballast water is simply seawater that is stored in large tanks in the vessel. The uptake and subsequent discharge of ballast water presents a biosecurity risk in that invasive biota can be transported from the point of uptake to the point of discharge, along with the water. The Department manages the biosecurity risk of such ballast water exchange by identifying pairs of ports for which such exchange presents an unacceptable risk, using models of sea-surface temperature data and the life cycle of a number of identified marine pests.

Ballast water presents a biosecurity risk in that invasive biota can be transported from the point of uptake to the point of discharge, along with the water

These port pairs are communicated in a risk table. Earlier ACERA work identified some shortcomings in the development and implementation of the models. CEBRA Project 1031C, which involved cooperation with ABARES, provided fixes to these shortcomings in an updated set of risk tables. The adoption outcome is that these tables have been accepted and implemented by the Marine Pest Sectoral Committee, which is the peak regulatory body.

1402B: Tools and Approaches for Invasive Species Distribution Modelling for Surveillance

CEBRA facilitated the participation of the company Bayesian Intelligence in the development of exposure models for New Zealand forests and for the Northern Australian Quarantine Strategy (NAQS) surveillance systems for fruit fly incursions in Northern Australia. These models are complete. CEBRA's new project 1502E will link them to the spatial models developed by Dr Simon Barry of the CSIRO, as part of CEBRA's research activities.

1403A: Intelligence Gathering and Analysis

CEBRA's IBIS project continues to provide valuable intelligence especially for animal and marine pests and diseases. The developer, Technocrat, made a number of recommendations to improve site functionality, confirmed by two independent reviews of the system. The most important are to migrate the site to a more flexible and efficient operating environment, and to improve the graphical interface. This work will be the major focus for IBIS in 2015-16. This will provide the platform for developing a generic site that can be adapted to a range of other domains.



1304A: Cost Effective Surveillance of Foot-and-Mouth Disease

The project showed that a number of active surveillance protocols for foot-and-mouth disease (FMD) are not cost-effective. The only possible candidate is bulk-milk testing, which is clearly cost effective post-incursion. This provides the Department with a valuable response strategy should an FMD outbreak occur. It also highlights the need to invest in an enhanced passive surveillance system, and to make certain that the current passive surveillance system remains effective. The results of Projects 1304A (FMD surveillance) and 1405C (Torres Strait Island pathway analysis), when combined, along with revised ACERA work on Red Imported Fire Ants and Hawkweed, were presented to the National Biosecurity Committee as part of a platform to help determine the optimal allocation of biosecurity funding to these potential and ongoing incursions.

1405A: Ornamental Fish Import Surveillance Systems

Every year, Australia imports about 20 million ornamental finfish. Trade in ornamental finfish is of particular biosecurity concern worldwide because they carry a range of parasitic, bacterial, and viral pathogens, including iridoviruses. It is well known that global trade in ornamental fish contributes to spread of these transboundary infectious pathogens. Proposed changes to risk management of this pathway 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. Such a system requires a risk-sensitive system that monitors the risk of several target pathogens as well as providing intelligence about changing patterns of disease epidemiology and emerging diseases, in the manner of syndromic surveillance. The adoption outcome for this ongoing project is that a monitoring system proposed by this CEBRA project, which is based on the industrial quality control algorithm CSP-3, has been implemented on a trial basis in each port of entry – Melbourne, Sydney, Perth and Brisbane.

1405C: Torres Strait risk and resource allocation project

The Bayesian Network is being used by the Department in Cairns to understand and analyse key potential pathways, and their associated risks in the Torres Strait Island (TSI).

The Bayesian Network is being used by the Department of Agriculture in Cairns to understand and analyse key potential pathways

The Bayesian Network also highlights major points where there is a lack of understanding about these pathways, and where additional data and expert elicitation is needed. The consequence measures developed in this project are being used to calibrate potential damages from an incursion, with a particular focus on issues of key concern to the Department – Papaya Fruit Fly, Citrus Canker and rabies. The results of Projects 1304A (FMD surveillance) and 1405C (TSI pathway analysis), when combined, along with revised ACERA work on Red Imported Fire Ants and Hawkweed, were presented to the National Biosecurity Committee as part of a platform to help determine the optimal allocation of biosecurity funding to these potential and ongoing incursions.

1405D: Illegal Logging Sampling Strategy

Illegal logging is a considerable threat to the biodiversity and health of global forests. The Australian Government introduced legislation requiring importers of timber products and domestic processors of Australian grown raw logs to assess and manage the risk that the products they import or process are illegally logged (the Illegal Logging Prohibition Act 2012 and Illegal Logging Prohibition Regulation 2012). The Department is responsible for designing and implementing a compliance assessment program for the regulation, to assess the compliance of regulated clients. This project focused on two areas, namely (i) the provision of sampling advice about targeting and (ii) data analytical support for the analysis of data provided by Customs. A sample survey design was developed by the Department with CEBRA expert input, and the results of the analysis of the Customs data. The adoption outcome is that the survey is ongoing, and the statistical advice provided by CEBRA has shaped the design and intended analysis.

PHD Students

CEBRA has made 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 PHD STUDENTS

STUDENT	TITLE	SUPERVISOR
CURRENT PHD STUDENTS		
Bisono, Indriati	PhD: Modelling spatial extremes	A/Prof Andrew Robinson
Dodd, Aaron	PhD. Predicting invasion success	Prof Mark Burgman
Hemming, Victoria	PhD. Selection of experts for expert judgement using test questions	Prof Mark Burgman
Hicks, John	MPhil. Robust optimal decision making in traditional Aboriginal culture	Prof Mark Burgman
Jones, Stuart	PhD. Numerical methods for biosecurity risk analysis	Prof Mark Burgman
Malishev, Matthew	PhD. Feeding ecology and behaviour	Prof Mark Burgman
Rose, Lucy	PhD. Managing Melbourne water for biodiversity	Prof Mark Burgman
Yuan, Peixin	PhD. Performance of CSP algorithms under incomplete inspection	A/Prof Andrew Robinson
COMPLETED PHD STUDENTS		
Karavarsamis, Natalie	PhD. Methods for estimating occupancy	A/Prof Andrew Robinson
Lazaridis, David	PhD. Regularised mixed-effects models	A/Prof Andrew Robinson

Institutional Contracts and Consultancies

The specific expertise of CEBRA's staff have resulted in several institutional contracts and consultancies being awarded to CEBRA. These consultancies require experience in contract management, administration, financial planning, strategic planning and business management.

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 David Keith Prof Richard Kingsford Prof Mark Burgman Dr Emily Nicholson Dr Tony Auld A/Prof Jon Rodriguez Dr Tracey Regan Dr Philip Pisanu Dr Rebecca Lester
Australian Research Council	2011-2014	DP110103159 New models for effective surveillance	\$255,000	Prof Mark Burgman Prof Colin Thompson A/Prof Andrew Robinson
Australian Pesticides and Veterinary Medicines Authority	2014-2015	Risk screening tool	\$241,500	Prof Mark Burgman
Chevron	2015	Review of Barrow Island BioSecurity Surveillance System	\$147,300	Prof Mark Burgman
Australian Customs and Border Protection Service	2015	Enhanced sampling program	\$44,000	A/Prof Andrew Robinson
Department of Infrastructure and Regional Development	2015	Report on Utility of ETD Deployment Arrangements	\$77,990	A/Prof Andrew Robinson

04 DOCUMENT & COMMUNICATE FINDINGS



Publications

Many of CEBRA's reports have been published in a range of international scientific journals, ensuring the latest findings are communicated to the scientific community, students, governments and other interested stakeholders around the world. CEBRA publications have appeared in Conservation Biology, Ecological Applications, Risk Analysis, PLoS One, Diversity and Distributions, and Applied Ecology among others.

TABLE 5 LIST OF RESEARCH PUBLICATIONS

	ISI IMPACT FACTORS 2014	NO. OF CITATIONS AS AT 30/6/15
IN PRESS/EARLY VIEW		
Burgman, M.A. (2015 in press) <i>Trusting judgements: how to get the best out of experts</i> . 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	–
Dodd, A. J., Burgman, M. A., McCarthy, M. A. and Ainsworth, N. (2015 in press) The changing patterns of plant naturalizations in Australia. Diversity and Distributions	3.667	–
Elith, J. (2014 accepted). Chapter 6: predicting distributions of invasive species in Walshe, T.R., Robinson, A., Nunn, M. and Burgman, M.A. Risk-based decisions for biological threats . Cambridge University Press	N/A	4
Ha, P.V. and Kompas, T. (2015) Solving intertemporal CGE models in parallel using a Singly Bordered Block Diagonal ordering technique. Economic Modelling	N/A	–
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	2.944	–
King, S.L., Schick, R.S., Donovan, C., Booth, C.G., Burgman, M., Thomas, L. and Harwood, J. (2015 in press) An interim framework for assessing the population consequences of disturbance. Methods in Ecology and Evolution	6.554	–
2015		
Akter, S., Kompas, T., Ward, M.B. (2015) Application of portfolio theory to asset-based biosecurity decision analysis. Ecological Economics 117: 73-85	2.72	–
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	3.667	2
Fithian, W., Elith, J., Hastie, T. and 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	6.554	10
Guillera-Arroita, G., Lahoz-Monfort, J.J., Elith, J., Gordon, A., Kujala, H., Lentini, P.E., McCarthy, M.A., Tingley, R. and Wintle, B.A. (2015) Is my species distribution model fit for purpose? Matching data and models to applications. Global Ecology and Biogeography Vol 24 (3) 276-292	7.242	5
Jaskierniak, D., Benyon, R., Kuczera, G., and Robinson, A.P. (2015) A new method for measuring stand sapwood area in forests. Ecohydrology Vol 8 (3) 504-517	2.426	1

TABLE 5 LIST OF RESEARCH PUBLICATIONS CONT.

	ISI IMPACT FACTORS 2014	NO. OF CITATIONS AS AT 30/6/15
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., Oliveira-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	7.241	1
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	1.495	–
Lyon, A., Wintle, B. and Burgman, M. (2015) Collective wisdom: methods of confidence interval aggregation, Journal of Business Research 68, 1759-1767	N/A	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: Jarrad, F., Low-Choy, S. and Mengersen, K. (eds) Biosecurity surveillance: Quantitative approaches . CAB International	N/A	–
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	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: Jarrad, F., Low-Choy, S. and Mengersen, K. (eds) Biosecurity surveillance: Quantitative approaches . CAB International	N/A	–
2014		
Burgman, M.A. and Regan, H.M. (2014) Information-gap decision theory fills a gap in ecological applications. Ecological Applications 24, 227-228	4.093	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	4.165	1
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	4
Cox-Witton, K., Reiss, A., Woods, R., Grillo, V., Baker, R.T., Blyde, D.J., Boardman, W., Cutter, S., Lacasse, C., McCracken, H., Pyne, M., Smith, I., Vitali, S., Vogelnest, L., Wedd, D., Phillips, M., Bunn, C. and Post, L. (2014) Emerging Infectious Diseases in Free-Ranging Wildlife-Australian Zoo Based Wildlife Hospitals Contribute to National Surveillance. Plos One 9 (5)	3.234	4
Elith, J. and Burgman, M.A. (2014) Reply to Kriticos et al. NeoBiota , 23, 95-99	N/A	–
Guillera-Aroita, 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	5.322	2
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	53
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	4.165	12
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	3.667	2
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	4.774	10

	ISI IMPACT FACTORS 2014	NO. OF CITATIONS AS AT 30/6/15
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	4.165	2
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	3.667	2
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	4.564	1
Runge M.C and Walshe T. (2014) Identifying objectives and alternative actions to frame a decision problem. In: Guntenspergen, G.R. (ed) Application of Threshold Concepts in Natural Resource Decision Making . Springer	N/A	1
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	5
2013		
Addison, P.F., 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	3.667	15
Burgman, M. A. and Yemshanov, D. (2013) Risks, decisions and biological conservation. Diversity and Distributions 19: 485-489	3.667	3
Burgman, M., Roberts, B., Sansford, C., Griffin, R. and Mengersen, K. (2013) The role of pest risk analysis in plant biosecurity. In: Gordh, G. and McKirdy, S. (eds) The Handbook of Plant Biosecurity . Chapter 9, pp. 235-267. Springer, New York	N/A	–
Burgman, M.A., McCarthy, M.A., Robinson, A., Hester, S.M., McBride, M.F., Elith, J. and Panetta, F.D. (2013) Improving decisions for invasive species management: reformulation and extensions of the Panetta-Lawes eradication graph. Diversity and Distributions 19:603-607	3.667	7
Cruse, B., Liedoff, A., Vesk, P.A., Burgman, M.A., and Wintle, B.A. (2013) Hydroperiod in the main driver of the spatial pattern of dominance in mangrove communities. Global Ecology and Biogeography 22, 806-217	7.223	7
Decrouez, G. and Robinson, A.P. (2013) Time-series models for border inspection data. Risk Analysis 33: 2142-2153	2.502	–
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	4.774	413
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	2.255	9
Elith, J. and Franklin, J. (2013) Species distribution modeling. Encyclopedia of Biodiversity , 2nd Edition, pp. 692-705. Academic Press, Waltham	N/A	–
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	0.953	11

TABLE 5 LIST OF RESEARCH PUBLICATIONS CONT.

	ISI IMPACT FACTORS 2014	NO. OF CITATIONS AS AT 30/6/15
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	3.667	12
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. and Buckley, Y.M. (2013) Predicting species distributions for conservation decisions. Ecology Letters 16: 1424-1435	10.689	105
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	3.667	13
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	3.02	–
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	2
Keith, D.A., Rodriguez, J.P., Rodriguez-Clark, K.M., Nicholson, E., Aapala, K., Alonson, A., Asmussen, A., Bachman, S., Basset, A., Barrow, E.G., Benson, J.S., Bishop, M.J., Bonifacio, R., Brooks, T.M., Burgman, M.A. (2013) Scientific Foundations for an IUCN Red List of Ecosystems. PLoS ONE 8(5): e62111	3.234	67
Lyon, A., Gossel, 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	3.667	6
Lyon, A., Mooney, A. and Gossel, G. (2013) Using AquaticHealth.net to Detect Emerging Trends in Aquatic Animal Health. Agriculture 3(2), 299-309	N/A	–
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	N/A	3
Phillips, S.J. and Elith, J. (2013) On estimating probability of presence from use-availability or presence-background data. Ecology 94: 1409-1419	4.656	23
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 (<i>Xanthomonas citri</i>). Diversity and Distributions 19: 590-602	3.667	5
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	–
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	2.723	2
Sutherland, W.J., Spiegelhalter, D. and Burgman, M.A. (2013) Twenty tips for interpreting scientific claims. Nature (Comments) 503: 335-337	41.456	30
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	2.116	6

Presentations

CEBRA technical staff have been invited to make Keynote, Plenary and Session Chair Representations of their research findings. The academics are also regularly invited to make presentations at national and international conferences and attend workshops to keep up-to-date with the latest research and issues within the industry. A summary of these representations is as follows:

TABLE 6 LIST OF PRESENTATIONS

DATES	TOPIC / EVENT	LOCATION	ORGANISATION	FACILITATOR
2015				
26-28 June	Data Deluge: Can Policy Follow Science? At Salzburg Global Seminar Annual June Board Meeting: People and Power: Will We Recognize the World in 2030?	Salzburg, Austria	Salzburg Global Seminar	A/Prof Andrew Robinson
17 June	Risk analysis – Statistics for the Office of Transport Security	Canberra	Crawford School of Public Policy, ANU	A/Prof Andrew Robinson
12 June	The role of science in Australia's Environmental Policy at <i>Australian Academy of Science</i>	Canberra	Department of the Environment	Prof Mark Burgman
3 June	Better Biosecurity Risk Analysis	Tbilisi, Georgia	Ilia State University	A/Prof Andrew Robinson
27 May	Science & Policy Colon Delicately Ironic Simile at <i>National Science Exchange Conference</i>	NCC Canberra	Department of Agriculture	A/Prof Andrew Robinson (Key Note)
18-21 May	Quarantine regulators workshop	Pattaya, Thailand	Department of Agriculture	A/Prof Andrew Robinson
14 May	Portfolio allocation for biosecurity measures	Canberra	National Biosecurity Committee	Prof Tom Kompas
22 April	Portfolio allocation and active surveillance measures	Melbourne	Animal Health Committee	Prof Tom Kompas
21 April	Scientific Judgement	University of Melbourne	School of Geography	Prof Mark Burgman
13-17 April	Data: The Bigger They Are, The Harder We Fall at <i>31st IEEE International Conference on Data Engineering</i>	Seoul, Korea	BioBAD: Big Data Analytics for Biosecurity	A/Prof Andrew Robinson (Key Note)
13-17 April	United, We stand: Combining Cross-Governmental Data Resources to Refine Border Activities, at <i>31st IEEE International Conference on Data Engineering</i>	Seoul, Korea	BioBAD: Big Data Analytics for Biosecurity	A/Prof Andrew Robinson (Key Note)

TABLE 6 LIST OF PRESENTATIONS

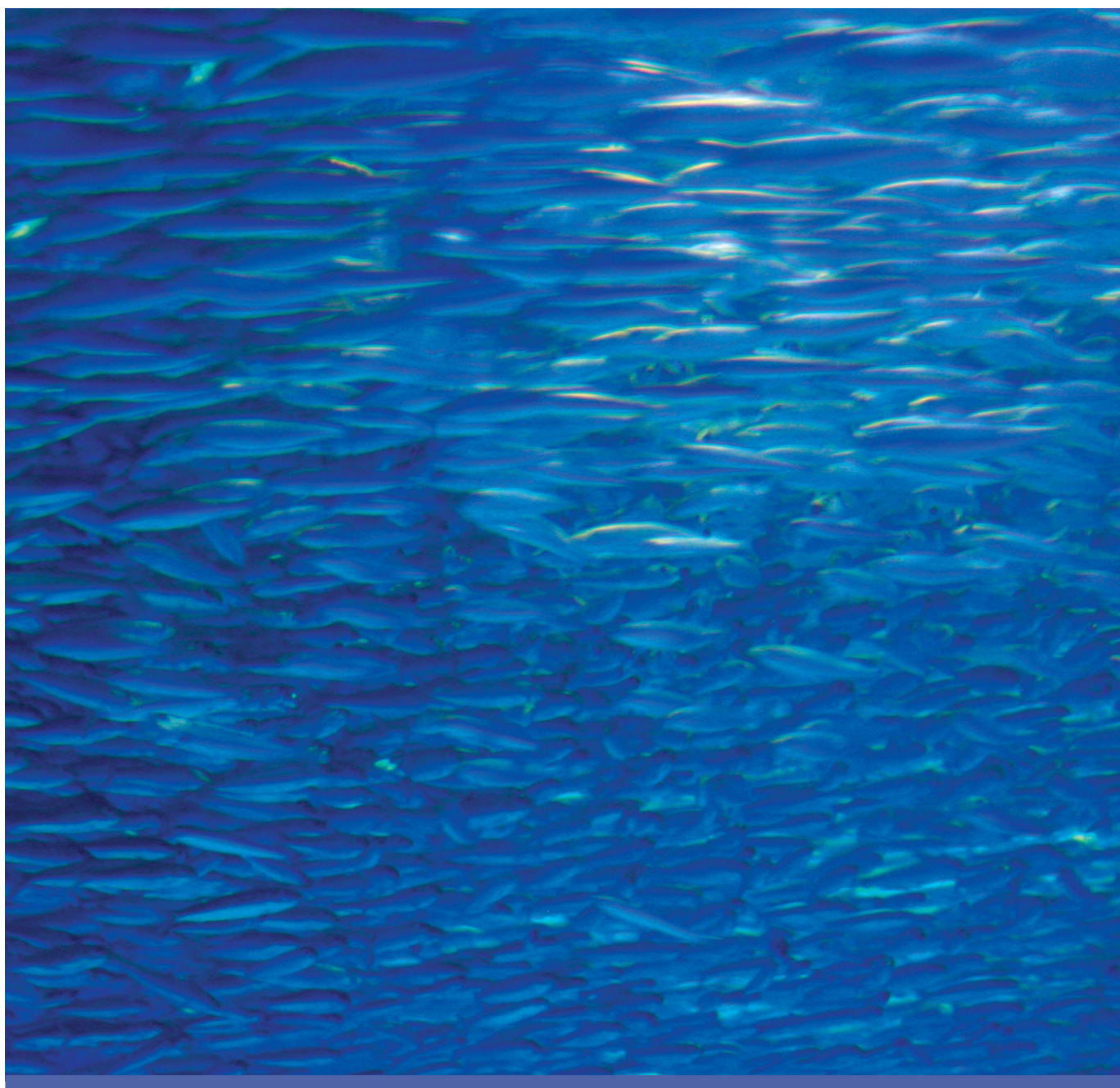
DATES	TOPIC / EVENT	LOCATION	ORGANISATION	FACILITATOR
4 April	Dealing with uncertainty in population models, at <i>International Symposium on Biological Conservation Planning Under Uncertainties</i>	Tokyo, Japan	Faculty of Agriculture, University of Tokyo	Prof Mark Burgman
19 March	Risk based inspection systems, at <i>Commission on Phytosanitary Measures, Tenth Session</i>	Rome, Italy	Food and Agriculture Organisation of the United Nations	Prof Mark Burgman
6 March	Budgeting a portfolio allocation approach to biosecurity	Canberra	National Biosecurity Committee	Prof Tom Kompas
3 March	What is risk and why does it matter to farmers?	Canberra	ABARES Outlook 2015	Prof Mark Burgman
1 January	Species Distribution Modelling 2-day workshop	Brisbane	Student Conference in Conservation Science	Dr Jane Elith
2014				
24-28 November	Poster presentation at DAA9 Conference – <i>9th Symposium on Diseases in Asian Aquaculture</i>	Ho Chi Minh City, Vietnam	Asian Fisheries Society & The Department of Animal Health	Dr Geoffrey Grossel
4-7 November	Poster presentation on Making principled Predictions: A Truth Serum for Interrogating Big Data	Riva Del Garda, Italy	ForestSat	Dr Andrew Robinson
24 October	A portfolio approach to allocating resources for biosecurity	Canberra	National Biosecurity Committee	Prof Tom Kompas
13-14 October	Four lecture workshop series on biosecurity concepts	Peruvian Biosecurity Regulator	SENASA	Dr Andrew Robinson
7-11 October	Costs and Benefits of incorporating uncertainty into Forest Harvest Scheduling	Salt Lake City, USA	Society of American Foresters	Dr Andrew Robinson
26-27 August	When does poor governance presage biosecurity risk? At SRA ANZ Risk Beyond Numbers Conference	Palmerston North, New Zealand	SRA ANZ	Dr Andrew Robinson
26-27 August	Tips for policy makers to interpret scientific advice At SRA ANZ Risk Beyond Numbers Conference	Palmerston North, New Zealand	SRA ANZ	Prof Mark Burgman (Plenary)
22 August	Can quantitative risk methods help make better quarantine decisions?	Brisbane, Australia	International Horticulture Conference	Prof Mark Burgman
3-7 August	ML vs MRR: Weibull parameter Estimation for Making Decisions	Boston, USA	American Statistical Association	Dr Andrew Robinson
8 July	International Biosecurity Intelligence System: a collection and analysis tool for early warning, better planning and rapid response at <i>AMSA National Convention 2014</i>	Adelaide	AMSA	Dr Geoffrey Grossel

DATES	TOPIC / EVENT	LOCATION	ORGANISATION	FACILITATOR
4 April	Approaches to Targeting Biosecurity Risk at <i>Biosecurity Round Table</i>	Canberra	Department of Agriculture	Dr Andrew Robinson
2 April	The intelligence game at COST <i>Expert Judgement Conference</i>	Glasgow, Scotland	University of Strathclyde	Prof Mark Burgman (Key Note)
5 March	Approaches to Targeting Biosecurity Risk: Adding Value to Valued Biosecurity	Canberra	ABARES Outlook 2014	Dr Andrew Robinson
2 February	Estimation of the Approach Rate From Border Inspection Data	Rotorua, New Zealand	Australian and New Zealand Industrial and Applied Mathematics (ANZIAM)	Dr Geoffrey Decrouez
1 January	Species Distribution Modelling	ANU Canberra	International Biogeography Society	Dr Jane Elith
2013				
26 November	Uncertainty in Expert Judgement: implications for Risk Communication at <i>Australian Government Regulators' Scientific Network</i>	Canberra	Department of Agriculture	Prof Mark Burgman (Key Note)
11 November	How to win friends and influence people: automatically assigning resources based on risk	Canberra	Department of Agriculture	Dr Andrew Robinson
22 October	Intelligence and Uncertainty in Risk Analysis	Melbourne	FSANZ	Prof Mark Burgman Dr Andrew Robinson
17 September	Strategic Risk Workshop	Rydges, Melbourne	Defence Science Institute	Prof Mark Burgman Dr Ann Nicholson
12 September	Performance Indicators for Regulatory Inspectorates at <i>SRA ANZ 7th Annual Conference</i>	Canberra	SRA ANZ	Dr Andrew Robinson
12 September	Using Inspection Information to Identify and Ameliorate Risks, and Monitor Performance of Risk Management at <i>Maths of Planet Earth Biosecurity and Bioinvasion Workshop</i>	Canberra	CSIRO	Dr Andrew Robinson
12 September	The Intelligence Game at <i>SRA ANZ 7th Annual Conference</i>	Crawford School, Australian National University	SRA ANZ	Prof Mark Burgman
11 September	Making Science Work for Government at <i>1st Global Conference on Research Integration</i>	Manning Clarke Centre, ANU	ARC Centre of Excellence in Policing and Security	Prof Mark Burgman

TABLE 6 LIST OF PRESENTATIONS

DATES	TOPIC / EVENT	LOCATION	ORGANISATION	FACILITATOR
4 September	Making science work: effective environmental science for regulators and policy makers	Cairns	James Cook University	Prof Mark Burgman
3 September	Making Science Work for Government at <i>CEED Annual Conference</i>	University of Queensland	CEED	Prof Mark Burgman (Plenary)
12 August	Using Border Information in Smarter Ways for Identifying Risks and Monitoring Performance of Risk Management at <i>New Zealand Plant Protection Society Symposium: Risk Analysis for Imports and Exports</i> .	Napier, New Zealand	New Zealand Plant Protection Society	Dr Andrew Robinson
11-15 July	Models for Spatial, Temporal and Network Data – A UAI Application Workshop at the <i>Conference of Uncertainty in Artificial Intelligence</i>	Bellevue, Washington USA	The Association for Uncertainty in Artificial Intelligence	Dr Ann Nicholson Dr Yung En Chee
8-12 July	Experts, judgement and the intelligence game at <i>Mathematics of Planet Earth Australia 2013</i>	Melbourne	AMSI	Prof Mark Burgman
11-12 July	Symposium: New Opportunities at the Interface between Ecology and Statistics	University of NSW	Ecological Statistics Research Group	Dr Jane Elith
8-12 July	Experts, judgement and the intelligence game at <i>Mathematics of Planet Earth Australia 2013</i>	Melbourne	AMSI	Prof Mark Burgman
11-12 July	Symposium: New Opportunities at the Interface between Ecology and Statistics	University of NSW	Ecological Statistics Research Group	Dr Jane Elith
1-5 July	Winter School in Mathematical and Computational Biology	University of Queensland, Brisbane	ARC Centre of Excellence in Bioinformatics	Dr Jane Elith

05 GOVERNANCE



Chair's Report – CEBRA Advisory Board

CEBRA continues to go from strength to strength in pursuing the research challenges in national biosecurity posed by the Australian Government's Department of Agriculture and the New Zealand Ministry of Primary Industries. CEBRA is based at the University of Melbourne and so research excellence is a key component of CEBRA's mission.



It is sometimes thought that working on practical problems diminishes the quality of the research being carried out. That has certainly not been the case in

CEBRA's portfolio. The dialogue that precedes the approval of the research projects addresses both the business needs of the funding agencies but is also acutely cognisant of the need to tackle problems with deep intellectual challenges. As the Director, Professor Mark Burgman, asserts the problems that arise from this deep engagement are actually harder than those which spring from the current research literature.

CEBRA's Advisory Board is acutely aware of the need to balance the government agencies' requirements for impact with the University's requirement for demonstrated research excellence. And indeed the governance of CEBRA has been constructed to achieve just such a balance.

There is a fine interplay between the Biosecurity Research Steering Committee, with its strong roots in the needs of Government to have certain key areas of biosecurity researched and the Science Advisory Committee, which assesses not just the impact of the research but its scientific quality and feasibility. The CEBRA Advisory Board looks at the entire portfolio, the recommendations of the Science Advisory Committee and commends the agreed portfolio to Government.

The CEBRA Advisory Board does more than this however. It addresses questions related to the scientific and business environments in which the Centre plays its role, questions of business strategy and outcomes and the evolution of the Centre. We ensure that every voice around the Board table can be heard, and furthermore we evaluate our performance at each Board meeting as well as annually by means of an anonymous survey. It is pleasing to note that Board members feel that their individual voices can be heard and furthermore that the Board is coming to grips with the Centre's key strategic challenges.

The dialogue that precedes the approval of the research projects addresses both the business needs of the funding agencies but is also acutely cognisant of the need to tackle problems with deep intellectual challenges.

We are really fortunate to be dealing with an exceptionally talented leadership and management team. Biosecurity risk is embedded in a broader class of problems related to the quantification and management of risk. CEBRA's research has broader application to a much wider class of risk challenges.

In fact, the collaboration between the government departments as custodians of many of the important questions related to biosecurity risk and the University and its collaborators, who collectively nurture a truly talented research team, offers a possibly unique

example of just how such a deep and valuable collaboration can occur. Such collaborations don't just happen; they involve hard work in building trust, effective communication and excellence in delivery. Leadership skills of the highest order are called for.

On behalf of my colleagues on the CEBRA Advisory Board we are privileged to play our part in the governance of an outstanding collaboration.

Dr Ron Sandland AM FTSE
Chair, CEBRA Advisory Board

Such collaborations don't just happen; they involve hard work in building trust, effective communication and excellence in delivery.

TABLE 7 CEBRA ADVISORY BOARD MEMBERS

NAME	POSITION	ORGANISATION
Dr Ron Sandland AM FTSE	Chair	Independent
Dr Vanessa Findlay	Board Member (Cth), Retired	Department of Agriculture, Plant Division
Dr Kim Ritman	Board Member (Cth), Retired	Department of Agriculture, Plant Division
Ms Louise Van Meurs	Board Member (Cth)	Department of Agriculture, Plant Division
Ms Karen Schneider	Board Member (Cth)	Department of Agriculture, ABARES
Prof Peter Bardsley	Board Member (Host), Retired	University of Melbourne, Economics
Prof Aleks Owczarek	Board Member (Host)	University of Melbourne, Maths and Stats
Prof Pauline Ladiges AO FAA	Board Member (Host)	University of Melbourne, BioSciences
Prof Colin Wilks	Board Member (SAC Chair)	University of Melbourne, Veterinary Science
Dr Roger Paskin	Board Member	Primary Industries and Regions South Australia (PIRSA)
Ms Christine Reed	Board Member	Member Ministry of Primary Industries NZ
Prof Mark Burgman FAA	Board Member (Ex Officio)	University of Melbourne, CEBRA
A/Prof Andrew Robinson	Board Member (Ex Officio)	University of Melbourne, CEBRA

Scientific Advisory Committee Terms of Reference

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

The role of the SAC will be to:

- Assist the Director in evaluating research proposals based on criteria of:
 - Scientific and practical merit for risk analysis;
 - Capacity/capability to deliver; and
 - Budget viability.
- Obtain peer reviews of final reports prior to submission to the Department of Agriculture 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 (20 or so) 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.

TABLE 8 SCIENTIFIC ADVISORY COMMITTEE MEMBERS

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	RMIT University
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

NAME	ORGANISATION
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
Dr Steven Mascaro	Bayesian Intelligence Pty Ltd

Key Performance Indicators

CEBRA's objectives and outcomes against KPIs are summarised in the following table. In all cases, KPIs were achieved and many cases they were surpassed.

TABLE 9 KEY PERFORMANCE INDICATORS

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.	<ul style="list-style-type: none"> 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	<p>The key issues addressed this year included:</p> <ul style="list-style-type: none"> Adoption strategy Communication strategy Business development Basis of state interaction with CEBRA Review of the 2015/2016 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 and final reports.
	Director attends BRSC meetings to provide context and details of the research projects undertaken by CEBRA and engages with Department of Agriculture (DA) 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.
	<p>Evaluation of Board Performance, will follow the following three step process;</p> <ol style="list-style-type: none"> 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 to be completed and presented at CEBRA Advisory Board Mtg # 9.

TABLE 9 KEY PERFORMANCE INDICATORS CONT.

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 / DA / 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 DA 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 DA and MPI on July 14, 2014.
		Review budget and workplan and approve (subject to amendments).	DA / MPI	DA and MPI approved the budget and workplan on September 19, 2014.
		Advise Centre of any KPIs to be included or core activities to be treated as specified core activities in the workplan.	DA / MPI	No additional KPIs have been included in the workplan. Project 1404C remains specified core material.
	Payment of Funding.	DA and MPI to pay the Centre Funding Payments by six monthly instalments.	DA / MPI	MPI paid invoice 685870 on August 15, 2014 and invoice 696033 on January 30, 2015. DA paid invoice 685474 on August 7, 2014 and invoice 695902 on February 4, 2015.
	Provision of quarterly Progress Report (PR) on Centre activities.	Centre supplies DA and MPI with progress reports as set out in Schedule 3 of the Funding Agreement.	Business Manager	<ul style="list-style-type: none"> PR # 4 was submitted to DA/MPI on November 12, 2014 PR # 5 was submitted to DA/MPI on March 31, 2015 PR # 6 was submitted to DA/MPI on July 27, 2015
	Provision of Financial Report (FR) for the previous six months setting out the funding expended or committed.	Centre supplies DA and MPI with a financial report for the preceding six months biannually as set out in Schedule 3 of the Funding Agreement.	Business Manager	<ul style="list-style-type: none"> FR # 3 was submitted to DA/MPI on January 14, 2015 FR # 4 was submitted to DA/MPI on July 13, 2015
	Provision of Annual Report for each financial year.	Host supplies DA 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 prior to September 30, 2015.

STRATEGIC OBJECTIVE	KEY PERFORMANCE INDICATOR	MEASURES	OFFICER	PROGRESS / OUTCOME
	Auditor's Report confirming the Recipient has managed the Funding and kept accounts and records in respect of this Deed.	Host supplies DA 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 was submitted to DA / MPI on August 24, 2015.
	Provision of Final Report on Centre activities at the completion of the term.	Host supplies DA 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 2015.
	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.

TABLE 9 KEY PERFORMANCE INDICATORS CONT.

COMMUNICATIONS				
STRATEGIC OBJECTIVE	KEY PERFORMANCE INDICATOR	MEASURES	OFFICER	PROGRESS / OUTCOME
<ul style="list-style-type: none"> 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	The Board has spent considerable time with Jenny Barbour developing a Communications Strategy in 2014/2015, who will take carriage of implementation during 2015/2016.
	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 four presentations badged as CEBRA work. Details are available in Table 6.
		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. Details are available in Table 6.
	Recognition	At least 3 invitations to chair, host conferences, participate in key advisory forums, or similar.	Director	<ul style="list-style-type: none"> Prof. Burgman was a plenary speaker at the Society of Risk Analysis Australia and New Zealand conference in NZ, and a keynote speaker at the European Cooperation in Science and Technology (COST) Expert Judgement Conference. A/Prof Robinson was a keynote speaker at the National Science Exchange Conference and the 31st IEEE International Conference on Data Engineering.
	Collaborations: Development of research opportunities and the funding base.	At least 3 substantial collaborations with research organizations; per year.	Director	Collaboration agreements have been executed with: <ul style="list-style-type: none"> CSIRO Massey University Technocrat University of New South Wales
		At least 1 New contract with Government agencies other than the funding agency; per year.	Director	<ul style="list-style-type: none"> CEBRA staff continue their work on developing a screening tool for Australian Pesticides and Veterinary Medicines Authority (APVMA) CEBRA staff are working with the CRC Plant Biosecurity on the Barrow Island biosecurity surveillance system CEBRA staff are working with the Office of Transport Security on the utility of Explosive Trace Detections CEBRA staff are working with Customs on developing a sampling regime for international mail

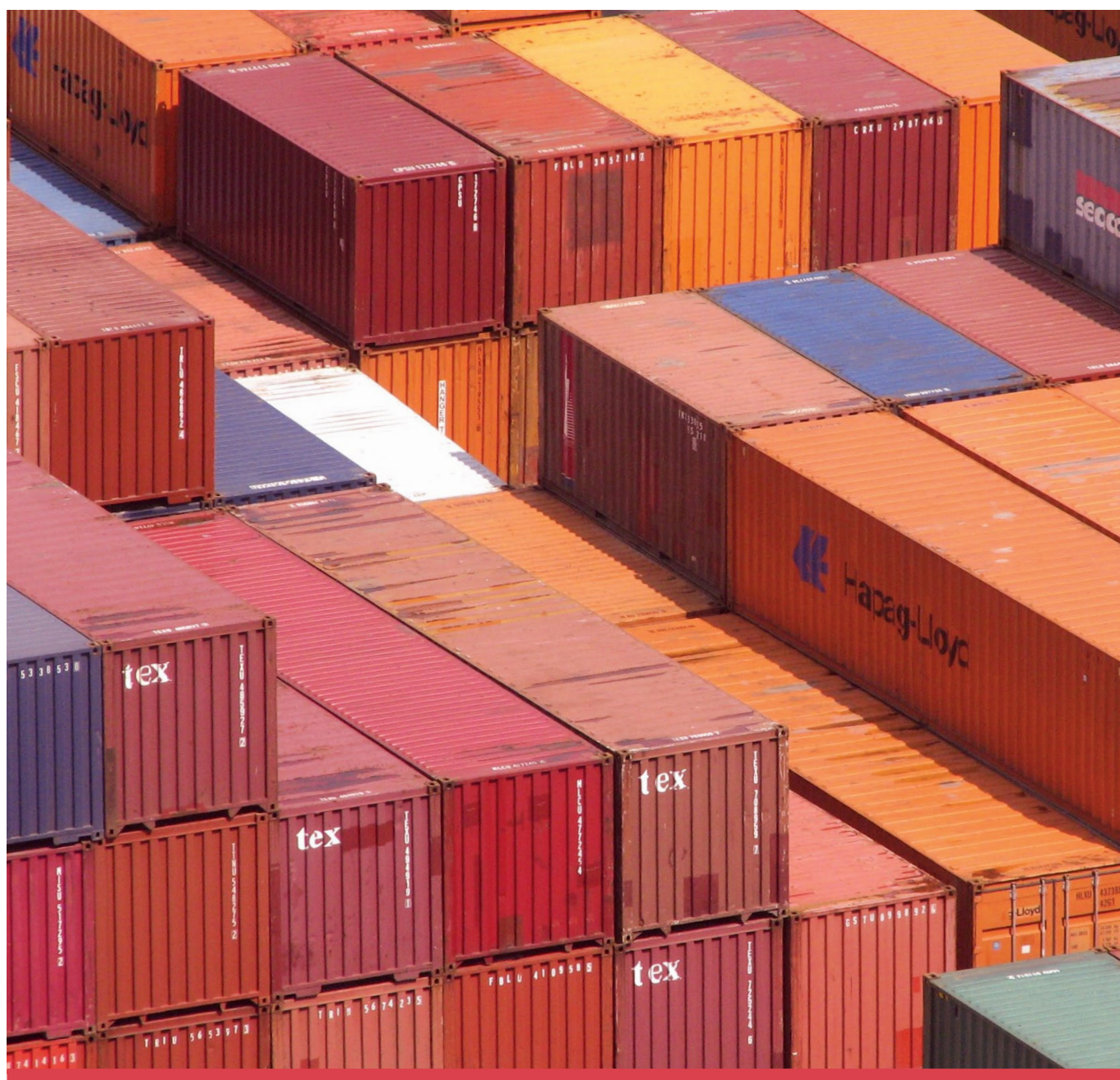
STRATEGIC OBJECTIVE	KEY PERFORMANCE INDICATOR	MEASURES	OFFICER	PROGRESS / OUTCOME
	International links and networks.	At least 1 international visitor per year.	Director	CEBRA hosted Malcolm Hunter Jnr and Aram Calhoun from the University of Maine in December 2014.
		At least 1 visit to international laboratories by Centre personnel per year.		<p>Andrew Robinson was invited to present four seminars in Lima, Peru, by SENASA, the Peruvian biosecurity regulator (October 13-14, 2014). The presentation titles were:</p> <ul style="list-style-type: none"> • CEBRA: Past, Present, Future Strategic Directions • Importation of Plant Products to Australia • R is for Regulators • Post-border Surveillance: A Case Study in Citrus Canker
	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. The website will be refreshed in 2016.

TABLE 9 KEY PERFORMANCE INDICATORS CONT.

RESEARCH				
STRATEGIC OBJECTIVE	KEY PERFORMANCE INDICATOR	MEASURES	OFFICER	PROGRESS / OUTCOME
<ul style="list-style-type: none"> 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 nine project proposals submitted to the steering committee in the 2014/2015 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 6.
	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 (DA) 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 (DA) and MPI	Biosecurity Research Section confirms progress towards adoption reporting is on track.

STRATEGIC OBJECTIVE	KEY PERFORMANCE INDICATOR	MEASURES	OFFICER	PROGRESS / OUTCOME
		Provide an update against the adoption strategy given the outcomes of the research project with an indication of DA and MPI intention and pathway to adoption.	CEBRA, MPI and DA Project Leaders	DA 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: <ul style="list-style-type: none"> • 1304B Final Report • 1302A Final Report • 1301A Interim Report • 1301C Final Report • 1305A Interim 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.
	Contribute positively to the University's ERA by achieving quality research outputs based on standard measures.	Organizational H-Index.	Director	<ul style="list-style-type: none"> • CEBRA's H index is 11 • CEBRA/ACERA's combined H index is 44
		Number of Publications per year by Centre staff.	Director	CEBRA staff have published several journal articles badged as CEBRA work. Details are available in Table 5.
		Other Research Income.	Director	CEBRA staff are undertaking additional research contracts for other agencies. Details are provided in Table 4.
	Build biosecurity risk analysis capacity in Australia and New Zealand.	Number of research higher degree students enrolled.	Director	CEBRA is currently supporting seven higher degree students.
		Number of research higher degree students graduated.	Director	Natalie Karavarsamis and David Lazaridis completed their PHD.
		Number of post-doctoral research fellows employed.	Director	Jane Elith, Terry Walsh, Bonnie Wintle, Frith Jarrad, Jan Carey & Anca Hanea provided in-kind support to the Centre.

06 FINANCIAL STATEMENTS



Financial Report Summary

TABLE 10 CEBRA FINANCIAL STATEMENT 2014/2015

INCOME	\$
Balance Brought Forward	466,945
Department of Agriculture	1,793,000
Ministry for Primary Industries	292,494
Host Contribution	587,950
Interest	21,020
SUB-TOTAL	2,694,464
OPERATING FUNDS (REVENUE + BALANCE CARRIED FORWARD)	3,161,409
LESS EXPENDITURE	\$
Salaries	2,361,302
Operations	325,105
Business Development	223,730
Research Contracts	18,092
SUB-TOTAL	2,928,229
BALANCE	233,180

CEBRA In-Kind Statements

TABLE 11 CEBRA IN-KIND STATEMENT 2014/2015

	%	\$
PAYROLL COSTS FOR RESEARCH STAFF (MELBOURNE UNI FUNDED)		
A/Prof B. Wintle	10%	17,595
Dr J. Elith	25%	28,941
Dr J. Carey	25%	23,799
Prof M. McCarthy	10%	21,202
Dr F. Jarrad	10%	6,492
Dr L. Rumpff	10%	7,390
SUB-TOTAL		105,419
INFRASTRUCTURE 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
Ms J. Holliday	50%	\$21,623
Dr T. Hollings	100%	\$86,490
MELB UNI FUNDED		
A/Prof. B. Wintle	10%	\$8,649
Dr 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		320,016
INFRASTRUCTURE 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%	\$19,500
SUB-TOTAL		120,900
TOTAL		585,254

Auditors Report

The terms of the agreement between the Commonwealth and the University of Melbourne require an independent audit opinion to be provided on the financial statements and core activities of the centre.

Consulting Technology



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 for the period 1 July 2014 to 30 June 2015.

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

I confirm that in my opinion:

- the University has incurred \$2,928,229 in expenditure on the Project; and
- the contributions of the University is \$587,950 in cash and \$585,254 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.

Date: 24 August 2015

David Fraser

Delivery Partner, Accounting and Assurance

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07 OUTLOOK



Future Outlook

CEBRA's research agenda for 2015-16 has now been confirmed across all of our core activity areas. Our research program over the next 12 months will see us implement an exciting research program.

With a focus on research driving better practice, it will be particularly exciting to see our new external research contracts implemented over the next 12 months. The opportunity to work with the private sector implementing management programs based on our research in a commercial setting is a great validation of the important work the team at CEBRA do.

Our research is aimed at delivering tools that have a real world impact and improve Australia's capacity to effectively manage and respond to biosecurity risks. In 2015-16, collaboration with industry, government and other research institutes, both domestically and internationally, will continue to be critical to underpinning this important work.

Confirmed Research Projects for 2015/2016

DATA MINING

- 1501C: Improving ballast water risk tables
- 1501E: Compliance and risk based sampling for horticulture exports
- 1501F: Import clearance performance measurement

SPATIAL ANALYSIS

- 1502C: Estimation of national-level farm demographic data
- 1502D: Criteria in prioritising plant pests along the biosecurity continuum
- 1502E: Risk maps for optimising biosecurity surveillance

INTELLIGENCE

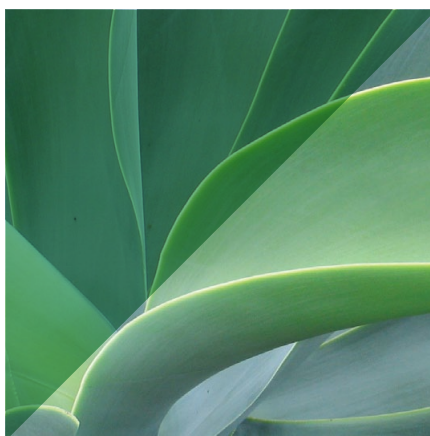
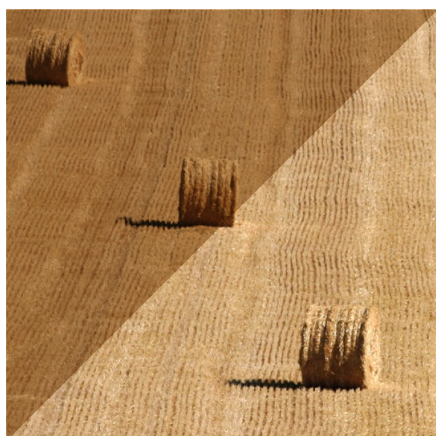
- 1503A: Intelligence gathering and analysis
- 1503B: Intelligence tools for regulated goods traded via e-commerce

SYSTEM BENEFIT COST

- 1504C: Testing incentive-based inspection protocols
- 1504D: Using decision support tools in emergency animal disease planning and response

PATHWAYS

- 1505A: Ornamental fish import reform



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