# 2021 National Biosecurity Forum

Session 4: Science and innovation

(Duration 1 hour 26 mins 29 secs)

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## Introduction

This is the transcript of the National Biosecurity Forum, session 4, presented by the Department of Agriculture, Water and the Environment.

## Transcript

[Session begins]

Richard Morecroft: Well now, let us move on to our final session this morning in just a moment, but just before we do that, let's return to the Mentimeter opportunity. And our Mentimeter question this time is what industry are you from? Let us know where you're from, what sector you're from, and it will be great to be able to see. So already great diversity from wine which I think was the very first and we've even got beekeeping, which is wonderful to see. Melons, motor vehicle industry, government of course, both state and federal, I imagine, and a great diversity of different areas of focus. And of course, in our last discussion panel and our last presentations with Leanne and Joanne, we saw that tremendous cooperation between the private sector on the issue of biosecurity.

So great to see so many different sectors involved once again in that word cloud there. So thank you very much for those responses. Great to be able to see those different areas of involvement. And of course, once again, it's tremendous to see that so many of you have involved yourselves in this forum, as I mentioned yesterday, over 1100 registrations. And as we could see from that Mentimeter response from literally every sector. So thank you very much indeed. Let's move on to our final session this morning, which is focused on science and innovation. And I think we all understand that to help Australia manage the growing biosecurity risks that we are undoubtedly facing, science and innovation are absolutely vital. Now, encouragingly, there is a lot of work underway in this space, constantly evolving to create a smarter and stronger biosecurity system.

So in this session, you're going to hear about the use of innovative technologies and how these are helping manage risks associated with specific challenges, like for example, wildlife smuggling and cargo pests. We will also hear some very interesting biosecurity research that further highlights, why biosecurity is so important for Australia and for our trading partners. And our first presentation in this session reveals the very excitingly innovative use of technologies to assist wildlife conservation in Australia. And to explain what's happening in that area, I'm delighted to be able to welcome Vanessa Pirotta. Now, Vanessa is a data scientist and communicator for Rapiscan systems. Their x-ray detection technology is going live in just a couple of weeks’ time. And these new technologies will be part of strengthening Australia's national biosecurity efforts coupled with our international commitments, of course, to protect wildlife. So Vanessa, a very warm welcome. And please tell us more.

Dr Vanessa Pirotta: Good morning and thank you so much Richard. It is absolutely my pleasure to be presenting to all of you today. And thank you so much for sticking around for day two. This is a great last day to all be celebrating the use of science, innovation and all things wonderful for biosecurity here in Australia. And as part of my work today, I'm going to be showing you a little bit about what we're up to in the biosecurity world when it comes to using innovative technologies for Australian wildlife conservation, but also conservation globally. And it's very important that I mention that I'm here on behalf of Rapiscan systems, working in collaboration with the department as well as the Taronga Conservation Society Australia. So this is very much innovation and collaboration right here. Now, as many of you would be aware, we are here at obviously the national biosecurity forum, but for those who do need that refreshing reminder, what is biosecurity?

And this is a thing that I was thinking about when preparing this presentation. Really, if we break it down into two things, we've got bio, so if you're a biologist, you'll know it's living things or life of, and then that second component, which is security. So my background and my work is largely focused in the biology component, but bringing that into the world of biosecurity is incredibly crucial because working with different minds can come together to help solve really, really big problems. And as you'll see, biosecurity and wildlife conservation is absolutely key today. And so one of the things I wanted to talk about is, well, what needs protecting? Why should we care about the biosecurity of Australia? And why should we care about our marine ecosystems, our marine environment, the world that we are looking around our backyards. These are all incredibly important to us.

And so whether that be the milk in your breakfast or the avocado you might have had on toast, or maybe having a cup of tea now or a coffee, or if you can think back to your kids' cereal and all over the breakfast table, or while you are sitting there and watching me talking today while you're wearing a nice Merino jumper. The point of this slide and the point that I want to start off with is we have a wonderful and wild, natural biodiversity and ecosystem here in Australia that we need for protecting. And it's important to both you and I. So we're here today because we're talking about something that is important and applicable to each and every one of us. And yes, we should care, but unfortunately Australia's natural fauna and flora faces a number of threats, and there are a number. But one of the threats that I'll be talking about today is illegal wildlife trafficking.

This is also known as animal smuggling or smuggling in general. And the thing is, what is wildlife trafficking? Well, I spent many times and trying to define it, and it is defined in a number of different ways. But it's really important that I start with the clean slate. So you all have this understanding as to why we're doing what we're doing and really in terms of biosecurity, this is directly applicable. And so illegal wildlife trafficking really talks about that deliberate and illegal movement of wildlife across international borders. But we can also think about the movement of wildlife between states and territories here in Australia as well. And unfortunately, it's not just an Australian problem. It is a global problem. This is a problem all around the world. And there are a number of drivers and reasons as to why people want to move animals in awful confined environments.

And one of them is the medicinal medicine trade. So people might want to use animals for certain parts that are unscientifically proven. We also have ornaments. People like the way animals look and want to have them on their walls, or make really random things out of them for around their house. And one of the biggest is the illegal wildlife trade or the illegal pet trade, where people want animals to help portray their status in society. And Australia has some really amazing and unique creatures that will help people do that. And so, as you can see picture here, this is quite a sombre picture, but this is a reality of what we are dealing with, Australian natives going overseas in these awful confined places, environments. It's awful, it's cruel and it's not fair on the animals. And unfortunately, people who smuggle animals will do it in ways in which they can try and hide them and not be detected, until they meet us the border force... with border force rather, and also at Australia's frontline.

And I will also point out that Australian reptiles are also a key species or target in the illegal pet trade, where we see animals such as the blue tongue lizards, as well as shinglebacks, which can reach only a couple hundred dollars locally, but internationally can be up to $20,000. So it is crazy, but it's not just about Australian animals going out. I mean, that is a big, big problem, but it's also about animals coming in. And that is what we refer to as exotics. And in this picture, don't worry. They're not all going to WA. Unfortunately they're going to many places around Australia, but some examples of animals that are deliberately brought in through the illegal pet trade, like on top, we've got an example of a corn snake and those animals that are just not wanted to come into Australia, but unfortunately will find a pathway in. And we need to make sure that they are appropriately dealt with. So this is a big problem and I hope I've raised this problem. And if we can think back to the start of my talk, we need to protect this biodiversity because it has applications and it really impacts all of us each and every day.

In addition to this, as I was saying before, being that global problem, well, unfortunately around the world, the removal and the addition of animals into different areas can bring with that invasive species, which can disrupt ecosystems as well as that it can introduce disease. And as we spoke about yesterday, the talking about COVID and the highlighting of zoonosis. This is where animals can transmit disease to humans has now really become that breakfast and dinner table discussion in the every day. So people are now really aware of zoonosis and the potential capabilities of animals to transmit to people. And as a result, many of these implications for countries worldwide, such as disrupting the biodiversity, the natural ecosystems in which they function, remembering that animals and plants play key roles in how they make things happen. As well as that tourism, people want to come to Australia to see our animals and our wildlife.

If we remove those, we can potentially remove that tourism dollar as well. And as you would all very much be aware of the agricultural industry, which is worth billions of dollars to Australia and it's really important and something that we should all be proud of and worth protecting. So hopefully I've made my case today that you know what? This Vanessa person she's right, we should really be doing a lot to protect our biosecurity. Well, what are we doing about it in terms of wildlife conservation? Well, nationally, we are doing a lot, which is a good thing, and we're having a national discussion today and yesterday. So we have key environmental legislations to protect our fauna and flora, such as the environmental biodiversity and conservation act. We're also looking at those future directions and future focuses of how we can keep up with the problems or the potential problems that may come in the future.

And as well as internationally, we are signatories to CITES. We also have that international obligation to protect our animals. And for those who aren't familiar with the United Nations sustainable development goals, well, there are 17 of them briefly on your screen right now. And this is a key focus for protecting life on land, but also in the water. And you might think are people smuggling marine animals? Well, yes, there are components of the marine environment being smuggled. And so, for example, the queen conch shell. These shells are quite large. They're beautiful. These are worth $20 million on the illegal pet trade each and every year. This is US dollars. So this is a big problem, but also corals and fish. People have tried to smuggle fish into Australia. You should Google it. And as part of that, number 17 is partnerships with the goals.

So this is all about working together collaboratively. And so my role is really to bring science, technology industry and different stakeholders together to try and solve this problem of illegal wildlife smuggling through the use of innovative technologies. And this is where I really want to highlight the collaborative work and where this work of technology fits in. And then I'll go into the technology component. So we have the Australia's frontline, which I like to have as a nice serious line, because we have a huge, as I've just said, national and international obligation to protecting our wildlife and our fauna. And so as part of that, that's a collaborative process. So we have human detection, we have the sniffer dog detection, which is great. And then we also have the technology component. And so the idea is that these are to be working collaboratively and complementary to each other.

Existing now we have a combination of tools and we've got the 2D X-rays, which is where you would've gone into travel, remembering those days where you'll start to do them soon, where you'll place your bag into a scanner and your bag will be checked for any potential hazards. 2D X-rays like how you are seeing me right now, whether you are watching me on a computer screen or a giant screen at your work office, you can just see me in the screen. But if you were to look behind you can't see the back of my head or how clean my office is. But with 3D X-ray where you could potentially do that 3D X-ray allows us to look inside your bag, but also around and behind it. And by flipping it and we can do this all without having to touch your bag.

But by using the technology of real time tomography, where we send x-rays through a machine known as a real time tomography 110 machine, which I'll show you in just a moment, to produce a 3D image. And so it breaks the image down in sections. And we are able to manipulate it, which is super cool. So if you are not a computer buff and I must say, I'm not really a computer buff as well, but this is where we all come together to try and understand the technology and work towards understanding how it's working. So you might be travelling to Melbourne and you might be taking some fruit or a banana. We can then look at that through using our 3D X-ray images to create an image like this. And we are already doing this for biosecurity risks here in Australia. And what we'll do is we'll take a number of those images.

So the bananas and apples in a variety of different shapes and in different environments. And then complicate the situation and then train the computers to look for the items. So we create a number of detection algorithms. And so already Rapiscan systems has done this for fruit, meat, vegetables and working on seeds. And so naturally as part of that, there was the wildlife component. So this all falls underneath the biosecurity focus that Rapiscan systems is working on, which is a great focus for us all, especially because these are the things we all want to protect. Now, the work that we're specifically doing is creating a number of different algorithms to try and detect illegal wildlife trafficking. And so some examples of how we are doing this is by using real life animals. Now these animals are not live for these trails. So, these animals have passed and confiscated in a number of ways, but they do come to us from the Taronga Zoo or Taronga Conservation Society Australia.

So this is where the collaborative partnership comes together. So for example, we might take a shingle back, which is a shingle back lizard. These animals are the animals that unfortunately are often trafficked and put them through the RTT 110 remembering real time tomography. So it goes through, this is how we scan luggage right now in certain parts of Australia and your mail. So Christmas mail will be coming to you via machine that double checks if there's anything in there likely and it shoots an x-ray at it from its stationary gantry and the item goes through and there is x-rays that come at it from around a circle. And then it produces a 3d image, just like what you can see here. So there are a number of different components to this. What we are looking for is the shape, density, material and we complicate the situation a lot more.

So we can train computers to look for the shape of these items in complicated scenarios. And so these are our illegal wildlife detecting algorithms. Now, as part of our preliminary results now ongoing work, we have created algorithms to detect certain animal subclasses. So this is really great news. So with a focus on birds, lizards and fish, but there's still more work going on in the background. Now, this idea of what you can see, I've provided a sample image here. This is a very much not a real-world scenario. If an animal smuggler was likely to do this, they wouldn't present the animals so nicely and neatly, they would likely have them unfortunately placed in socks or rice cookers. It's really grim. And what we really want to do at the start, we were training algorithms or training computers rather is to allow the computer to go, okay, well, this is what I'm starting off with.

I need to learn this shape and already you can see that there's green boxes around these shingle backs. We have snakes and an Eastern water dragon here. We've also got a turtle and a crocodile up there as well. But already, we have detection algorithms working on these few individuals here that have been picked up. So the green box will highlight to someone working in the field to say that there's something here. We need to take a closer look, whether it bring in border force to physically inspect the bag or detector dogs to sniff it out and see if there's anything else that... Do we have a live detection? And the idea of the accessibility component is that this is a user-friendly system, it's software that can be deployed in Australia, but also potentially globally in the fight against illegal wildlife trafficking. And here are some images because it's always good to show you a few images.

We've got shingleback lizards up here in a different image here, very compromising placement of them. We've got birds, which look like little... Well, they're little chickens. And then in the middle here we have two crocodiles. As this example, it's a very simplistic scan to your right. We then have a lace monitor. And then this is a queen conch shell. These are the shells, which are worth millions of dollars annually in the illegal wildlife smuggling trade. And this then links on to the future work. So while we have a very much Australian focus, our work remains global because a lot of the work we are doing is to really expand the function of these algorithms, but starting off with an Australian focus to then look at the global problem of illegal wildlife trafficking through some examples such as ivory. And so what you can see here is we've had access to some confiscated items.

So this piece here is some ivory, as well as ivory carving. So what the 3D technology is enabling us to do is take a really fine and detailed vision of what's inside a bag to then highlight the material, the density and all this other information that a computer can then go ping, I've got something here, take a look. And obviously with these things, as you would know, especially in the COVID environment, with more data, we have more knowledge. So going on it will enable us to collect more information to then build bigger and better and stronger algorithms. So we've got this projected expansion of our work to not only be focusing on and continue our focus on Australian wildlife, but also that international component looking at ivory and other sources of trafficking, examples, such as pangolin scales, which if you don't know what pangolin is, Google it. They're unfortunately one of the world's most trafficked animals.

And as I said before, multiple algorithms, because once we build certain algorithms, we can then use that information to then build other new algorithms, to strengthen our detection capabilities. And like with many things, there's always an opportunity to learn more. So if any of this work was of interest to you, I'll show you where you can learn more in just a moment. But as I said, it is just bit of a summary. In conclusion the work that we are doing for biosecurity is applicable to both you and I. It's all about safeguarding our environment and our natural fauna and flora. But this is a global problem. And biosecurity is really benefiting from new technologies, such as the use of 3D X-ray technology. Because what it's allowing us to do is to look inside and around items where we never really had the opportunity before with 2D.

So it's evolving and it's also evolving as smugglers evolve their methods of hiding animals in luggage and mail pathways. And this is something that we should all be really proud of, because this is Australian led research using innovative technologies. And as I said before, if you do want to learn more, we had the unique opportunity to have our work featured in the ABC's flagship science show Catalyst, which is known as the wildlife revolution. So if you'd like to learn more you can watch it now on iView, obviously you'll wait till tomorrow or at least after the forum today, where you can watch that and learn more about the work that we are doing. And this is a photo of Dr Ann Jones and myself in the Sydney gateway facility, where a lot of your luggage, or your mail rather, is probably being scanned right now to be sent around the world or come to you at your house. I must say, I'd like to say a very big thank you for your attention and thank you so much for having me today. And thank you very much, Richard. And I look forward to answering your questions at the end of the session today.

Richard Morecroft: Thank you very much, Vanessa. Thank you. And we certainly look forward to you participating in that discussion panel, but it's exciting. And also very encouraging to hear how this innovative application of x-ray technology can provide this new perspective on biosecurity as well. Of course, as being such a valuable tool in wildlife protection and conservation. So thank you very much, indeed Vanessa. Well, it's time to meet our next presenter now in this science and innovation session. And she is Lisa Linssen general manager of RingIR Australia. Lisa is going to guide us through new Australian technology, different new Australian technology, that allows the identification of chemical gases and can detect pests in shipping containers. So, Lisa, I'm going to hand over to you to explain how this technology can help in a very practical way when it comes to detection of risk in the field. Lisa.

Lisa Linssen: Thank you for having me today. My name's Lisa Linssen and I'm general manager of RingIR. So RingIR is a small startup. We're Australian owned. I'm based in Sydney, but we have our manufacturing lab and our research and development group in Melbourne and we have a sister company in New Mexico. So today's presentation. Excuse me, I have lots of notes just because I've got a lot to get through and I want to make sure that I get everything and I don't miss anything. So today's presentation is titled detecting fumigants and biosecurity priority pests using real-time vapour detection.

So what that means is RingIR is dedicated to improving the safety of all personnel working with or in close proximity to potential chemical hazards. In everyday terms, we can detect any gas down to parts per billion in several seconds. So, that's kind of mind-blowing technology that's available to us at the moment that we're working with. So we've developed a portable air monitoring system capable of detecting, as I said gases, organic and inorganic volatiles, vapours, aerosols and liquid headspace down to parts per billion within several seconds. Our aim is to provide better decision-making tools for operators in the field. This means that critical responses can be made faster and with greater confidence. So our technology is really a portable unit and we're taking the lab with you wherever you need to go.

So the picture here is one of our older boxes from a previous project that we've done. So I'll talk to it at the moment and then get through to what we're doing at the moment. So that box, and what we're doing now, is described as TRL 6 and is a highly refined system with easy-to-use interfaces and provides a real time measurement system and sample identification. Our device is portable and has been built within a standard transport case, so that one's easy to move around. That example we've got there is probably 10 or 12 kilograms, but as I'll explain later, we've got different versions. So that one's also powered by a mil-spec battery and can operate for eight hours, or it could be vehicle mounted or it can also go through a mains power, which means you'd lose a lot of the weight there as well. We have an onboard pump which allows direct vapour sampling whilst having carbon filtering to reduce hazards to the end user.

The system is a laser-based device and has been independently tested to meet class one laser certification. And our current testing has demonstrated detection and identification capabilities of over 60 chemicals from a wide range of concentrations. And that's many thousands of parts per million. So really dense concentrations down to single digits parts per billion. So now I'll get onto the technology part. The capability is made possible by utilising real time cavity ring down spectrometry. This technique involves firing a laser pulse into a cavity with highly reflected mirrors. As you can see on the diagram, the pulse is reflected in a loop, travelling many hundreds of metres and gradually decaying over time. So for greater sensitivity, you want a longer path length. So you have a larger cavity and larger system, but for less finite work, you can have a smaller system. The echo of the pulse can be measured by detector and is shown as a ring down.

If we were to add a chemical vapour to the cavity, the bonds of this chemical will vibrate at specific wavelengths. As the chemical absorbs the energy, it reduces the echoes and shortens the ring down time. So you can see in the first graph how it's quite high and then over time, it reduces in intensity. Rapidly repeating this process over a wide range of wavelengths produces what we call a molecular fingerprint. So in the bottom right hand corner, that is a unique fingerprint and every chemical has its own fingerprint, which we will go through in a minute.

So this is back again to the box that I just showed you before. So RingIR has designed our boxes to be simple to operate and interpret in different conditions. So here we have a GUI design of what you'd see on the front display of a box if you're seeing acetone. So you do the measurements and that would come up on the computer saying detection, acetone. So the interface is controlled via a touch screen and the operator can choose to initially set a background or just go straight into sampling. And we have multiple operating modes. So it could be a single point scan or you could do continuous scanning over time and walk the unit around, so to speak.

This can be done using one of the accessory hoses, and the vapour can be measured without any physical interaction with the material. So you can poke the hose into where you're going. You don't actually have to get in there, get involved with what you're doing. And then the system automatically performs analysis and prompts the operator with pertinent information if a database match is found. Once again, that's the example of, hey, we've just detected acetone. And then you can ask for more details or less details and we can design the GUIs to say as much or as little info as you want.

So technology can identify chemicals with a unique IR spectra and can determine the chemicals’ concentrations. Our unit then quantifies in real time, alerting the end user to important changes in threat level, such as permissible exposure limits. So here in the graph, we have chemical A and chemical B and you can see that we've chosen two chemicals, which are actually quite similar in nature, but you can see that they still do have different peaks and troughs. And we use our algorithms to work out which peaks we need to look for and move on from there. And then do the analysis.

This here is the quantification, which helps us with the concentration. So you can see we've got high intensity down to low intensity. So we have algorithms which also can tell us down to parts per billion or high level parts per million, just what you're looking at. So it's qualitative and quantitative. So I think that's pretty special. So now getting onto what we're doing here. So fumigants are chemically diverse range of biocidal vapours, released in shipping containers to eliminate concealed pests that pose a threat to Australia's biosecurity. The biocidal properties of these chemicals pose a significant threat to the health of personnel unloading and investigating the compliance of shipping containers in the form of both acute and chronic exposure. RingIR has been contracted by the Department of Agriculture, Water and the Environment to develop a detection system that simultaneously identifies and quantifies fumigant hazards, using a low burden user friendly device. Our technology has a potential to dramatically improve the safety efficiency and scope of routine container screening.

So we have already done a phase one project, which was completed in June 2021 and that demonstrated that the technology can sense and differentiate between phosphine, methyl bromide and sulfuryl fluoride at part per million concentrations. So this was actually done with another box that we had, and we were also able to detect and distinguish between several possible interferent chemicals that people might be using and just common interference that can also pose some problems. So we're currently doing a phase two project and that sees us to deliver a specific box just for this fumigants project. So at this stage, we're aiming for a portable network enabled, six kilogram system that will be able to be calibrated and detect, identify, and alarm for phosphine, methyl bromide and sulfuryl fluoride above and below the major occupational health and safety values, such as the permissible exposure limit and the threshold limit value.

And also once again, distinguish between the interferent chemicals. So this box will still be a larger box at six kilograms, because we're still doing the R&D we need to work out our peaks, what we're looking for, finalise the algorithms and all the rest. But in the long term, we believe that we can get down to a two-kilogram portable box, once again, depending on what type of battery people wanted and what type of life cycle. So that box will be made later this year. So we're still finalising and building the box. The chemical testing will take place March and we're aiming for some field trials in May. And the delivery of this box will be in June next year. So that's pretty exciting. We're all looking forward to getting on with that and getting some results.

So, moving along from that, biosecurity protects Australia's livelihood and it is vital to strengthening and supporting our environment and economy, including tourism, trade and agriculture, obviously, which is why we're all here. Hitchhiker pests are invasive species with the potential to inflict significant damage on our agricultural industries, environment and broader economy. They have been found in increasing numbers on and within shipping containers, due to the accelerated movement of people and products within the global supply chain. The RingIR detection system is currently being trialled by the Department of Agriculture, Water and Environment as a tool for identifying infested shipping containers, by monitoring for the presence of species-specific volatile pheromones and other airborne biomarkers.

So, we've just finalised this contract yesterday, so we're all ready to go. We're planning to have our prototype constructed for this in February next year. I'll read from this bit, because I don't want to muck anything up. So we will deliver a prototype detector in June of next year, which has been optimised for increased sensitivity down to parts per trillion. So this box, because we're trying to smell pests, we're trying to smell insects, we don't know what wavelengths we're looking at, we don't know what type of concentrations. So for this first box, we're doing like a mega box. So as I explained earlier, the sensitivity is all about our cavity length and the path of the laser. So we're making a mega box so that we can detect as much of the different smells, the different pheromones and different chemicals of the different type of animals that we're looking at.

So this one will be quite a big hefty box, but we're trying to get down to potentially parts per trillion measurements. And we're doing a wide range of chemicals for that. So as part of that, we are working with Melbourne based agricultural bioscience research facility, AgriBio, and RingIR will access a number of problem invertebrate species currently in Australia for testing. So we'll be testing the Australian pests at the moment. And if the first phase of this trial is successful, the next phase of the project will focus on the detection of foreign invasive species. So once again we'll have the prototype constructed February and the testing at AgriBio will be taking place February through to May and then we'll have hopefully some great, great conclusions. So this slide here, this is the current proposed testing regime at AgriBio, that's in the matrix.

As you can see, we have 14 different types of bugs and pests represented in the list and they will be tested, analysed and recorded over five different days. So that's just an example of our test matrix. What we'll be testing on day one to three, obviously four and five, we've got a different range of bugs. So we've got several beetles, several moths. So we'll also be testing the different life cycles. So from eggs, right through to adults and also dead, et cetera. So it will be interesting to see if we will be able to say this is a beetle and what type of beetle it is and what the life stage is. So it's very innovative. It's amazing. Can't wait to get the mega box involved and do this and see what we can come up with.

I would also like to point out I was excited about the group except for the red back spiders at the bottom. That was a late edition. And yeah, so that's one of the ones we will be testing as well. So stay tuned for those results in May, 2022. So finally, thank you for listening to our presentation. Sorry, I was reading a bit from this slide, but I have a lot to get through and I wanted to get through as accurately as possible. If anyone has any questions or wants to get in contact about any chemical detection questions that they may have for their applications, please do not hesitate to call. Thank you very much.

Richard Morecroft: Well, thank you very much, Lisa for those fascinating insights into how real time vapour detection can play such an important biosecurity role. And great to see progress towards its general application. So thank you. And we look forward to your participation in the discussion panel very shortly. And in fact, mentioning that we have a number of questions that have been coming through from you already, but please do send us questions so that we can try and put them to our presenters. And if you can indicate for which presenter they're intended, that can be very helpful indeed. We would like you to be part of that discussion panel. Now let's continue. And Andrew Robinson, CEO of CEBRA and professor of biosecurity at the university of Melbourne is joining us now for the next presentation. And CEBRA has introduced a new project estimating our trading partners, exposure risks to new pests or diseases, but how do we develop a strong and efficient biosecurity system while also allowing for increased global trade and increased global human movement, particularly once COVID restrictions perhaps become less. Well, I'm going to hand over to Andrew to share the focus of this project today. So a very warm welcome to you, Andrew.

Andrew Robinson: Thank you, Richard. Those were some cracking presentations with some fabulous gadgets. I feel like an episode of Letters and Numbers following two episodes of Dr Who. We're just going to be talking about some modelling and some statistics. And I'm afraid it's not so flash as what we've seen so far, but we will press on. The case has been convincingly made that biosecurity risk is increasing and will continue to increase the interconnectedness of human populations on the globe through flight routes and through shipping routes is only increasing. And these flight and shipping routes are bringing increasing numbers of pests to our borders, increasing sharply in many cases, enhancing the need for a strong and resilient and responsive biosecurity system. And an example of the recent biosecurity event that's in everyone's minds, in COVID-19, shows that just a start point anywhere in the globe can result in substantial and significant risks across the entire system.

So what do we do? What do we do to develop our strong and efficient biosecurity system that also accommodates the increased global trade and human movement that we wish going forward for society? Well, biosecurity is a key part of this picture and border intervention itself is a key part of the biosecurity system. Trade restrictions and border intervention rates are usually based on how risky we think a pathway is. And that can be based on a policy or it can be based on the interception history, but these measures are also based on the distribution of the pest around the globe. This is tricky when your pest is moving quickly, spreading quickly and not easily detected by exporting countries. There are pests that can travel around the globe almost undetected. And how do we put in place order measures against these pests where we suspect they're out there, but we don't know they're out there. In order to do this properly, we need to proactively estimate the establishment exposure to get better intervention.

And I'm going to decompose this establishment exposure into some fundamental components. I'm going to choose three fundamental components for this exposure. Firstly, we have to have propagule pressure. That's the number of pests trying to arrive at the border. And secondly, we have to have a suitable abiotic environment, meaning a suitable climate, enough rainfall and the right temperatures. And sometimes even the right soil, we also have to have right biotic environment. So I'm thinking there about the availability of host materials, the availability of food sources, et cetera. We need the alignment of these three factors in order to be able to figure out what the establishment exposure is. And those three things are really hard to know about.

So even though they're hard to know about, we really need to do something. We've got imperfect and incomplete data. So we've got to make the most of the data that we have and we have unknown models and speculative models. So we need to use assumptions and rules of thumb, but we need to make sure that they're all grounded in common sense. So the approach that we took in this project and when I say we, I really mean James. I'm really just a grey bearded passenger. Was to get the foundations right, using the data that are available, build the bridges. And then as more data come available or more processes become better known, we can add complexity. This is one of the really exciting areas of science at the policy interface is you're obliged to try to keep things coherent and keep things connected.

And you can't just arbitrarily dip into any type of complexity that you want to get. So the following slide has a brief glimpse of getting the foundations right. This is pre-complexity. This is the simple model. We've got the sources of data up at the top. We've got the thing in the green cylinders because as everybody knows, data are green coloured. We have the activities in the parallelograms and we have outcomes down the bottom. And so this is the end to end solution that we use to solve the problem to get from very simple high level data, to being able to get some insight into what the global risk is. And I have to start by... I guess I have already started, by apologising for the brutal evisceration of James' research that I'm undertaking here to squeeze this into a 15-minute gap.

We focused on a commonly known pest, the Brown Marmorated Stink Bug as a case study. It's a pest of agriculture. It's highly polyphagous, eating more than 100 hosts. But it's also a huge nuisance because it aggregates in large numbers in the wintertime and it could store up in your warehouse or drive around in your car or seek shelter in your walls. Its native range is in East Asia, but over the last 10 years or so, it's invaded large parts of the United States and parts of Europe. And it's from this bulwark, from this vanguard, that BMSB has become a significant international biosecurity threat. And it hitchhikes in large numbers. So in applying this approach to predicting global movement risk for the Brown Marmorated Stink Bug, what were our assets? Well, we had border deception data across a five-year period and we could identify the pathways upon which those border interceptions occurred down to a four digit tariff code, which is simple economic description of the type of goods.

And we could identify the country of origin of the goods that they came on. And we also knew the number of consignments by country by year and by tariff that we could use to try to predict the Brown Marmorated Stink Bug behaviour. And we also knew how many consignments had been inspected, which is a measure for screening effort again by tariff and country and year. So we could use those two pieces of information together to try to get a measure of the risk of the Brown Marmorated Stink Bug arriving on different pathways. And we have a list of countries that have established Brown Marmorated Stink Bug populations. And we have a list of susceptible commodities. What we didn't have a wish list was reliable statistics of the value and size of the individual consignments and border interception data from any other country and consignment volume data from the other countries.

So really we had to build a risk model using Australian data and then try to predict the risk among other countries based on their trade. So we got access to the UN Comtrade database to try to think about, remembering back to the second slide of the presentation, on all the activity going on amongst the various countries. We accessed the UN Comtrade database, which is the largest publicly accessible repository of international trade data, a huge database of more than three billion records which provides standardised data on the export and import trade flows among all the countries. And we could use that. And the Australian inspection data and the information that we had on the Australian consignments, we could use all that, knit it together in some way to come up with predictions about the risks that different countries would pose to each other.

And as part of my high-level summary of the project, I'm going to draw a discreet veil over all the mathematical and statistical details and put in this little intermission slide. And I want to add in passing, for those among us who follow such things, the phrase there ‘then a miracle occurs’ is particularly appropriate in this case, because all of the analysis were done using Bayesian statistics. So now I'm going to summarise some of the results that we've got. What we found was, and this is quite comforting, there's a (log)-linear increase in the interception events occurring with increasing trade. So the more activity on the pathway there was the more likely we were to find stuff on it, to find specifically, BMSB, this makes us very happy. We also found that different countries were more likely to be sending goods that had BMSB in them.

And we've got a little risk table there, or a risk graphic there, that doesn't include all of the infected countries, but nonetheless includes the headline countries where BMSB is known to be solidly active and to be a biosecurity risk. And we found also a biosecurity risk for the exports. Furthermore, this is a much trickier one to pick apart, we could find which tariff codes were more likely to contain BMSB and it's the seats and it's the containers. And it's the tractors. And what that graphics showing us is that these pathways have much higher exposure to BMSB in the Australian data than other pathways do. So these are the ones where we would target further intervention.

So now we have a model that we fitted to the Australian data and we know approximately what the relative amount of trade is in these economic areas among all the other countries. We could predict the BMSB arrivals for all countries coming from the imports of infected countries. And we could sum that across all the tariffs for each country, bringing up this beautiful map. Of course, that's going to assume that our interception data is representative. So this gives us the propagule pressure. This gives us the push into the ports globally for BMSB coming from trade, but it's not the whole picture. We also need to consider the abiotic environment mentioned before and the biotic environment, how do we get to those? So we've developed a way of creating climate suitability maps for any pest. This one specifically for BMSB. And we can see that we've overlaid the observations of BMSB. Those are the blue dots against the global climate map that is tuned to their location.

And each of these, there are numerous different ways to estimate the suitability of climate. All of them require different assumptions. All of them have different interpretations and all of them have different advantages and disadvantages. There's really no single best method. But the one that we used is called range bagging, which is not quite as miracle requiring as the earlier model. It's pretty dang good, actually. So in addition to the global climate suitability map, we need to know what the pathways are within the country. So we wanted to disperse the arrivals from the port within the country as a function of human activity, but we didn't know that. So we used population density as a proxy for it. And so this global map shows us the population density that we could use as a proxy for the travel of cargo and passengers.

So we take this and we can weight it by climate suitability and then we can sum the scores within the country. And that brings us to our take home map. Everyone should be screenshotting this immediately. This is the log median BMSB exposure according to the CEBRA miracle model. We can see that the exposure is highest to Australia, but this should not surprise us because we use Australian inspection data to tune the model. So we know that we are going to be at highest risk. Everything else is going to appear to be a lower risk than us, but that's not what the point of the model is. The point of the model is to rate the other countries relative to one another. And that's what this map does. And here's the second part of the take home message also available for your screenshotting. We found exposure ranks of the top 15 non-infected countries based on interception trade data. Now you'll notice that I've said non-infected countries and United Kingdom is right there behind Australia. And it turns out that a couple of months after the analysis for this exercise was completed, the United Kingdom indeed reported an incursion of BMSB inside their borders. Consequently, providing us with some welcome and yet unwelcome verification of the model predictions.

So what about going forward? What can people do with this technology? Well, we've developed an online app that people can use to try to predict the global risk for different pests of the economic trade. What does it require? Well, you need a list of countries that are supply side for the pest. You need some interception data. You need some screening data, which is not easy to get and you need a climate model or we can roll one up for you. But if you put those things together, then you can use our Shiny app to get a relative risk of global supply of different pests. So I want to finish by my grateful thanks to the fabulous engagement we've had from the department and particularly Dr Brian Garms and a salute to our co-workers in the research firmament, CSIRO, the Centre for Invasive Species Solutions, the Plant Biosecurity Research Initiative, B3 in New Zealand and all of the universities. Thanks for your time.

Richard Morecroft: Thank you very much, indeed Andrew, for that presentation. It's so critical to be able to understand our trading partners, exposure risks, while at the same time being able to be realistic about human travel and of course the imperative of global trade. So some fascinating material there in that presentation. Thank you very much indeed. And Andrew will be joining us for our panel discussion in just a moment because we have arrived at our final panel discussion for this morning, where of course we have the opportunity to put your questions and thank you for sending them in, but please continue to send them in. If you still have some to go, to put your questions to our speakers now, as well as our presenters Professor Andrew Robinson, Dr Vanessa Pirotta and Lisa Linssen. We have some additional members of the panel to further inform this topic of science and innovation. Andy Sheppard joins us again from the CSIRO. And we have Geoff Grossel director at the department who is working on eDNA research and market development sector. So in fact, perhaps Geoff Grossel, I will bring in first, if I may, as we begin this discussion. And Geoff, how did you take an eDNA research project that actually started 10 years ago to the national eDNA testing program?

Geoff Grossel: Thanks Richard. It's a good question. And it really goes to the heart of what research or the eDNA pathway is. And we call that the research to market pathway. So traditionally an eDNA program's a great example of this. And it's a good case study to examine. Traditionally, you've got your research and your researchers are living on this side of the village, and then you've got all your business analysts and your people, contractors and procurement specialists and venture capitalists, they're living on the other side of the village. And the researchers get through their research and then push it out into the bay and hopefully it'll float and who's going to pick it up or who's going to jump on board. Usually we don't know. So that's traditionally what happens and almost always, you don't get what we say is a good return on your investment.

So we've taken a much different approach mimicking other industries, IT industries do this well, big pharma, where we'd like to bring the two villages together, say into the community hall, if you like. And once we do and once we align the two tribes and they're working together with real purpose and real vision, we almost always get a great result. And that's that research to market success. More often these days, we move away from the traditional sciences and the pure sciences and the blue sky research. And these days investing entities want to see a good return on their investment. And this is a great way to get it. Bringing the end user, the clients together, the venture capitalists together. And in that it doesn't always work.

Then it starts to become a bit more like herding cats. So you sort of got to think yourself, you got to apply some pretty good program management to hold it in place and push it forward. But they're on the same page. They're all on the same page. They're not adapting something or trying to adapt something. They're on the pathway to market. No longer becomes a research-to-adaption pathway. It's all built in at the markets pathways already set, in course. And that works great, works fantastically. But there's one little thing I like to inject into that process. And that's a spirit of entrepreneurialism. I think that's really important. That's the thing that puts a fire under the pot. And you don't need everyone to be an entrepreneur, but you need that collective spirit of entrepreneurialism in that shared purpose. And you almost always get a great result and a great return on the investment which was what the research funding bodies and clients are looking for at the end of the day.

Richard Morecroft: Thank you. Well, it's a very positive vision, but thank you very much indeed Geoff. Now we've had questions coming in. So let me take one of those questions from our registrants, our participants. Thank you for those. This first one is for Vanessa Pirotta. Vanessa, the question is, is there any biosecurity testing or sampling for legal seed imports for external infection with pasture and crop pathogens? Will advances in DNA sequencing help sample for hitchhiker pathogens? Can you address that one for us?

Dr Vanessa Pirotta: Well, that's a very, very big question. And thank you for the question. And also that's a very good focus that we need to be looking at. The short answer to that is there's preliminary work going on. This is not my area of expertise, unfortunately, but the work that Rapiscan systems is doing with the detection of seeds is progressing. And I've put in a previous link to one of the answers online. And that will show you press releases is some of the work that we are actually doing. So, unfortunately, I won't be able to answer your full question, but that is very much a focus that biosecurity portfolio that I showed in my presentation and seeds is an ongoing and a project that is needing an adapted component to x-ray technology.

So you would've seen with the work that we were doing, we're using that really, really, really big RTT 110 using real time tomography. If we were to use that for seeds, unfortunately the x-rays are just too strong and it would just... You wouldn't see them because it would just blow the image out. So we're adjusting the use of technology using this really refined x-ray capabilities on a smaller scale to produce high resolution images for the detection of a variety of seed. So the work remains ongoing, but the work specifically to your question is likely to involve a variety of different collaborators to come together to hopefully well, sniff out (pardon the pun) and also see those types of biosecurity threats from the flora components side of things. So, sorry I can't answer it completely, but hopefully that helps.

Richard Morecroft: No look, thank you very much, Vanessa. And great to hear about that ongoing development and the evolution of the ideas and the technological concepts. Lisa, we're going to come to you next. And a question has come in for you, which I will now read. And that is how many gases can be detected from one sampling? How many from one sampling?

Lisa Linssen: Yeah, it's a great question. I should add that we also do have other projects that we're working with defence and border forces and for security applications. So we've got quite a few different projects on the go at once. So we've currently analysed about 60 or 70 different chemicals. A lot of those are toxic industrial and general chemicals and we are looking at doing some mixtures. So that would be a 50/50 mixture and other percentages and three and four unit mixtures. What we believe that our algorithm can do at the moment is it will separate the different components based on the wavelengths that it looks at. And then it will give you a percentage accuracy. So it might say I'm 80% sure it has this chemical. I'm 70% sure it has this chemical. We're still working on it and we're still getting there, but it's looking good and we believe that we can do mixtures and multiple chemicals at once.

Richard Morecroft: And again and thank you, Lisa. And again, there's that sense of where you are is exciting, but also where you can go clearly has so much more potential to be developed. Can I bring you in here, Dr Andy Sheppard from the CSIRO because we've been hearing about such extraordinary technologies and possibilities this morning, I mean, in your opinion, how are some of the technologies which we've covered in this session? How are they or how will they provide really tangible outcomes for biosecurity?

Andy Sheppard: Well, thanks Richard. I mean, there are a plethora of new technologies becoming available and they deal with a number of areas. Obviously the focus of this session has been on identifying stuff that could get in, in order to try and keep it out. There's a huge development in terms of diagnostics and detection technologies, far too many to go through here in detail. There is also a plethora of developments in technologies that'll help us intervene and take action when incursions are detected. But I think Andrew's presentation really gives good example of how modelling and science is informing intelligence gathering, which is another key area for biosecurity, where we are really doing very little research and yet there are huge gains to be made. And then for me, the fourth area is scenarios and modelling in the degree to which they can help us in our preparedness as a nation to be able to respond to incursions when they come and also actually manage and support us when we undertake an incursion in real time, to be able to support decision making.

Richard Morecroft: Thanks very much Andy. And Andrew, Andy just mentioned your work then in his response, there's a question that's come through for you specifically, which says, how could your approach be used more broadly by, it says by department, but either by the department or in fact, perhaps by multiple departments, for example, looking at other priority pests and diseases or groups of pests or diseases, what do you think Andrew?

Andrew Robinson: Thanks for that question. It's a really important one because we don't want our work to be stuck in the context in which it was developed. It turns out that the approach that James developed to solve this problem is quite generalizable. And indeed we could use the interception records for different types of pests, other than BMSB. A complication arises when we think about climate suitability. When we think about climate suitability, it may well be that pests don't have commensurate climate needs. So coming up with a map across different climates could be tricky, but not impossible. So I think in short, it's an intriguing challenge. And I believe that our approach would scale to solve that problem.

Richard Morecroft: Thank you very much. Vanessa, we've had another question come in for you. And it's a very simple one. It simply says, why is it important we focus on reptiles first.

Dr Vanessa Pirotta: Great question. Well, the idea of focusing on reptiles is, we don't often know what is being trafficked in Australia with regards to reptile trafficking. So this is really important for us to have a little bit of knowledge in the reptile world. So rather what I'm trying to say here is that when people traffic animals, there is a lot we don't know what they're doing with trafficking in terms of what and when they're trafficking certain species. So finally, we do have some intelligence to show that reptiles are a key focus. So with that focus, we go forward and know okay, so this is what people are actually doing with reptile smuggling. And we know that they're doing that. So let's focus on what we already have knowledge on and then try and pick up the pieces of where we might be thinking people are smuggling other animals.

So for example, we know that there might be smuggling of birds and that's another area that we're starting to focus on, but in lieu of a lot of knowledge and information on certain species or what people are moving around, we will use the information that we have on some animals that we know are trafficked and then pick up the pieces with, say, for example, targeting things like eggs and other potential species such as small mammals, because that could also be part of illegal wildlife trafficking world that we just simply don't know about. But reptiles in short are something that we know is being trafficked and a great starting point for our initial algorithms that were developed.

Richard Morecroft: Thanks, Vanessa. The next question has come in for you Lisa and it is, is the RingIR technology able to detect diseases in animals before any signs and symptoms show up?

Lisa Linssen: Great question. The easiest way to probably answer that is our sister company in the US, RingIR. Inc, they have been doing some breath analysis on COVID. So they have been getting people to breathe into a bag and then the air in the bag goes through the unit and they can detect COVID positive and COVID negative. So I would probably say, yes, we've been working on the COVID situation probably for 12 months and it's looking very promising. But there's a lot of other issues. And there's a lot of other things that you're smelling and we're not exactly sure what the chemicals we are that we are smelling and all the rest. But I'd probably say there's definitely potential. And there'd be something that we would be interested in showing.

Richard Morecroft: Thank you very much. Andy, I can see that you are indicating desire to come back into the discussion. So please join us again.

Andy Sheppard: Yes. I just wanted to highlight a really exciting technology in diagnostics, particularly in animal health, which is the use of micro RNA biomarkers as a way of detecting diseases. Micro RNAs are produced by the body as soon as any infection takes place. And so micro biomarker profiles and particular diseases and most diseases have unique profiles can be detected before you can pick up the virus or the bacterium, and before you can pick up the antibodies. So it's a classic new test that can allow you to detect disease before you can see any symptoms. And we've developed it in CSIRO test for COVID. And it's also been developed for a number of animal diseases, and they can be put on handheld on portable platforms. So this is a diagnostics approach. In the future, we'll be able to answer the question that's been posed. Thank you.

Richard Morecroft: Yeah, very exciting potential. And thanks for mentioning it Andy. Geoff, look, if I could come back to you, because as you were explaining, you had a real excitement about that entrepreneurial potential in this research, the development, the approach, as you are listening to our group of presenters here today, how are you feeling about those possibilities? What are your reactions to what they've been talking about?

Geoff Grossel: Positive.

Richard Morecroft: Excited.

Geoff Grossel: Yeah. I think it's important. I think it's been missing in traditional research for a long time. Like I say, out of the industries do it much better. The IT industry obviously has been the really burgeoning entrepreneurial spirit has come out of that industry and pharmaceuticals in particular. But there are big incentives driving that as well, big dollar incentives. So in biosecurity, not so much, but you still need to foster the entrepreneurial spirit because it's where the passion comes from to actually make something happen at the end of the day. Bring it beyond research and make it useful.

Richard Morecroft: Thank you. Andrew, can I bring you back in again, because we've got a very specific question here, which I'm not sure you'll be able to answer, but perhaps you will. The question is to you. Do you have on hand the current proportion of container consignments, which are inspected within Australia and within New Zealand? Do you have those figures?

Andrew Robinson: I can answer that question. I do not have them.

Richard Morecroft: Okay. Just maybe while the que... I mean, obviously that question raises a sense of concern, I suppose, about what proportion of containers do get really carefully checked out without having the precise figures. Do you have a sense of what your thoughts about that might be?

Andrew Robinson: Yes. A number of a number of years ago after the outbreak of foot and mouth disease in the United Kingdom, this is in 2001. So I'm going back in time. The federal government specified that 100% of sea containers should be examined externally, six side examination. 100% of sea containers was something like two million sea container interventions a year. So we did a risk analysis on that set of outcomes. And we found that inspecting 100% of containers was not an efficient use of border resources. So at that time, the department came to the decision that it would undertake a risk based analysis of a risk based intervention on containers. And just pick primarily on containers that were likely to be high risk because they were carrying Giant African Snail and then have a reduced level of intervention to monitor the pathway for the balance of the containers. So, that was something down to around 30%. I believe that the department inspects fewer than 30% at the moment.

Richard Morecroft: There is a question now for you, Vanessa, and it is a very practical one about the technology. The question is, can you easily ramp up the x-ray intensity and denature seeds?

Dr Vanessa Pirotta: Ooh, interesting question. Now I'm not 200% sure about that, but the reason for that is because I'm working on the bigger machine. So, that would be in specific relevance to that smaller x-ray machine. Now, my brief understanding is that I don't believe so. However, it's always watch this space type scenario. And the other thing I'll point out is that when something is scanned, the idea is to have it remained only minimal exposure to x-rays and then it's gone. So I would have to provide further information on that and something we can do in the near future, especially when we release some exciting results from the seed work. So thank you for your question.

Richard Morecroft: Well, it obviously was an interesting possibility of a duality of function for the x-ray machinery. But as you say, watch this space and let's see if there are possible developments. And look speaking of possible developments coming back to you, Lisa, it was fascinating to hear the ways in which there have been such a trail of evolution in the research and application that you've been doing. But if you can put on idealistic hat for a moment, what for you does success really look like with the new detection technology that you're talking about when it's working well? What does that model eventually in a practical sense look like?

Lisa Linssen: Yeah, that's a big question. And there's a lot of ways to potentially answer that. I think our technology can give a capability that's currently not there. There's a few devices out there that can detect gases and they take several minutes to work, or you have to do some sampling and then go elsewhere. The big thing about us is that we can detect any gas down to parts per billion in several seconds. So I think success for me is seeing us open capabilities that haven't currently been available, whether that's agriculture, security, defence. There's hundreds of different applications. So just seeing it in use.

Richard Morecroft: Thank you very much. Well, again, very positive opportunities to look forward to. And probably a final question for this discussion, that's come in for you, Andrew. And it says, can your model be extended to account for climate change and changes in trade flows?

Andrew Robinson: Thanks for that question. The answer is yes. If we can track the changes in trade flows or even predict them, and if we can predict different scenarios of climate change, then we can develop new maps and new models that will account for both of those things. Indeed, possibly even connecting them together. That's a great idea.

Richard Morecroft: Well, thank you very much, indeed. In fact thank you to all of our panellists for the involvement in that discussion. Andy Sheppard from CSIRO, Geoff Grossel from DAWE, Dr. Vanessa Pirotta, Lisa Linssen. And of course, Professor Andrew Robinson, thank you very much, indeed all for being part of our final discussion panel for this morning. And speaking of final, we thought we might do a final Mentimeter for our discussion panel today, or to conclude our discussion panel today, but to involve all of you who are watching in the process. And the Mentimeter question is how would you like to be involved? And it's very much an emphasis on how would you like to be involved in the national biosecurity strategy development? What is the words or the roles that come to mind when you see the possibilities of the future?

And that's a very practical word to come up with straightaway workshops, metadata, the big picture, making your own contribution and information, keeping you informed. Now, so many opportunities and possibilities are coming in. It's hard to read them all immediately, but you can see the ways in which there is really strong potential for active involvement, as well as the reception and distribution of information about the issues that we've been talking about today. So a great contribution of ideas from all of you as we have been seeing on a regular basis as this forum has continued. So thank you for that Mentimeter response. And the excellent discussion which we were involved with just a few minutes ago really brings this morning's session of the forum to a close today, really has been a very important overview of a range of research and partnership activities, as well as we've heard, truly innovative technologies, all of which import that is support the important biosecurity efforts in Australia.

And once again, very warm, thanks indeed to all of our forum contributors. Now, a reminder that a recording of all of the sessions from the forum today and yesterday as well will be available on the website shortly. And of course, don't forget we haven't quite finished yet. If you are involved with the forum, because we do have a further session and it should be a really fascinating one this afternoon at 3:00 where we're going to hear more from this year's Australian biosecurity award winners. It's a chance for you to put questions to them about their work and hear from them once again, to expand on their areas of activity and focus. But now it's time for me to hand over to Andrew Tongue co-chair of the national biosecurity committee to conclude our forum today. Welcome back, Andrew.

Andrew Tongue: Thanks very much, Richard. I've only got four reflections and it is challenging to be around passionate, clever, committed people in biosecurity. They really force you to look at yourself and think, well, I got to rise to that challenge. My four reflections, the power of science and digital to transform biosecurity. There's so much we can do now that we couldn't do before. And how are we going to make that come true? And as we bring that science in a digitally enabled way, we can bring it to the whole of the country. So what does that look like? So I think we need to talk a little bit more about that and think about that. The strength in communication and engagement, bringing people with us on this journey and revealing to Australians, some of the threats that we face, but also some of the clever things we can do to protect ourselves and our continent, data and analytics.

So being tough on the numbers, we're going to come into a fiscally constrained environment in the not-too-distant future. How are we going to be smart? And how are we tough on the numbers and bringing that to governments, to industry, to the community and informing the option set. And finally, a reflection about our region, so hearing from colleagues in New Zealand and the great work that they're doing really made me think about in future bringing colleagues in from the Pacific islands, from Indonesia, from Timor into a wider regional conversation about biosecurity. As I said, we need to be a good neighbour, and we are only as strong as the neighbours around us. And so having listened to the richness of the conversation this morning and yesterday, shouldn't we be inviting a few more people in to listen to the conversation and also to learn from them. So, that's something I need to talk about with my colleagues. So thanks very much Richard.

Richard Morecroft: My pleasure and speaking of colleagues, it's also a great pleasure to be able to welcome Malcolm Letts, the other co-chair of the national biosecurity committee for some reflections on our forum.

Malcolm Letts: Thank you. And I'll just add to Andrew's comments in relation to, and I agree wholeheartedly with his commentary. Look, I think there were some beautiful things for me today in the presentations, and they were all very powerful, the bringing together a biology and technology and digital technology. The importance backing off yesterday in relation to the surveillance and preparedness piece. So the real emphasis on that and the fundamental part of that is everyone sharing the responsibility. So actually being able to raise the awareness and the ownership across the nation in relation to that. And I think Tim's presentation, the ‘Ko Tātou This Is Us’, was really powerful in relation to the learning, as Andrew said, from what the new Zealanders have done.

But also there's a lesson in there from extending too far and trying to push with that actually having everyone coming along on the journey with you was also very powerful. I think on Remembrance Day, I think some of us Richard will have three moment silences now because we are on different time zones to obviously Canberra. And so it will be a day to remember. And I think a bravery award should go to [inaudible 01:25:20] for suggesting that the detective dogs was a better podcast than his boss. So I'd like to just end it there. And thank you, Richard, thank all the speakers for their fantastic presentations. I think it's been a wonderful two days and a richness added today on yesterday, which has been very worthwhile. Thank you very much.

Richard Morecroft: Thank you very much indeed Malcolm. And yes, as you say, it has been a wonderful forum with all of our presentations, but also with all of your questions and participation. So thank you very much indeed. To all of you who have joined us from all parts of Australia, from New Zealand and as we said from even further locations around the world over the last two days, thank you very much indeed. Thank you for all of that. And we are very much looking forward to this afternoon's discussion at 3:00. See you then, but for now good afternoon.

[Session ends]