cebra
Centre of Excellence for Biosecurity Risk Analysis

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MESSAGE FROM THE DIRECTOR

Welcome to 2020!

The new year has brought with it a few reminders of the very real threat that invasive species pose to Australia's primary industries, environments and people.

In January, panama disease—which can cause wilting and ultimately, plant death—was detected at a banana farm in far north Queensland. Recently, fall armyworm, which is known to damage 350 plant species including wheat, fruit and vegetable crops, was detected in the Torres Strait and in Cape York. These are the first detections of this species in Australia. The recent bushfires also have environmental and biosecurity consequences, including in affected alpine areas, as discussed by our researcher James Camac in a recent article for the Mountain Research Initiative.

To address the changing challenges of biosecurity, CEBRA fosters an environment of learning and engagement. Our researchers regularly attend and present seminars and workshops to maintain our position as a leader in biosecurity risk analysis. Late last year, Natasha Page (featured in this newsletter), attended an uncertainty quantification workshop at ANU. More recently, CEBRA researcher Natalie Stoeckl, who is based at the University of Tasmania, visited our main office to present to the group on her contribution to CEBRA project 170713: *Value of Australia's biosecurity system*. Read more about the great work Natalie has been doing together with our researchers Aaron Dodd, Tom Kompas, John Baumgartner and others in this newsletter.

In February, CEBRA hosted the most recent meeting of the Biosecurity Data Analytics Working Group (BDAWG) online. CEBRA started BDAWG in 2018 to connect international biosecurity practitioners across borders to tackle biosecurity problems that affect the world at large. Currently, BDAWG has twelve members across five research and regulatory organisations. The focus at the most recent meeting was on timber packaging data. By combining datasets from New Zealand, Australia, Canada and the US, we hope to identify common risk factors.

I'd like to thank Nathaniel Bloomfield for taking the reins at the recent BDAWG meeting and also congratulate him on the recent publication of his article for the University of Melbourne's Pursuit, an online platform that makes research palatable to the general public.

The article piqued the interest of local radio station RRR, who followed up by bringing Nathaniel into the studio for an interview. Well done, Nathaniel!

Andrew Robinson

Managing Director,

Centre of Excellence for Biosecurity Risk Analysis

IN THIS EDITION

Research fellow Natasha Page

Natasha Page joined CEBRA in August 2019. She comes with a Masters in Science (Computing) specialising in Computational Management from Imperial College, London. During her studies, she gained experience in machine learning, optimisation and advanced data analysis techniques and carried out a research project in collaboration with Royal Mail. This project involved applying integer programming—an optimisation tool that restricts some variables to integers—to the problem of vehicle optimisation at Royal Mail delivery offices. 'The project used a robust approach in order to account for uncertainty,' Natasha says. 'I produced promising results with regards to the possibility of reducing the size of the fleet as well as analysis on how the optimal values vary throughout the week, potentially saving Royal Mail £2–4 million ($3.8–7.7 million) per annum during the next two years.' For her efforts, Natasha was named a runner-up for the May Hicks award from the Operational Research Society.

After completing her Masters, Natasha took up a research position at Imperial College, London. This project applied data analytics and optimisation techniques to improve the speed and efficiency of industry partner Three Media Associates' products.

Natasha also has experience working for a healthcare company, using data analysis to identify efficiencies that could be gained within NHS services, particularly in the primary care sector. 'I found this work very rewarding as I was able to experience the impact that I was having on the services and it made me realise how much I value working in an applied space,' Natasha says.

At CEBRA, Natasha is currently working on an advanced profiling project, seeking new ways of profiling air passengers to determine the risk that they are carrying biosecurity risk material. This is a topic that CEBRA has looked at before, but with more data now available, new methods of tackling this problem are being investigated. 'A side of this project that I find particularly fascinating is that of handling bias in the data,' Natasha says. 'If a profiling method is being used to determine who to screen, items are more likely to be found on individuals who fit that profile and so it would be easy to create a biased model.'

Natasha is also working on a project for the New Zealand Ministry for Primary Industries, looking at a risk–return approach to surveillance optimisation. This is building on CEBRA's past work in this area, which looked at optimal surveillance from a risk perspective. By overlaying an economic model to the existing model, this project focuses on risk reduction rather than simply risk.

Natasha is thoroughly enjoying her time with CEBRA. The work has allowed her to bring together all of the techniques she has learned across her work and study. Being new to the world of biosecurity, she has found it interesting to learn the specific intricacies of the problems that the field faces and how research can make a difference.

'Working with the department and MPI to solve real problems that they are facing day-to-day is incredibly rewarding,' Natasha says. 'Also, the people at CEBRA are all excellent. You really couldn't ask for a nicer environment in which to work and that makes all the difference.'

Researcher profile: Dr Raphael Trouvé

Growing up in France, Raphael had a strong interest in science, but at the end of high school he had a hard time choosing which discipline to specialise in. He settled on the Bachelor of Biology program at the University of Caen. 'The subject was interesting, but I found biology to focus too much on the small details. I wanted to get the big picture. What's bigger than trees?' Raphael says. He went on to complete a Masters of Forestry and a PhD in Forest Modelling at AgroParisTech. The masters involved opportunities to study at the Swedish University of Agricultural Sciences in Uppsala and the University of Natural Resources and Life Sciences in Vienna. 'That's probably where I caught my travel bug!' Raphael says.

In 2015, Raphael moved to Australia to begin a postdoc at the University of Melbourne's School of Ecosystem and Forest Sciences, where he collaborated with Andrew Robinson on statistical puzzles. In 2018, at the end of the postdoc, Andrew invited Raphael to work on a new project looking at alternative statistical frameworks for border inspection, together with forest mensurationist Professor Mark Ducey. 'I applied for the job, got the job, and this is how I started working at CEBRA,' Raphael says.

At CEBRA, Raphael has worked on inference frameworks for border inspection in collaboration with the Department of Agriculture, Water and the Environment and New Zealand Ministry for Primary Industries. The project looked at ways to combine different sources of information to develop assurance about the regulatory compliance of consignments. Raphael explains: 'Briefly put: if we know something about a pathway, do we need to inspect as many samples every time as if we know nothing?' Since joining CEBRA, Raphael has enjoyed applying and expanding his data analysis skills to biosecurity. 'Working at CEBRA has been a good opportunity to make an impact on real world issues.'

Raphael's favourite species of tree are the common oak *(Quercus robur)* and sessile oak *(Quercus petraea)*. 'I have a large common oak individual in my garden back in Normandy. It is a superb tree. As for sessile oak, I spent most of my PhD working on it, so it is also a bit special to me,' Raphael says. 'In Australia, I like the gigantic and iconic mountain ash *(Eucalyptus regnans)*—the tallest flowering tree on Earth—but also the more tortuous old mountain grey gum *(Eucalytpus cypellocarpa)* and river red gum *(Eucalyptus camaldulensis)*.'

Project update: the value of Australia's biosecurity system

Australia's biosecurity system provides a substantial benefit by avoiding or minimising the harm caused by invasive pests and diseases. This value is difficult to quantify. This is because the system has a complex interplay of parts across supply chains, geographies, jurisdictions and stakeholders.

CEBRA project 170713: *Value of Australia's biosecurity system,* (an extension of 1607A) is a multi-year project that aims to estimate a defensible value for Australia's biosecurity system. The research will contribute to an assessment of the health of the biosecurity system through annual reporting requirements; provide evidence and context in conversations with governments from all jurisdictions, industry and the community; and inform and contribute to a national biosecurity strategy, Intergovernmental Agreement on Biosecurity and the National Environmental Biosecurity Response Agreement reviews.

CEBRA's approach to the problem involves:

- clearly defining Australia's biosecurity system
- determining the value and geographic distribution of assets protected by the biosecurity system, across Australia
- identifying the key classes of pests and diseases at risk of entering Australia, estimating their capacity for spread, and the associated asset-specific damages
- modelling the arrival, spread, and damages caused by forty classes of pests and diseases across Australia over the next twenty years, both with and without a biosecurity system in place.

The initial stages of the project delivered a comprehensive review of the biosecurity economics literature; identified suitable methods, measures and indicators of the types of value generated by biosecurity interventions; and outlined a framework for estimating the value of Australia's biosecurity system. Later stages reviewed and standardised existing estimates of value; included measures of market values provided by the Australian Bureau of Agricultural Resource Economics and Sciences (ABARES); extended these estimates to include non-market values by using 'benefit transfer' measures and the best procedure for undertaking non-market valuation generally; and refined methods to properly aggregate measures of value up to the system scale. The final stage applied the framework, combining research, data sources and aggregation methods to estimate the value of Australia's biosecurity system.

The project framework classifies assets protected by the biosecurity system into natural capital, physical infrastructure, human and social capital; however, data and knowledge deficiencies prevented the team from assessing the potential impact of incursions on human and social capital. To calculate the value of the biosecurity system, CEBRA considered the current flow of benefits from key assets given predicted incursions, both with and without existing biosecurity measures. The benefit of the biosecurity system can then be calculated by comparing the predicted flow of benefits over the next twenty years—which gives an estimate of the damages avoided under the biosecurity system.

Natural capital, in this instance, supports numerous benefit flows, including industries such as agriculture and forestry. Data estimating the value of agriculture and forestry was sourced from the ABS, ABARES and the Department of Agriculture, Water and the Environment through the ALUM (Australian Land Use and Management) classification. Other benefit flows associated with natural capital include those relating to recreation, aesthetics, bequest/existence values, erosion control, water purification and carbon sequestration. The values of these benefit flows were estimated using benefit transfer functions derived from data published in the scientific literature. The value of companion animals was estimated from information about per person expenditure on domestic pets (dogs, cats and recreational horses); and physical asset values were estimated using a subset of data from the ABS's experimental capital accounts (annualised estimates of the net capital at risk from incursions).

The annual values of the benefit flows generated by assets which are protected by Australia's biosecurity system was estimated.

While every attempt was made to find and incorporate relevant data, the data available contains some knowledge gaps. For example, one area that would benefit from further research is Indigenous cultural values. Placeholder values have been estimated from data available (to ensure these values are not overlooked), but an Indigenous-led project would better inform the analysis in this area.