New Challenge 5:

New Zealand's Biological Heritage

May 2013

Following the Decision by Cabinet to combine Challenges 5 and 7 (Biodiversity and Biosecurity) Professor Penman and Dr Ferguson from the National Science Challenges Panel combined those Challenges to form 'New Zealand's Biological Heritage'

Challenge 5	
Title	**New Zealand's Biological Heritage – protecting and managing our biodiversity, improving our biosecurity, and enhancing our resilience to harmful organisms**
Opportunity	New Zealand's biodiversity is a unique combination of high levels of endemism (species known only in New Zealand) and an economy strongly based on the use of exotic species. We value both indigenous and introduced biodiversity yet our current understanding of the implications of biodiversity change and loss, and biosecurity threats—even at the broadest scale—are still very limited and fragmented. New approaches are required that integrate biodiversity and biosecurity management more holistically where all elements (ecosystems, species and genes across indigenous and introduced species) contribute to sustaining and protecting our economy, environment and society. We must develop a scientifically-based understanding one of the great unresolved questions in ecology - the specific nature of interdependencies between the structure and diversity of biotic communities and the functioning of natural and production ecosystems. The dominance of introduced species in many of our ecosystems means that we are vulnerable to the impacts of unwanted plant, animal and microbial organisms through incursions or the naturalisation of species previously under cultivation (the formation of weeds). These impact not only on primary production, but across all ecosystems, requiring an understanding of vulnerability and resilience across diverse systems (including the natural estate, primary production, urban, aquatic and other terrestrial environments). We have world-leading researchers in biosecurity and biodiversity and this Challenge aims to build and expand on existing collaborations (e.g. Better Border Biosecurity) and provide a platform for research on wider areas of pest and disease management (including insects, disease vectors, pathogens of plants and animals, and weeds in terrestrial, aquatic and marine environments). We particularly need to establish the importance of biodiversity as a major factor in the the delivery of ecosystem services (e.g. production of food and fibre, carbon storage, maintenance of water and soil quality, regulation of climate change) and develop innovative tools and management systems against threats to such services. These include pre-border risk assessment, development of border detection systems and acceptable approaches to eradicating and controlling establishing, and established populations, based on sound science yet with social acceptability. Biodiversity and the protection of our natural and production environment from biological threats, has deep resonance with communities so this Challenge will also build the framework to engage in 'citizen science' to build partnerships for biodiversity management. *The Panel concluded that supporting this Challenge would create significant additionality with strengthened co-ordination and integration flowing from the multi-disciplinary and cross-institutional research needed to meet the Challenge.*
Science Goal	Resolve the interactions and interdependencies of biodiversity (ecosystems, species and genes) and the impacts of invasive organisms across a range of land uses and scales to support evidence-based decisions on biodiversity and biosecurity management, protection of the natural estate and production environments, and the provision of ecosystem services
Societal Goal	Biodiversity in our natural and production environments is valued, protected and managed across a range of scales for wide environmental, economic, cultural and societal benefits, and management systems involve socially acceptable technologies and policies

Themes	Examples of Research Activities
Discovery, characterisation and risks	Building information - data quality and availability Filling data gaps (e.g. microbial diversity) Determining societal values for biodiversity and their implications Assessing risks from potentially invasive species (including zoonoses)
Interdependencies, functions and ecosystem services	Identifying complexities, dependencies and interactions Understanding species occurrence and environmental change Establishing functional and evolutionary relationships Optimising multiple ecosystem services
Threats and resilience	Understanding impacts of pests, climate change, land use etc. on distributions Determining relative stability and resilience of different environments Developing whole system models across a range of scales and resource use
Eradication and management of invasive organisms	Identifying factors that result in the establishment of invasive species Scaling up from island sanctuaries to mainland and area-wide pest management Developing new tools for eradication and management of invasive species
Detection, measurement and assessment	Optimising management interventions and measuring biodiversity gains Developing sampling, detection and identification systems Assessing qualitative and quantitative changes to ecosystem services
Social partnerships and licence	Developing new frameworks and business models for biodiversity management Building social acceptability of new management systems and pest control technologies Developing the role of 'citizen science' as a driver for change

Comments	
Readiness:	The biodiversity and biosecurity research community is well connected with strong user and societal links. Improving coordination through this Challenge will give immediate benefits through the more integrated approach to threat management and effect a step change in understanding and managing our biodiversity. The Challenge has some well-established international links.
Other notes:	This is an area with extensive capability in most elements of biodiversity and biosecurity. We have good collections and databases, and science capability in biosystematics, evolutionary biology, ecosystem interactions, pest and disease management, and restoration ecology. We need to build more capability in economics, social valuation, bioinformatics and modelling. This Challenge will be contingent on building a strong foundation and infrastructure in bioinformatics where databases can be openly accessed across a range of ecosystems and scales. Partnerships with Government, business, NGOs, Māori etc. will be critical to identifying specific research needs and to implementing any new technologies and management systems. Dr Ferguson's and Professor Penman's interests in this area were noted