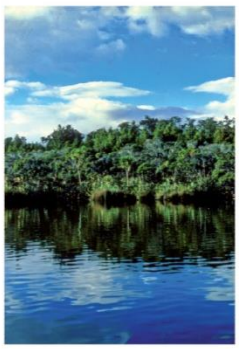

Strategic roadmap for biosecurity and biodiversity research

Envirolink Advice Grant 1474-ESRC265

Landcare Research
Manaaki Whenua

Strategic roadmap for biosecurity and biodiversity research

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Summary

Project and Client

This report provides a framework to define medium to longer term (10–20 years) research, science and technology priorities for biosecurity and biodiversity outcomes of regional councils and unitary authorities (a '*Strategic Roadmap*' for biodiversity and biosecurity research). It was completed by Landcare Research for Environment Southland (on behalf of all regional councils and unitary authorities) during December 2013 to October 2014, and funded by the Ministry of Business, Innovation and Employment via an Envirolink Advice Grant (Project 1474-ESRC265).

Objectives

- Complete a strategic scan of the operating environment to determine a set of high-level goals.
- Complete a critical review of keystone reports and legislation to determine broad research priorities and possible intermediate outcomes.
- Conduct a facilitated workshop with a 'strategic advisory group' to test, review and revise information obtained through the above processes.
- Map potential and preferred implementation pathways to identify opportunities to leverage, align and speed delivery.
- Develop a strategic roadmap and accompanying report reviewed and approved by workshop attendees.

Methods

- We interviewed a variety of key individuals in the biodiversity and biosecurity sectors in New Zealand to ensure coverage of research needs in terrestrial, marine and freshwater environments.
- Appropriate legislation and recent reports were reviewed to identify emerging priority issues for biosecurity and biodiversity in New Zealand.
- We 'road-tested' the issues that emerged from the interview process at a workshop with a core group of participants (a 'strategic advisory group' approach).
- From the interviews and initial workshop, key priorities were distilled into a set of (1) **overarching goals**, (2) **strategic research priorities** and (3) **pathways to implementation**. At the specific request of the Bio-Managers, the final set of strategic priorities is deliberately high-level in order to encompass marine, freshwater, and terrestrial research needs.

Results

- From the strategic scan and interviews, a set of common overarching goals were identified. They were:

  - Halt and reverse the decline of native biodiversity.
  - Reduce land-use and invasive-species impacts in freshwater and marine ecosystems.
  - Ensure integrity of ecosystem services and natural capital.
  - Improve environmental outcomes through increased community awareness.
  - Anticipate and plan for future risks.
- Research priorities to achieve the goals, and specific recommendations on pathways to implementation to achieve national coordination and increase uptake of research findings across the biosecurity and biodiversity sectors, were also identified.

Recommendations

Recommended priority research areas, in no particular order, were:

1. Scaling up: landscapes and seascapes
2. Ecological monitoring and reporting
3. Surveillance and detection
4. Novel tools, tactics and strategies for pest and weed control, and Improvement of existing tools, tactics and strategies
5. Pathway analysis
6. Data management
7. Social science and citizen science
8. Risk analysis and prioritisation
9. Ecosystem services and valuation of natural assets
10. Modelling to predict future scenarios and risks

Recommended pathways to implementation were:

'Outward focus':

- Make this *Roadmap* available to external parties once it is approved by RCs/UAs.
- Identify key individual(s) in the Bio-Managers' Group to be involved in the annual scanning, scoping and planning of research activities by research providers. Strategic national and international scans should also be undertaken periodically to ensure that this *Roadmap* and associated research priorities remain relevant in a dynamic environment.
- Put in place mechanisms for allocation of RC/UA funding, with funding to be allocated for a minimum of 2–3 years (i.e. on a longer time-frame than just one year), in line with priorities identified during scoping and scanning processes above and with the goals

articulated in this *Roadmap*. With the recent approval of the Biological Heritage National Science Challenge, the *Roadmap* can now provide a vehicle to connect with wider developments in biodiversity and biosecurity research prioritisation, and thus has the potential to provide a highly effective and efficient delivery pathway from research to end-user outcome benefits.

- Consider adopting an 'adaptive management' or 'learning by doing' paradigm for research activities in order to learn from large-scale management interventions, where appropriate.
- Conduct a strategic scan of agencies best suited to handle problems (e.g. new incursions) appropriately with the resources and skills at their disposal.
- Link community engagement activities currently undertaken by RCs/UAs more formally with the relevant research priorities identified. This should include embedding mātauranga Māori research approaches where appropriate.
- Approach potentially responsive industry partners who may be seeking improved environmental outcomes as part of their wider mandate, with a view to collaboration.
- Identify and progress a small number (2–3) of potential philanthropic opportunities to proposal stage, using this *Roadmap* as evidence of long-term planning for research activities by RCs/UAs, and of a commitment in principle to strengthening community/iwi/industry engagement. The recent success in securing funding from the Robertson Foundation Aotearoa by Hawke's Bay Regional Council, in partnership with the Department of Conservation and iwi, could be used as a model.
- Commission an Envirolink medium advice grant with the purpose of (a) conducting a workshop with the relevant research providers to familiarise RC/UA staff working in biodiversity and biosecurity with current research activities and engage them in shaping future research activities, and (b) conducting a stocktake of current research activities in the Natural Resource Sector in order to identify priority needs specifically designed to help RCs/UAs strongly engage with national opportunities such as the Biological Heritage National Science Challenge.

'Inward focus':

- Consider funding a 'knowledge broker' position tasked with translating research findings from providers into 'plain English' and interpreting their utility for policy development. Alternatively and at the least, specifically request knowledge transfer activities when developing contracts with research providers.
- Provide a report to the Bio-Managers' Group and Chief Executives' subgroup (e.g. twice a year) on the above activities, with recommendations for actions where specific advocacy or support is required to achieve identified strategic goals. Again, individuals who are willing to take on these roles should be specifically identified, possibly via the formation of a subgroup that spans a number of working groups, in order to form a collective view of top priority research activities for the coming year(s).
- Develop a national-level, cross-council process for 'reporting back' by attendees at relevant national and international conferences. Willing individuals would need to be identified to implement this process.

1 Introduction

The Bio-Managers' Group of Regional Councils and Unitary Authorities (hereafter RCs/UAs) in New Zealand have recognised the need to take a long-term (10–20 year) view of research needs to ensure they can deliver on biodiversity and biosecurity outcomes. This is particularly pertinent in the context of the National Science Challenges (NSC), because many major agencies and research providers in New Zealand are seeking to align with the Challenges. It is even more significant in light of the 'rolling together' of biosecurity and biodiversity research into a single Biological Heritage Challenge.

The following report summarises the strategic landscape for biosecurity and biodiversity research in New Zealand and provides an overarching framework from which to define research, science and technology priorities for biosecurity and biodiversity as they relate to RCs/UAs. The focus is on the medium to longer term (10–20 years). It was completed by Landcare Research for Environment Southland during December 2013 to June 2014 with feedback from the Bio-Managers' Group in December 2014. This report was funded by the Ministry of Business, Innovation and Employment (MBIE) via an Envirolink Advice Grant (Project ESRC265).

2 Background

2.1 Purpose of the *Strategic Roadmap*

The aim of the Bio-Managers' Group in seeking development of this *'Strategic Roadmap'* is to ensure that research prioritisation for biodiversity and biosecurity by RCs/UAs fits within a national picture. By reviewing the wider operating environment and mapping potential delivery pathways, the *Roadmap* aims to provide the Bio-Managers' Group with a clear set of goals from which to plan and prioritise research, as well as contribute to more collaborative prioritisation efforts across these sectors nationally. The *Roadmap* will help direct resources and research needed to resolve key problems in biodiversity and biosecurity looking forward 10–20 years and beyond.

2.2 Initial steps towards the *Roadmap*

As a first step, the Bio-Managers' Group met (October 2013) to discuss this strategic context and develop initial research initiatives. It was agreed that such a document should:

- Guide and inform decision making about where and how to use financial and other resources to achieve the *Strategic Roadmap's* objectives.
- Fit within the existing governance and advisory structure of the Bio-Managers Group and its relationship as a Special Interest Group to the Regional Council Biosecurity Working Group (BWG) and Biodiversity Working Group (BDWG).
- Provide an overarching framework to define science, research and technology priorities for biosecurity and biodiversity as they relate to RCs/UAs – focusing on the medium to long term (10–20 years).

- Describe the ongoing steps needed to achieve research needs in biodiversity and biosecurity beyond the life of this project, including specific recommendations for appropriate structures and 'ways of operating' to ensure RCs/UAs remain collectively on track.

With the recent approval of the Biological Heritage NSC, the *Roadmap* can now provide the vehicle to connect with wider developments in biodiversity and biosecurity research prioritisation, not only through the NSC, but also in relation to its associated CRI core funding, university-based CoREs (Centres of Research Excellence) and MBIE contestable funding that may be aligned with the NSC in future investment rounds. The *Roadmap* thus has the potential to provide a highly effective and efficient delivery pathway from research to end-user outcome benefits.

This is the first time such a document has been developed by RCs/UAs for the biosecurity and biodiversity research sectors.

3 Objectives

- Complete a strategic scan of the operating environment to determine a set of high-level goals.
- Complete a critical review of keystone reports and legislation to determine broad research priorities and possible intermediate outcomes.
- Conduct a workshop with a 'strategic advisory group' to test, review and revise information obtained through the above processes.
- Map potential and preferred implementation pathways to identify opportunities to leverage, align and speed delivery.
- Develop an A3 Strategic Roadmap and accompanying report reviewed and approved by workshop attendees.

4 Methods

4.1 Strategic scan of the operating environment

The authors sought information from a variety of key individuals in the biodiversity and biosecurity sectors in New Zealand (see Appendix 1) to ensure coverage of biodiversity and biosecurity research needs in terrestrial, marine and freshwater environments. Interviews were conducted informally as a conversation, ensuring all questions were covered during the interview but in no particular order.

4.2 Review of key reports and legislation

Appropriate legislation and recent reports (see Appendix 2) were reviewed to identify emerging priority issues for biosecurity and biodiversity in New Zealand and internationally. Just one deserves mention here: the recently-completed *Strategic roadmap for land and water research* (Collins et al. 2014). That *Roadmap* is cross-referenced here for consistency.

4.3 Strategic Advisory Group

The authors 'road-tested' the scan and delivery pathways that emerged from the interview process with a core group of regional council participants (a 'strategic advisory group' approach). This group provided a quorum of experienced managers, fully aware of the *Roadmap's* intended nature and audience, who it was envisaged would assist others in the Bio-Managers Group, and in the BDWG and BWG, with implementation of the final *Roadmap*. They were: Richard Bowman (Environment Southland); Kevin Collins (Waikato RC); Philippa Crisp (Greater Wellington RC); Stephen Hall (Taranaki RC); and Campbell Leckie (Hawke's Bay RC).

4.4 Mapping of priorities and implementation pathways

From the interviews and initial workshop above, the many detailed research needs were distilled into a set of (1) overarching goals; (2) strategic research priorities; and (3) pathways to implementation (effectively 'ways of operating') that could be employed by regional councils and unitary authorities to achieve efficiency across the biodiversity and biosecurity sectors, and to ensure that the *Roadmap* would be an enduring document.

At the request of the Bio-Managers' Group, strategic directions were kept deliberately high-level to encompass marine, freshwater, and terrestrial priorities in biodiversity and biosecurity research. Each research priority was also categorised according to whether the Strategic Advisory Group agreed RCs/UAs should be '**leaders**', '**influencers/partners**', or '**followers**' in a particular area.

5 Results

5.1 Overarching goals

From the initial strategic scan, literature review, and Strategic Advisory Group workshop, a set of common overarching goals were identified. These goals provide the framework for this *Roadmap*. They are:

- Halt and reverse the decline of native biodiversity and protect natural habitats.
- Reduce land-use and invasive-species impacts in freshwater and marine ecosystems.
- Ensure integrity of ecosystem services and natural capital.
- Improve environmental outcomes through increased community awareness.
- Anticipate and plan for future risks.

Goals 2–5 are similar to those identified by Collins et al. (2014) in the *Strategic roadmap for land and water research*, and all of them emerged broadly as priority areas for research in the Biological Heritage NSC (with the exception of marine ecosystems, which are outside the scope of that Challenge).

5.2 Strategic research priorities

These priorities are not ranked, but are the top 10 priorities identified by the strategic scan, interviews, and literature review.

Priority 1: Scaling up: landscapes and seascapes

Relevant ecosystems: Terrestrial, marine, fresh water

Recommended role of RCs/UAs: Regional leaders; national influencers/partners

Context: Initiatives such as 'Predator-Free New Zealand', while still an aspirational goal, highlight the drive to 'scale up' management activities in terrestrial, freshwater and marine environments, and link such activities explicitly to large-scale improvements in desired assets (e.g. better connectivity for native biota), as well as to economic, cultural, and social outcomes. Currently, management approaches employed by RCs/UAs appear to fit broadly into two camps: either landscape-scale management (tens to hundreds of thousands of hectares), or alternatively, 'site-based' approaches, focused on high-priority sites. Either way, management of threats and responses across regional boundaries will be required to achieve a national focus and to determine how a network of interconnected ecosystems (including freshwater systems) fit within a larger national picture.

This priority therefore brings a sharper focus to integrating site-based and landscape-scale management interventions. Sites are deemed critical to protect specific values in specific places, but habitat loss has reduced connectivity among them. Conversely, landscape-scale management interventions by default bring a range of jurisdictions/ecosystems (including

fresh water) and land-use types into the mix – lending themselves to explicit integration of economic, environmental, cultural and social benefits depending on the type of management intervention. This priority therefore links with Priority 7: Social science and citizen science.

Key research needs:

- Identification of situations in which landscape-scale and site-based management approaches could be integrated. This could be established as an 'adaptive management' experiment (see Recommendations).
- Determination of situations where multi-regional or national-scale coordination among RCs/UAs would enhance scaling-up efforts.
- Development of novel tools and improve existing tools for managing threats cost-effectively at a landscape scale (see Priority 4 below).
- In areas where eradication of specific threats is not feasible, appropriate pest density–impact thresholds need to be determined that still achieve the desired asset response(s) across interconnected landscapes.
- Quantify key resource transfers between major ecosystem types, particularly land and fresh water and between forest fragments and surrounding productive lands. Examples include nutrient and faecal-matter runoff from productive land, or the contribution of riparian zones as sources of pollinators for adjacent productive lands. These topics were identified as priorities in the *Roadmap for land and water research* and in the Biological Heritage NSC.

Priority 2: Ecological monitoring and reporting

Relevant ecosystems: Terrestrial, marine, fresh water

Recommended role of RCs/UAs: Influencers/partners

Context: Monitoring (and surveillance; see Priority 3) is a fundamental part of activities for both biodiversity and biosecurity. It is essential to evaluate management interventions, to quantify ecosystem 'health' and ecosystem services, and to determine the state and trend of exotic and native biota and habitats.

Monitoring is usually conducted in a MERI (Monitoring, Evaluation, Reporting and Improvement) framework, and the current framework of choice for RCs/UAs is EMaR (the Environmental Monitoring and Reporting initiative which is a joint effort between RCs and MfE). Needs include: (1) identification of a set of indicators suitable for freshwater and marine biodiversity and biosecurity (including which external agencies to work with); (2) determine the available datasets in relation to these indicators; and (3) determine how to process available data. EMaR is linked to LAWA (Land, Air, Water Aotearoa) although at present this connection sits primarily with key RC staff who are represented on the LAWA project.

Key research needs:

- Development of monitoring tools, technologies and strategies that are cost-effective, simple to use, and sufficiently sensitive to changes in the resource indicators. This includes development (or in some cases refinement) of cultural indicators of biodiversity and mātauranga approaches.
- Development of monitoring protocols applicable to a range of taxa and ecosystems nationally, and aligned with those developed, or in development by, other organisations (e.g. Department of Conservation (DOC), the Sustainability Dashboard [University of Otago], and the current MBIE-funded 'Trustworthy Biodiversity Measures' project).
- Start with the goal in mind: a clear linkage between management actions, and monitoring of both threat response and biodiversity/ecosystem-level outcomes in relation to those management actions. Importantly, this means that it is not appropriate to monitor everything; rather, indicators should be chosen to provide clear evidence one way or another of the response of threats and outcomes (e.g. biodiversity responses) to management interventions.
- Consideration should be given to adequately resourcing appropriate analyses with enough statistical power to interpret monitoring data, including interpretation of 'citizen science' data.
- Development of monitoring methodology to measure ecosystem resilience and biotic resistance to perturbations (e.g. climate change or land use intensification) and the impacts of threats on the condition of desired assets, including impact threshold levels and degree of reversibility (related to Priority 1).

Priority 3: Surveillance and detection

Relevant ecosystems: Terrestrial, marine, fresh water

Recommended role of RCs/UAs: Influencers/partners

Context: Research needs under this priority are closely linked to research needs for monitoring. A key issue is the development of best practice, creating national protocols with up-to-date techniques able to be applied at regional and local scales. Tools and approaches need to be appropriate, affordable and practicable, and coordinated and reported nationally. Again, all monitoring should be conducted in a MERI (Monitoring, Evaluation, Reporting and Improvement) framework. Clear links to LAWA and the EMaR initiative exist as for Priority 2 above.

Key research needs:

- Detection devices with appropriate sensitivity and specificity.
- Quantified 'detection probabilities' for a range of devices and taxa.
- Rapid, in-field diagnostic techniques (including molecular/DNA techniques) for new and emerging pests and diseases/pathogens.

- Being confident of the ability to detect organisms at very low densities, for early warning and rapid response to new incursions, and for detecting reinvasions of established pests into previously-controlled areas.
- Development of surveillance and detection techniques applicable across a range of taxa and ecosystems nationally.
- Best practice guidelines for citizen science projects: appropriate protocols for analyses and interpretation of surveillance data, including interpretation of 'citizen surveillance' data.

Priority 4: Novel tools, tactics and strategies for threat management and improvement of existing tools, tactics and strategies

Relevant ecosystems: Terrestrial, marine, fresh water

Recommended role of RCs/UAs: Regional leaders; national influencers/partners

Context: This priority area addresses the requirement by RCs/UAs for better tools and strategies for threat management. These are needed to satisfy the demands of communities for greater reduction of pest impacts on the environment and the economy, and often must be achieved within tight resourcing constraints. Development of novel tools and refinement of existing tools was also identified as a top priority research area in the Biological Heritage NSC. We anticipate a significant process for prioritisation of the top research needs over the coming 12 months, so our recommendations for research needs are deliberately high-level.

Research activities around risk analysis and prioritisation, while strategic in nature and therefore related to this Priority, are covered under Priority 8.

Key research needs:

- Development of cost-effective, publicly acceptable tools for managing mammals, weeds, pathogens, and invertebrates; in terrestrial, freshwater and marine ecosystems over large scales and in the long term. A particular priority is the development of humane methods of control of invasive mammal species.
- Management of multiple mammal pests using strategically-integrated combinations of tools and strategies, both at sites and on a landscape scale. This will require greater understanding of pest biology and their interactions with each other and their environment.
- For weeds, the need is to better understand which plants are likely to become invasive and therefore should be contained or eradicated, and which weeds are serious ecosystem transformers so they can be prioritised for action (see Priority 8 below).
- Development of tools (or adoption of tools from international partners) to rapidly combat the emergence of new pests: this is particularly a post-border issue for RCs/UAs (e.g. incursion pathways between regions) but can apply to pre-border problems.

- Development of biological control for priority mammal pests. A decision support system may be required in order to prioritise investments in this area, which is usually regarded as 'high risk, high return'.
- Refinement of biological control assessments (for both invertebrates and weeds which already have established biocontrol research efforts), e.g. improved predictors of success or failure and likelihood of success relative to the up-front costs of control. In parallel, effective tools for programme performance measurement and monitoring are required.

Priority 5: Pathway analysis

Relevant ecosystems: Terrestrial, marine, fresh water

Recommended role of RCs/UAs: Leaders regionally; influencers/partners nationally

Context: Several drivers of global change (e.g. climate change, land-use change, altered global trade patterns) have been linked to the emergence of new pests and diseases – both in New Zealand and internationally. This is a major focus of the study of biological invasions. Identifying, predicting, and mitigating potential routes (or 'pathways') of invasion is therefore essential. Understanding invasion pathways, both pre- and post-border, would enable RCs/UAs to take a proactive and nationally-coordinated approach to biosecurity, especially in high-risk areas with high traffic volumes or entry points and determine to what extent pathways can be managed to prevent breaches or closed down.

Recent amendments to the Biosecurity Act now enable a 'pathways management' approach to be used in terrestrial, freshwater and marine environments at both regional and national levels. There will be considerable need to better understand the nature and function of a range of pest pathways to effectively implement this. RCs/UAs view the Ministry for Primary Industries (MPI) as the national leader for pathway management, particularly in the context of marine biosecurity, but acknowledge the greater role of RCs/UAs in managing invasion pathways within and between regions.

Key research needs:

- Understanding, in partnership with MPI, of the origin of potential new invaders (i.e. before they arrive in NZ). Influence MPI to increase funding for research into 'new to New Zealand' pests and to invest in 'pre-emptive' biological control for pests likely to arrive, so that action can be taken quickly.
- Understanding of the origin of post-border invasions (i.e. movements of pests within and between regions), using a 'risk analysis' approach (and see Priority 8 below). Understanding potential range expansions of pests, pathogens and weeds, and how these may impact on indigenous biota and ecosystems, should be given priority.
- Quantification of dispersal and movement patterns and mechanisms for a number of priority weeds and pests in marine, freshwater and terrestrial ecosystems, in order to inform predictive models of invasion and spread (see Priority 10 below). This includes monitoring and development of surveillance and detection of organisms (Priorities 2 and 3 above).

- Better models of (1) distribution and spread as well as (2) interactions among key species in ecosystems, are required. These models' needs encompass (a) threats (e.g. wildlife diseases, plant pathogens), (b) control options (e.g. biocontrol agents), and (c) responses of native biodiversity to major perturbations such as changes in climate and land use.
- When developing plans for mitigating spread of organisms among regions, such plans should make explicit use of information on the dispersal and movement data and models provided by the research activities above.

Priority 6: Data management

Relevant ecosystems: Terrestrial, marine, fresh water

Recommended role of RCs/UAs: Followers/influencers

Context: The curation, management and accessibility of data and databases, including interoperability, were recognised as a priority issue for New Zealand, and not just for RCs/UAs. It was recognised that RCs/UAs were not appropriate organisations to lead research initiatives around improved data management, but had a keen interest in ensuring that they were linked to such initiatives nationally, to facilitate informed decisions. See also recommendations under Section 5.3 ('Perceived need 1' below). At time of writing (late 2014) Land, Air, Water Aotearoa (LAWA), a public information portal that originated from RCs/UAs but now includes a number of partners, may present environmental information on biodiversity indicators by late 2015.

We suggest one modest research need (below) as a first step, because at the time of writing there is a lot of activity in development of nationally-coordinated databases for biosecurity and biodiversity (including in the Biological Heritage NSC and LAWA), and it may be prudent for RCs/UAs to adopt a 'wait and see' approach.

Key research needs:

- Collation, analysis, interpretation and modelling of the large volume of data generated by existing threat management activities is a research need in its own right (See Priority 10 g below). Collation of data on threat management (e.g. threat abundance or distribution) and environmental responses (e.g. state and trend of native biota; or economic valuation of protected assets) held in RC/UA databases and spreadsheets should be a first step towards a coordinated national picture and would be achievable in a modest time frame (e.g. 2–3 years) while waiting for a more coordinated national picture to emerge.

Priority 7: Social science and citizen science

Relevant ecosystems: Terrestrial, marine, fresh water

Recommended role of RCs/UAs: Leaders/influencers

Context: Better engagement of the public in biodiversity and biosecurity activities is regarded as a critical component of the current operating environment. This need was also recognised in the Biological Heritage NSC, and research activities in these areas are the focus of a considerable amount of effort internationally. This priority relates to Priority 1 ('Scaling up') where landscape-scale programmes will connect people daily to the importance of biodiversity and biosecurity issues for New Zealand.

While related, social science and citizen science are not the same thing; we provide recommendations for research in both fields below.

Key research needs:

- Social science need: Quantifying of trends in awareness, uptake, engagement and participation by the general public through (for example) situational interviews, app downloads, proportional change in people's willingness to engage in contentious issues constructively, proportional change in awareness and willingness to incorporate biodiversity in production landscapes. In particular the need is to understand how groups can come together or interact effectively to fight pests for as long as it takes to win, which often transcends funding, political cycles, and tenure of key individuals. There is a large body of literature internationally on this topic. Emerging trends are to aim for *public participation* in biosecurity and biodiversity activities (as opposed to just *public communication* or *public consultation*).
- Citizen science need: Appropriate design of citizen science projects, and quantifying bias in data obtained from citizen science activities (e.g. the use of phone apps to detect rare species or new incursions in the landscape). The technical term for this need is 'modelling the observation process' (Walvaert 2014).
- Citizen science need: Relating of data obtained using citizen surveillance to more robust monitoring and surveillance methods (see Priorities 1 and 2 above), in order to achieve extensive coverage for early warning and rapid response ('citizens as eyes and ears').

Priority 8: Risk analysis and prioritisation

Relevant ecosystems: Terrestrial, marine, fresh water

Recommended role of RCs/UAs: Leaders/influencers

Context: RCs/UAs recognised that regular reviews of their pest management plans provide a good opportunity to renew priorities for managing biosecurity risks, but were often focused on short-term challenges at a species level, and not always on the desired outcomes (e.g. biodiversity responses). An intervention-logic process was developed by Jones (2010) for RCs/UAs to help overcome this problem.

Internationally, there is a large body of literature devoted to optimal management of potential risks and threats, and prioritisation of new and emerging threats as well as existing pests. For example, climate change has the potential to release established organisms from current climatic constraints and for new problems to emerge.

In such cases, a clear framework for prioritisation is needed, and may require RCs/UAs to earmark resources in advance of problems emerging, and to develop pre-emptive plans for timely intervention. Research requirements include the need for cost–benefit analyses of management interventions in relation to the value of the desired outcomes (which relates to Priority 9 Valuation of natural assets below).

Key research needs:

- Improved risk assessment tools for effective strategic decision making for pest plant management, including development of national datasets and tools to model weed distribution and behaviour.
- Analysis to identify pathways of invasion to target surveillance efforts to the most likely locations for incursions (linked to Priority 5).
- Cost–benefit analyses of current and new control techniques for a range of threats, including effectiveness and efficiency at a range of spatial scales.

Priority 9: Ecosystem services and valuation of natural assets

Relevant ecosystems: Terrestrial, marine, freshwater

Recommended role of RCs/UAs: Influencers/partners

Context: There is a large body of literature on the 'value' of ecosystems and the services they provide. Such services (or natural assets) were classified into four categories for the Millennium Ecosystem Assessment (2006): provisioning, regulating, cultural, and supporting services. Each of these is subject to disturbance as a result of environmental change, such as climate or land use change. Central to managing whole-of-system responses to environmental change is the concept of resilience. Resilience is defined as the capacity to absorb disturbance and maintain function. New Zealand gains much value from its natural assets, and healthy, resilient ecosystems are needed to meet societal needs and aspirations regarding the benefits provided across biodiversity conservation and intensive primary production. Innovative management interventions are aimed at enhancing ecosystem functions and services while minimising biodiversity loss, thereby (in theory at least) maintaining resilience. These services or functions can then be 'valued', either in monetary or non-monetary terms.

Much of this value is intangible. We currently do not know much about the contribution of ecosystem services and natural assets to New Zealand's economic well-being, with the concomitant risk that natural assets will be undervalued as a result (NZIER 2013). However, a key barrier to using economic valuation is the cost and uncertainty of values obtained from the variety of techniques available. RCs/UAs could add value by co-funding studies that inform policy and decisions about New Zealand's natural assets.

Key research needs:

- Quantifying of ecosystem services from a range of terrestrial and freshwater ecosystems including those that sustain native biodiversity in production landscapes. Seek to understand *trade-offs* among ecosystem services and how optimal delivery of services can be achieved.
- Understanding about how disturbances (e.g. land use intensification, climate change, and biotic invasions) alter interdependencies among species in ecosystems, and linkages between ecosystems.
- New Zealand's native biodiversity quantified in monetary and/or non-monetary terms, including the value of assets protected through threat management (e.g. invasive species control). A standardised approach should be used to provide relative values for different types of natural asset or service (NZIER 2013), and evidence as to how biophysical cause-and-effect relationships translate into economic value.
- Quantification, using a standardised approach, of the extent to which New Zealand's economic activity depends on natural assets.

Priority 10: Modelling to predict future scenarios and ris**ks**

Relevant ecosystems: Terrestrial, marine, fresh water

Recommended role of RCs/UAs: Influencers/partners

Context: Predictive modelling helps provide explicit and clear 'scenario-type' information to explore (and if necessary mitigate) the outcomes of management decisions and actions. The key to good models is to have biologically meaningful parameters, to be clear about the assumptions behind them, and to keep them simple (the complexity–reality trade-off). 'Models' may be conceptual. In either case, part of the value of models lies in making us state our assumptions about how we think systems operate. They also encourage us to articulate the desired outcome(s) in advance.

Although this research need is listed as Priority 10 it is by no means the least important. Rather, we see it as a critical underpinning-need that integrates across Research Priorities 1–9 above. It is also a critical element in addressing future risks and threats, such as climate change. We recommend this priority cannot be conducted in isolation, and should be done using data generated from research conducted in the nine priorities above. This will ensure that predictions for future scenarios are robust and are built on defensible parameters. We assume that the desired outcome(s) have already been articulated as a first step.

Key research needs:

- Immediate need: collating, analysing, interpreting and modelling the large volume of data generated by existing threat management activities is a research need in its own right. We do not know of any efforts around nationally-coordinated collation of such data at the time of writing. The diversity of management activities being carried out by a range of management agencies, therefore, makes it difficult to identify any critical knowledge gaps that may exist. We suggest, however, that RCs/UAs could contribute

resources to collation of existing data if such activities align with the high-level goals in this *Roadmap* (and see Piority 6 Data management).

- Future need: predictive models, explicitly-paramaterised by data generated in the research priorities above, could be used in exploring future scenarios (e.g. major changes in land use, climate change scenarios, or threat management). In other words, their utility is in predicting and evaluating future scenarios. 'Models' come in various shapes and forms, and we recommend integration of modelling expertise into research teams when addressing the above priorities.

5.3 Pathways to Implementation

5.3.1 External communication, engagement and partnerships

Perceived need 1: Improved national coordination among agencies, including RCs/UAs

Recommended role of RCs/UAs: Influencers/partners

Key actions required to effect change:

- We discovered during our interviews that some external parties were unaware of the existence of both the RC/UA Research, Science and Technology (RS&T) Strategy, and the Special Interest Group (SIG) priorities from 2011, which are available online (see Appendix 2). This was perceived (perhaps wrongly) as a lack of clear articulation of RC/UA research needs (i.e. to other agencies and research providers). As a first step towards addressing this perceived shortcoming, we recommend making this *Roadmap* available to external parties once it has been finalised, perhaps via targeted approaches to key staff in those organisations. Identifying key individual(s) in the Bio-Managers' Group who could be further involved in scanning, scoping and planning research activities as part of annual processes run by research providers is the next step (see 'Perceived need 3' below). Engaging with emerging trends such as LAWA will also be vital.
- Coordination and collaboration of research activities across RC/UA boundaries (i.e. among individual councils) was perceived as fragmented. Addressing this perceived shortcoming could be achieved through communication among Bio-Managers, upwards to Chief Executives (see Section 5.3.2 below for proposed mechanisms), and externally to key agencies (DOC, Ministry for the Environment, MPI). Note that this recommendation refers specifically to research activities and not to operational activities.
- In some instances, areas of responsibility (i.e. agencies' mandates for funding research activities) were unclear. For example, marine/harbour environments were identified as a particular grey area. We recommend a strategic scan by RCs/UAs of agencies best suited to commission research (e.g. on new incursions), as an initial first step before knowledge gaps can be identified and research priorities developed.
- A focus on short-term research priorities was identified as a particular problem for RCs/UAs – both by themselves and by external parties. In order to shift research focus from short-term to medium- and long-term priorities, we recommend putting in place

mechanisms for allocation of some funding for multi-year projects (i.e. not just for one year), in line with priorities identified as part of scoping and scanning processes (e.g. through the Biological Heritage NSC process). This should include articulating how research findings should be incorporated into relevant policy and strategies.

Perceived need 2: Strengthen collaboration with communities, including industry and Māori

Recommended role of RCs/UAs: National influencers/partners; regional leaders

Key actions required to effect change:

- Many RCs/UAs already work closely with Māori. Nevertheless, there was a perceived need to improve collaborative partnerships and, in particular, understand iwi values in relation to both native and introduced species and their management and use. Engaging with Māori in order to better understand Māori knowledge of biodiversity and biosecurity issues that incorporate mātauranga Māori and Western knowledge in biodiversity/biosecurity management will be critical. We recommend (1) development (or in some cases refinement) of cultural indicators of biodiversity and (2) identification of which introduced pests impact on economic and well-being values cf. those that are regarded as a resource by Māori. Both these initiatives could be done in collaboration with relevant iwi and with Māori research providers in order to identify knowledge gaps and prioritise research activities.
- Many RCs/UAs also work closely with communities (e.g. through funding pest control activities or coordination of biodiversity monitoring). However, a growing number of communities are playing a role in biodiversity protection. They require coordination, particularly to meet landscape-scale goals. We recommend more formal linkage between community engagement activities currently undertaken by RCs/UAs, and relevant research priorities identified in Section 5.2 above. Of particular note would be the 'landscape-scale' and 'citizen science' research priorities.
- Formal recognition of sustainability goals is often embedded in primary sector strategies (see Appendix 2). However, we recommend a targeted approach to potentially responsive industry partners who may be seeking improved environmental outcomes as part of their wider mandate, with joint identification of research priorities for mutual benefit. Such an approach could take a long-term view; for example helping the primary sector plan for future threats such as climate change.
- Engagement with multiple partners (e.g. communities, industry and Māori) is a key criterion for obtaining philanthropic funding, as is the inclusion of a research component. We therefore recommend identification of a small number (2–3) of potential philanthropic opportunities by the Bio-Managers' Group that could be progressed to proposal stage, using this *Roadmap* as evidence of long-term planning for research activities by RCs/UAs, and of a commitment in principle to strengthening community/iwi/industry engagement.

Perceived need 3: Strengthen alignment with scanning, scoping and prioritisation processes conducted by research providers

Recommended role of RCs/UAs: Influencers/partners

Key actions required to effect change:

- Members of the Bio-Managers' Group are already closely involved with research currently being undertaken across a range of providers (e.g. with Strategic Advisory Groups). This provides a direct source of information about current research across a variety of organisations and fields, and potential uptake. However, there was a perceived need to strengthen input at scanning, scoping and planning stages with key research providers. Annual scanning and scoping arrangements are routine in most CRIs and in research consortia (e.g. B3 [Better Border Biosecurity]), and will be an integral part of the proposed Biological Heritage NSC. We recommend identifying key individual(s) in the Bio-Managers' Group who could become involved in, and familiar with, scanning and scoping activities conducted by research providers. This may require several individuals specialising in particular areas, in which case a 'reporting back' mechanism to the wider Bio-Managers' Group and Chief Executives would be needed (see 'internal communication' below). The onus is equally on research providers to invite nominated RC/UA staff to key scanning and scoping meetings so that they can articulate research needs and shape research priorities.
- Another key challenge is to effectively scan all available information about currently-funded research in the biodiversity and biosecurity sectors, and to process it in order to identify priority projects with a 10–20-year time horizon. Coincidentally, the 2014/15 financial year will be critical for such a stocktake, because it would align with planning activities in the Biological Heritage NSC. We recommend an Envirolink medium advice grant with the dual purpose of (a) conducting a workshop with the relevant research providers to familiarise RC/UA staff (working in biodiversity and biosecurity) with current research activities and shape future research activities, and (b) conducting a stocktake of current research activities in the Natural Resources Sector and identifying priority needs specifically designed to help RCs/UAs make the most of national opportunities such as the Biological Heritage NSC.
- RCs/UAs are all involved to a greater or lesser extent with decision making for Envirolink funding and with the Regional Council Science Advisory Group. These provide a critical focal point for collaboration in science and research for natural resource management. However, RCs/UAs can play a role in more actively shaping research activities, for example when reviewing national strategic research priorities and Envirolink Tools funding rounds. Referencing this *Roadmap* could be a first step.
- In our discussions with RC/UA staff, two separate concepts emerged for translation of research findings into readily-accessible information and for helping develop a more strategic view of key research priorities. One was a 'chief science advisor' role, and the second was a 'knowledge broker' role. The Strategic Advisory Group felt that a chief science advisor role may duplicate efforts in other agencies (e.g. DOC), whereas the knowledge broker concept was favoured. We therefore recommend that consideration should be given to developing a 'knowledge broker' position tasked with translating research findings from providers into 'plain English' and interpreting their utility for policy development.

5.3.2 Internal communication

Perceived need 4: Improved mechanisms for communication within the biosecurity and biodiversity advice structure

Recommended role of RCs/UAs: leaders

Key actions required to effect change:

A primary aim in developing this *Roadmap* was a desire to strengthen the focus of the Bio-Managers' Group towards longer-term strategic issues related to biodiversity and biosecurity, and to provide integrated solutions that enable collective action from RCs/UAs. Internal mechanisms already exist for communication. For example, the Bio-Managers' Group reports to the Regional Chief Executives group, and technical/policy support is provided to the Bio-Managers' Group by the Biosecurity and Biodiversity Working Groups (Appendix 4). The Bio-Managers' Group is also a Special Interest Group (SIG) for matters relating to biosecurity and biodiversity under the Regional Council RS&T Strategy 2011. The process for developing biosecurity and biodiversity research priorities therefore needs to fit within and be consistent with the Regional Council RS&T Strategy.

Nevertheless, there was a perceived need to strengthen communication processes within the biosecurity and biodiversity advice structure. In order to achieve this, we recommend the appointment of a standing joint subgroup/committee, comprised of members from the BWG, BDWG, or Bio-Managers' groups. The group would be responsible for:

- Maintaining a watching brief over the scoping and scanning (i.e. research 'formation') processes conducted by research providers (as identified in Section 5.3.1 above) including CRIs, universities, government departments, and others (e.g. OSPRI).
- Liaising with the Envirolink Governance Committee and providing appropriate input to the Regional Council RS&T Strategy and where appropriate working with key research providers to develop bids for the Envirolink Tools Fund.
- Maintaining a database of biosecurity and biodiversity research activities, once the initial stocktake (above) has been completed. We suggest that a 'refresh' of the database would need to occur every two years at a minimum, in order to capture new research initiatives.
- Actively participating in advisory roles alongside other stakeholders, with the aim of providing guidance on research priorities to key research providers. Identification of key individuals who can participate at all levels (e.g. Chief Executive, Bio-Manager, and Working Group levels) will be required.
- Developing a national-level, cross-council process for 'reporting back' by attendees at relevant conferences such as NETS (the annual education and training seminar of the NZ Biosecurity Institute), the New Zealand Ecological Society conference, and the Australasian Vertebrate Pest Control conference, in order to facilitate uptake of relevant research findings by practitioners.
- Providing a report to the Bio-Managers' Group (e.g. quarterly) and Chief Executives' subgroup (e.g. twice a year) on the above activities, with recommendations for actions where specific advocacy or support is required to achieve identified strategic goals. The current proposal to include a regional council Chief Executive on the Governance Board of the BioHeritage NSC will elevate the importance of such regular communication.

6 Conclusions

This *Roadmap* was developed because RCs/UAs recognised a need to take a wider strategic view of research activities in biodiversity and biosecurity, in order to have a stronger voice at the table in the scanning and scoping stages of research activities and to facilitate more rapid uptake of research findings. Going forward, key focus areas will need to be endorsed, resourced, and have individuals tasked with driving them. A focus on the priority research areas, and on the implementation pathways described in this *Roadmap*, should facilitate stronger collaborative efforts with industry, Māori, research providers, communities, and government departments.

Development of this *Roadmap* was conducted deliberately in tandem with early planning for the Biological Heritage NSC throughout 2013 and early 2014. Many of the research priority areas identified in this *Roadmap* are also priorities in the Challenge. The next phase (during the 2014/15 financial year) presents RCs/UAs with an opportunity to become engaged in research development in the early stages of research development as part of the Challenge.

Timelines for research and implementation activities are specified in Figure 1. Although this *Roadmap* takes a 10–20-year view, it is likely that strategic national and international scans of emerging issues will need to be conducted much more frequently. We chose 2018 as an intermediate date because it aligns with the first tranche of research funding in the Biological Heritage NSC.

7 Recommendations

A précis of priority research areas can be found in the summary and we do not repeat them here. Recommended pathways to implementation were:

'Outward focus':

- Make this *Roadmap* available to external parties once it is approved by RCs/UAs.
- Identify key individual(s) in the Bio-Managers' Group to be involved in the annual scanning, scoping and planning of research activities by research providers. Strategic national and international scans should also be undertaken periodically to ensure that this *Roadmap* and associated research priorities remain relevant in a dynamic environment.
- Put in place mechanisms for allocation of RC/UA funding, with funding to be allocated for a minimum of 2–3 years (i.e. on a longer time-frame than one year), in line with priorities identified during scoping and scanning processes above and with the goals articulated in this *Roadmap*. With the recent approval of the Biological Heritage NSC, the *Roadmap* can now provide a vehicle to connect with wider developments in biodiversity and biosecurity research prioritisation, and thus has the potential to provide a highly effective and efficient delivery pathway from research to end-user outcome benefits.
- Consider adopting an 'adaptive management' or 'learning by doing' paradigm for research activities in order to learn from large-scale management interventions, where appropriate.

- Conduct a strategic scan of agencies best suited to handle problems (e.g. new incursions) appropriately with the resources and skills at their disposal.
- Link community engagement activities currently undertaken by RCs/UAs more formally with the relevant research priorities identified. This should include embedding mātauranga Māori research approaches where appropriate.
- Approach potentially responsive industry partners who may be seeking improved environmental outcomes as part of their wider mandate with a view to collaboration.
- Identify and progress a small number (2–3) of potential philanthropic opportunities to proposal stage, using this *Roadmap* as evidence of long-term planning for research activities by RCs/UAs, and of a commitment in principle to strengthening community/iwi/industry engagement. The recent success in securing funding from the Robertson Foundation Aotearoa by Hawke's Bay RC, in partnership with DOC and iwi, could be used as a model.
- Commission an Envirolink medium advice grant with the purpose of (a) conducting a workshop with the relevant research providers to familiarise RC/UA staff working in biodiversity and biosecurity with current research activities and engage them in shaping future research activities, and (b) conducting a stocktake of current research activities in the Natural Resource Sector in order to identify priority needs specifically designed to help RCs/UAs strongly engage with national opportunities such as the Biological Heritage NSC.

'Inward focus':

- Consider funding a 'knowledge broker' position tasked with translating research findings from providers into 'plain English' and interpreting their utility for policy development; alternatively and at the least, specifically request knowledge transfer activities when developing contracts with research providers.
- Provide a report to the Bio-Managers' Group and Chief Executives' subgroup (e.g. twice a year) on the above activities, with recommendations for actions where specific advocacy or support is required to achieve identified strategic goals. Again, individuals who are willing to take on these roles should be specifically identified, possibly via the formation of a subgroup that spans a number of working groups, in order to form a collective view of top priority research activities for the coming year(s).
- Develop a national-level, cross-council process for 'reporting back' by attendees at relevant national and international conferences. Willing individuals would need to be identified to implement this process.

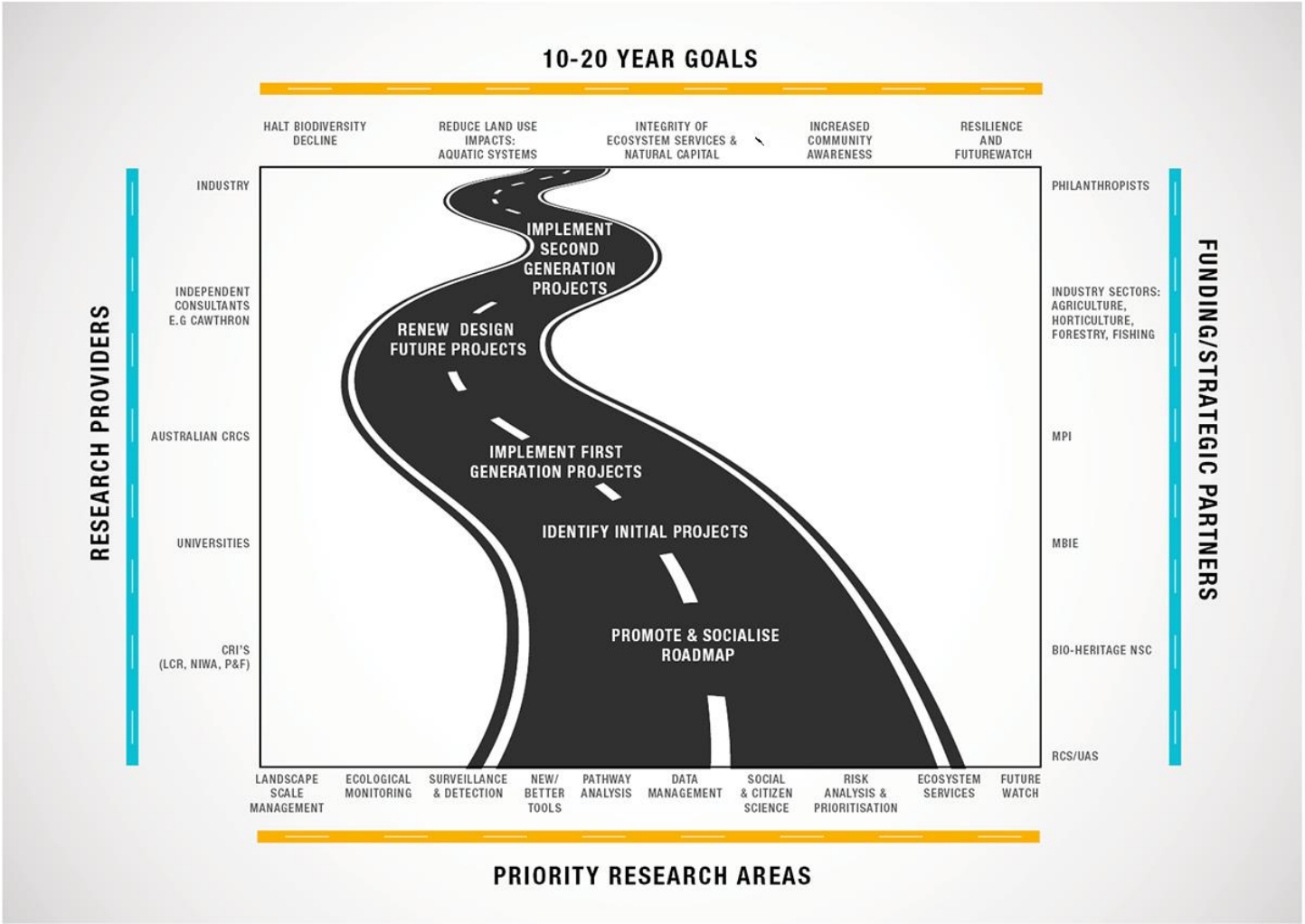

Figure 1 Strategic roadmap for biodiversity and biosecurity research for regional councils and unitary authorities.

8 Acknowledgements

We thank the numerous individuals from many organisations around New Zealand (listed in Appendix 1) who made the time to share freely their opinions and ideas to help improve regional councils' and unitary authorities' approach to biodiversity and biosecurity research. The Strategic Advisory Group (Richard Bowman, Environment Southland RC; Kevin Collins, Waikato RC; Philippa Crisp, Greater Wellington RC; Stephen Hall, Taranaki RC; and Campbell Leckie, Hawke's Bay RC) also provided invaluable advice and comments on priorities, level of detail required, and scope of this document. Phil Cowan, Lynley Hayes (Landcare Research) and John Clayton (NIWA) reviewed this report or provided useful advice. We thank Christine Bezar for editing. Funding for this report was provided through an Envirolink medium advice grant (ESRC265) from the Ministry of Business, Innovation and Employment to Environment Southland on behalf of all regional councils and unitary authorities.

9 References

Collins A, Weeks E, Leckie C, Stokes S, Hill R 2014. Strategic roadmap for land and water research. National Land Resource Centre Report LC1866. 20 p.

Jones C 2010. Linking regional pest management activities to outcomes: a template for using intervention logic models in regional pest management strategies. Envirolink Project 896-HBRC135. Unpublished Landcare Research Report LC89. 33 p.

NZIER (New Zealand Institute of Economic Research) 2013. Valuing natural assets essential for decision making. NZIER Public Discussion Document Working Paper 2013-03. ISSN (online) 1176-4384.

Welvaert M 2014. Citizen Science literature review: Exploring possibilities for biosecurity surveillance, understanding the observation process underlying citizen-science data and evaluating analysis strategies. Plant Biosecurity CRC Project 1029: Final Report Milestone 1.

Appendix 1 – Interviews of staff in the biosecurity and biodiversity sectors in relevant organisations across New Zealand

Table 1 List of individuals and organisations canvassed for their opinions on biodiversity and biosecurity priority areas of research, and potential modes of operating collaboratively with regional councils (RC) and unitary authorities

Individual	*Type of organisation*	*Organisation*
Jamie Ataria	Central Govt	EPA
Kate Litten	Central Govt	MPI
Paul Janzen	Central Govt	Parliament
Simon Andrews	Central Govt	TBfree New Zealand
Bill Simmons	Corporate/Industry	ACP
Duncan McMorran	Corporate/Industry	Connovation
Chris Garland	Corporate/Industry	Farming
Cam Speedy	Corporate/Industry	Genesis Energy
Malcolm Thomas	Corporate/Industry	Pest Control Research
David Teulon	CRI	Plant & Food Research
Graham Bourdot	CRI	AgResearch
Mike Dodd	CRI	AgResearch
Paul Champion	CRI	NIWA
Bruce Warburton	CRI	Landcare Research
Hugh Gourlay	CRI	Landcare Research
Phyl Lyver	CRI	Landcare Research
Jake Overton	CRI	Landcare Research
Roger Pech	CRI	Landcare Research
Elaine Murphy	DOC	DOC
Geoff Hicks	DOC	DOC
Alistair Fairweather	DOC	DOC
Simon Carlton	DOC	DOC
Carol West	DOC	DOC
Susan Timmins	DOC	DOC
John Parkes	Independent	
Shaun Ogilvie	Independent	Māori
Brian Plaiser	Independent	Predator–Free NZ
Wren Green	Independent	
John McClennan	Independent	
Les Kelly	Independent	
Mark Ross	NGO	Federated Farmers
Kevin Hackwell	NGO	Forest and Bird
Jenny Lynch	NGO	World Wildlife Fund
Liz McGruddy	NGO	
Mark Mitchell	UA	Auckland Council
Shane Grayling	RC	Bay of Plenty

Liz Garson	CC	Christchurch City Council
Tamsin Page	RC	Environment Canterbury
Dave Burgess	RC	Environment Southland
Derek Richards	RC	Environment Southland
Trevor Freeman	RC	Gisborne
James Lambie	RC	Horizons
Craig Davey	RC	Horizons
Jono Underwood	RC	Marlborough
Nicky Eade	RC	Marlborough
Don Mckenzie	RC	Northland
Lindsay Vaughan	UA	Tasman
Campbell Leckie	RC	Hawke's Bay
Nick Waipara	UA	Auckland Council
James Ross	Uni	Lincoln
Sue Worner	Uni	Lincoln
Mike Joy	Uni	Massey
Jon Proctor	Uni	Massey
Jacqueline Rowarth	Uni	Waikato
Craig Morley	Uni	Waiariki Inst. Tech.

Table 2 Summary of the number of individuals canvassed in organisations

Regional council or unitary authority	15
Crown Research Institute	10
Department of Conservation	6
University	6
Central Government	4
Non-governmental organisation	4
Independent	5
Corporate/Industry	5

Interview questions

With a few exceptions, all interviews were conducted by the same individual (M. Kavermann).

First set of questions: your experience, and your priorities right now

- As regional councils develop their *Roadmap*, how would you like to see the roadmap laid out? Have you had any experience developing strategic priorities either for your organisation or another one? What were the key elements that made it successful or not?
- In your opinion, what are the key strategic priorities for research targeted towards biosecurity and biodiversity issues in New Zealand?
- What do you think the regional councils' role is/should be?
- Various models exist for prioritising research funding. Two New Zealand examples include the Regional Council/DOC National Biocontrol Collective (an annual round-table process for prioritising biocontrol of weed species), and TBfree New Zealand's annual call for expressions of interest and subsequent funding of research priorities. Are you familiar with these models? How well do you think they work?
- How well would they work as a process for prioritising longer-term (10–20-year) research activities?
- If you were to start over again within your role, what would you prioritise differently? How do you see your role changing in the future to address biosecurity and biodiversity issues?

Second set of questions: thinking to the future

- What would you like to see happen with biodiversity/biosecurity research in New Zealand?
- What is the best way to phase in new priorities through time?
- Over what time frame should these changes occur?
- How do you see the changes being implemented (staff/contractors/legislation/regulations/bylaws)?
- What are the current biosecurity/biodiversity challenges you face? What are the current solutions to these problems? What future solutions can you envisage? Do you believe these issues will persist in the future?
- What other issues do you perceive encountering in 5–10 and 10–20 years? How would the challenges be addressed? Could these be resolved if no more funding were available?
- What level of funding would be required? In your opinion, is extra funding required 'twice as much' or an order of magnitude larger, or…?
- Who are the key players (individuals/groups/organisations)? In terms of agency coordination (i.e. council, MPI, DOC, TBfree New Zealand, etc.), what should be done to improve coordination among the agencies?
- What's stopping that from happening right now?
- Do you see any legislative challenges?
- What other major (or minor) challenges could you anticipate (immediate or in the future)? Why is it an issue? Who is it an issue for?

Appendix 2 – Relevant reports and legislation canvassed for priority research areas in the biodiversity and biosecurity sectors in New Zealand

Biodiversity Strategy (Department of Conservation & Ministry for the Environment 2000)
http://www.biodiversity.govt.nz/pdfs/picture/nzbs-whole.pdf

Biosecurity Strategy for New Zealand Tiakina Aotearoa, Protect New Zealand (Biosecurity Council 2003)
http://www.biosecurity.govt.nz/files/biosec/sys/strategy/biosecurity-strategy.pdf

Biosecurity Science Strategy for New Zealand Mahere Rautaki Putaiao Whakamaru (MAF Biosecurity 2007)
http://www.biosecurity.govt.nz/files/biosec/sys/strategy/2007-biosecurity-science-strategy.pdf

Business Growth Agenda (Natural Resources) (2012)
http://www.mbie.govt.nz/pdf-library/what-we-do/business-growth-agenda/bga-reports/BGA-Natural-Resources-report-December-2012.pdf

New Zealand Forest Owners Association Forest Biosecurity Strategy (2011)
http://www.nzfoa.org.nz/images/stories/pdfs/content/fbrcreports/strategy_130511.pdf
and Science and Innovation Plan (2012)
http://www.nzfoa.org.nz/component/docman/cat_view/77-research-science-technology?Itemid=27

Parliamentary Commissioner for the Environment Report *Evaluating the use of 1080: Predators, poisons and silent forests*. June 2011.
http://www.pce.parliament.nz/assets/Uploads/PCE-1080.pdf

Parliamentary Commissioner for the Environment Report *Water quality in New Zealand: land use and nutrient pollution*. November 2013.
http://www.pce.parliament.nz/assets/Uploads/PCE-Water-quality-land-use-web-ammended.pdf

Research for the Environment: Regional Council Research, Science & Technology Strategy. 2011 Review.
http://www.envirolink.govt.nz/PageFiles/29/Regional%20Council%20RST%20Strategy%20September%202011.pdf

Resource Management Reforms (Ministry for the Environment 2013)
https://www.mfe.govt.nz/rma/reform/rma-reforms.html

Science Counts! – DOC's Strategic Science and Research Priorities 2011–2016
http://www.doc.govt.nz/documents/science-and-technical/science-counts-2011-web.pdf

Strategic roadmap for land and water research (National Land Resource Centre 2014) (not online)

Relevant primary sector strategies were also identified and are included here as their stated priorities often align with those of regional councils and unitary authorities. They include:

- Fonterra's Sustainability and Environmental Policy
- DairyNZ Strategy for Sustainable Dairy Farming 2013–2020
- Beef and Lamb's Sustainable Land Management Policy
- Horticulture Industry Strategy 'Growing a New Future'
- Kiwifruit Vine Health Biosecurity Strategy (2014)
- FAR Research and Extension Strategy and Portfolio (undated)
- TBfree New Zealand National Bovine Tuberculosis Pest Management Plan (2012)

Appendix 3 – Potential sources of research funding

Below we list potential sources of research funding that could be leveraged for greater effect across the biodiversity and biosecurity sectors in New Zealand and internationally.

Biological Heritage National Science Challenge: Partnership and alignment with the Challenge is perhaps the single biggest (although by no means the only) opportunity for regional councils and unitary authorities to align their research needs with other major stakeholders in order to leverage opportunities and address key research priorities. Potential processes for alignment are discussed elsewhere in this report.

MBIE Contestable funding: Some (but not all) relevant MBIE Contestable funding will now be aligned with the Biological Heritage NSC. For research funding aligned with the Challenge, we recommend national coordination with the planning and prioritisation cycle for the Challenge, described in Section 5.3.1.

MBIE Envirolink funding: We note some planned changes to Envirolink funding. For example, MBIE may hand over control of the process to eligible councils. However, it is likely that (1) more stringent MBIE requirements around sign-offs will be put in place; (2) internal processes and documents – including new paperwork – will be put in place in order to ensure that MBIE staff understand the Envirolink process; and (3) MBIE is likely to re-evaluate the original overarching contract that was signed with research providers.

CRI Core funding and University CoRE funding: Some (but not all) relevant funding will now be aligned with the Biological Heritage NSC. For research funding aligned with the Challenge, we recommend national coordination with the planning and prioritisation cycle for the Challenge, described in Section 5.3.1.

Philanthropic funding: Many stakeholders, including research providers, are 'feeling their way' in terms of accessing philanthropic funding opportunities. The most likely option for success will be partnership with a range of stakeholders, including research providers. It would appear that philanthropic entities are seeking multiple outcomes from their investment (i.e. environmental, economic, social, and cultural benefits). These goals fit well with the regional council/unitary authority priorities described herein.

Australian Cooperative Research Centres (CRCs): Two relevant CRCs include the Invasive Animals CRC and the Plant Biosecurity CRC. Much of the research in both CRCs is highly relevant to RCs/UAs. The Invasive Animals CRC, in anticipation of a major rebid in 2016, is currently undertaking a strategic scanning and prioritisation process for future research. Both Landcare Research and DOC (as current participants) are keeping a watching brief on the process. B3 (the Better Border Biosecurity research alliance) has strong links to the Plant Biosecurity CRC.

MPI investments: These include the Sustainable Land Management and Climate Change Programme (SLMACC) http://www.mpi.govt.nz/environment-natural-resources/funding-programmes/slmacc-research-programme, the Primary Growth Partnership (PGP) Programme http://www.mpi.govt.nz/agriculture/funding-programmes/primary-growth-partnership.aspx (which is dependent on industry groups matching co-funding from MPI and is focused on economic growth through the primary sector), and the Sustainable Farming Fund (SFF)

http://www.mpi.govt.nz/agriculture/funding-programmes/sustainable-farming-fund.aspx which takes a broader triple-bottom-line approach to funding research in the primary sector.

Research funding from individual regional councils and unitary authorities: We note that individually, RCs/UAs generally do not have large amounts of dedicated funding for research. Collectively, however, they can provide a significant quantum of funding for priority projects or research streams. One example would be the National Biological Control Collective, dedicated to weed biocontrol. RCs/UAs can use such funding to leverage projects where there is a particular benefit to them.

Appendix 4 – Regional council biodiversity and biosecurity advice structure (as of June 2014)