

Project Proposal Template

A. TITLE OF PROJECT

1.2.2 Navigating marine social-ecological systems

B. IDENTIFICATION

Project Leader:

Karen Fisher
The University of Auckland
10 Symonds Street
Auckland 1010
New Zealand
k.fisher@auckland.ac.nz
+64 9 923 8410

Investigators:

Carolyn Lundquist, NIWA/UoAuckland
Kate Davies, NIWA
Alys Longley, UoAuckland
Will Allen, Will Allen & Associates
Richard Le Heron, UoAuckland
Paula Blackett, AgResearch
Judi Hewitt, NIWA
Alison Greenaway, Landcare Research
Kelly Ratana, NIWA
Simon Thrush, UoAuckland
Jim Sinner, Cawthron

C. ABSTRACT

The aim of this project is to enhance our understanding of key institutional, social and cultural facets of ecosystem-based management (EBM) to facilitate its implementation in New Zealand's marine estate. This involves: 1) considering the efficacy of methods that integrate concepts of cumulative impacts into decision-making frameworks; 2) assessing how Māori and stakeholders perceive risk and uncertainty associated with current and future marine activities; and 3) evaluating a range of methodologies for doing science that build trust in the knowledge produced to inform decision making. We will utilise a range of social science methods to engage Māori, stakeholders, industry representatives, resource managers, decision makers, and the wider New Zealand public to navigate key issues in the marine environment. To investigate how governance and management strategies address cumulative impacts, we will run a scenario workshop with decision makers, scientists and Treaty partners. To gain insight into public perceptions of risk and uncertainty, we will adopt an interdisciplinary arts-science methodology to produce a public performance and interactive online media component to engage the public. To explore trust, we will evaluate the trust-building capacity of the Sustainable Seas Challenge, and how trust is developed and maintained across a range of scientific methods and methodologies.

D. INTRODUCTION

The management and governance of coastal and marine social-ecological systems (SES) is complicated because of the countless interactions that occur among and between interconnected human and natural systems^{1,2}. To grapple with these challenges, a paradigm shift in the way New Zealand views, governs and manages its marine estate is needed to balance the enhanced use of

marine resources and good environmental stewardship, while meeting the aspirations and rights of society. Since the aim of the Challenge is to facilitate this paradigm shift through the development of ecosystem-based management (EBM) that recognises the full array of interactions within an ecosystem, including human, it is necessary to develop a comprehensive understanding of the dynamics of the ecological, political, economic and social systems. Considerable efforts have been and continue to be made to study the ecological dynamics associated with the successful implementation of EBM; however, further research is needed to understand how elements such as trust, power, and values in the performance of day to day management and governance activities can dramatically affect the definition and delivery of EBM³⁻⁵ and the granting of social licence to operate (SLO)⁶. Similarly, while the integration of diverse knowledge and value sets across academic disciplines, management practices, industrial regimes and public domains seems to be a given for EBM approaches, the realities associated with this practice remain a critical challenge^{7,8}. Finally, social-ecological change in the marine space, and our attempts to address it through the implementation of EBM, are likely to have socially differentiated impacts across a range of current and future stakeholders. Consideration of a wide range of users that goes beyond the differentiation between Māori and non-Māori to include age, gender, socio-economic status, and cultural identity, will be needed to address the social sustainability of differing economic and environmental options.

Institutional and political frameworks that can adapt to changing relationships between society and ecosystems in ways that sustain ecosystem services and support EBM^{9,10} are referred to as adaptive governance¹¹. Effective adaptive governance frameworks are formed from nested institutional arrangements and social networks operating at multiple scales¹⁰, and rely on the participation of individuals who provide leadership, trust, vision, meaning, knowledge, and memory^{12,13}. The establishment of governance regimes that exhibit these qualities will generally require substantial changes in the way humans relate to and govern SES¹³. The social sciences and humanities, including the arts, have an essential role to play in generating this change¹⁴. While the social sciences reveal patterns in our lives as individuals, groups, and society at large, the humanities help individuals to fulfil their potential by fostering creative thinking and providing a deep understanding of cultural diversity to enhance our understanding of human expressions, actions, and institutions¹⁵. It is the work of *Our Seas*, and this project in particular, to better understand the mechanisms that support or detract from the establishment of adaptive governance, harness these disciplinary strengths, and purposefully deploy them in an interdisciplinary context, thereby disrupting established ways of doing and enabling the creation of new navigable ways forward.

E. AIM OF THE RESEARCH AND RELEVANCE TO OBJECTIVE

Navigating the complexities associated with marine social-ecological systems will require an improved understanding of several key facets of EBM in New Zealand. This research will contribute to this understanding by: 1) considering the efficacy of methods that integrate concepts of cumulative impacts into decision-making frameworks; 2) assessing how Māori and a myriad of stakeholders perceive risk and uncertainty associated with current and future marine activities; and 3) evaluating a range of methodologies for doing science that build trust in the knowledge produced and inform decision making. In Phase 1 of the Challenge, this work will contribute an enhanced understanding of the barriers, boundaries, and possible pathways towards the establishment of adaptive governance frameworks needed to support the implementation of EBM. Adaptive governance approaches can enhance the utilisation of marine resources, while also enabling rapid responses to the kinds of shocks and surprises that are likely to be associated with cumulative impacts. This allows for the improved accounting of environmental and biological constraints in decision making.

F. PROPOSED RESEARCH

This project will utilise a range of experimental and conventional social science methods to engage Māori, stakeholders, industry representatives, resource managers, decision makers, and the wider New Zealand public in navigating key issues in decision making for the marine environment. There are three main interconnected components to this project:

Cumulative impacts

Cumulative effects, through the addition of new marine industries, climate change and other stressors that reduce environmental capacity, push on our limit-setting processes and increase the risk of limit failure and environmental, economic or social collapse^{16,17}. EBM that supports the management of ecosystems in a different way, and the development of tools that translate complex socio-ecological processes into dynamic management strategies that can react and adapt to change, are needed to avoid these pitfalls¹⁸. Previous work on this topic has highlighted the troubling disconnect between the different kinds of agencies in science, science funding, and management, and represented the pivotal challenge for managing cumulative impacts as institutional¹⁸.

To address these challenges, a workshop with 25-30 participants will be held in Wellington to investigate management and governance strategies that address cumulative impacts across multiple scales and from multiple sectors. This work builds on the successful non-sectarian thought experiments⁵ and horizon scanning activities¹⁸ conducted in the Marine Futures programme. Decision makers operating at a range of policy and management scales (e.g., Ministry for Primary Industries, Environmental Protection Authority including its Māori Advisory Committee Ngā Kaihautū Tikanga Taiao, Department of Conservation, Straterra, PEPANZ, and regional authorities) will be brought together with scientists and Treaty partners to conduct a scenario planning activity¹⁹ that will model and explore possible ways to establish adaptive governance frameworks that anticipate, respond to and address cumulative impacts. Specific consideration of Māori interests, including both cultural and economic perspectives, will be incorporated into this work. A range of up to four plausible marine policy and management scenarios will be developed in advance of the workshop to stimulate discussion among participants. Scenarios will highlight limitations associated with existing legislative frameworks and consideration of how mechanisms to increase the relevance and efficiency of scientific research to address cumulative impacts could be fostered to enhance policy development¹⁸. Scenario development will require a literature review of cumulative impacts, scenario planning processes and the kinds of scenario options that have been used elsewhere; however, the scenarios will be developed to reflect the specificities of the New Zealand context with particular attention given to the social, cultural, economic and political processes that have shaped, and continue to shape, marine SES. This will require a contextual review and policy analysis to determine a range of plausible policy responses to be explored. Scenario discussions will be seeded through the dissemination of information prior to the workshop, possibly through an online forum such as a short webinar or informational video, and presentations on the day.

The exploration of cumulative impacts undertaken in this research will lead to an improved understanding of how cumulative impacts could be managed in a marine space, as well as the identification of gaps in legislation and science and opportunities to address these gaps within Phase 2 of the Challenge. Information obtained from this workshop will be used to determine how these factors influence SLO and are used to inform decision making.

Risk and uncertainty

There are many challenges posed by scientific uncertainty, conflicting values, and social-ecological complexity in general, but decision making and management actions are still urgently needed within the marine space. Decision making can be aided by the identification and characterisation of risk; where environmental factors are a consideration; this often occurs in association with the 'precautionary principle'²⁰. Experts usually quantify risk in terms of probabilities and magnitudes²¹ or describe the sensitivity of an element of a system to a disturbance and the likelihood that such a disturbance will occur²². However, the classification of risk, both now and in the future, may vary widely depending on factors such as the cultural values and objectives of stakeholders, the indicators chosen to facilitate the tracking of status and trends, and the thresholds set to determine the desired level of system 'health'²². Common reliance on the calculation of risk by experts has perhaps contributed to the general conception that any other understanding of risk lacks legitimacy; however, different risk knowledge cultures can remain distinct but equally valid²³. Where there is uncertainty about the exact level of a threshold or limit, choices about acceptable risks require societal input²⁴. In acknowledging the importance of involving the public and the multiple knowledges and multiple priorities held within society that must be accounted for^{25,26}, arts-science collaborative practice that engages the performing arts creates opportunities to explore power-laden politics and identity, to elucidate societal concerns about the world, and to re-imagine alternative possibilities^{27,28}. In the context of EBM, performance can heighten the public's awareness of environment-society relationships, and evoke responses that expose perceptions and understandings of risk associated with current and future marine activities^{27,28}.

This component of the project will employ a radical interdisciplinary arts-science methodology to engage the wider New Zealand public in the conceptualisation of current and future marine risks and uncertainties. A key feature of this component is a public performance that will be staged at venues across New Zealand at times that draw large numbers of diverse members of the public. A collaborative team of researchers from arts and humanities, social science and ecology will work to identify the key concepts of risk to be explored through the performance. Explicit efforts will be made to develop a performance that engages with Māori perspectives on risk and uncertainty by working with emerging Māori performance artists as well as emerging and experienced mātauranga Māori researchers. The performance will incorporate aspects of live arts such as theatre, dance, music and performance art that will be coupled with online interactive media (e.g. video, mapping, surveys, apps, social media) in order to collect data on public perceptions of risk and uncertainty associated with coastal and marine spaces. The online component of the research will be developed as one method to capture participant responses to art performances. The project will also engage with social media and other online outlets to connect with a wider audience. This approach will engage the public imagination and provoke alternative understandings of the marine environment, while also capturing public perceptions of risk and uncertainty.

This work evolves from successful research undertaken in the Fluid City project, which sought to heighten awareness among diverse publics about water sustainability in Auckland²⁹⁻³². It also draws inspiration from participatory risk mapping methods which seek to establish risk parameters through performative group mapping techniques. The adoption of arts-science practice will enable us to explore new ways of disseminating scientific knowledge concerning the effects of a variety of industries and activities on the marine and coastal realm, and will be explored alongside the cultural acceptability of these activities and industries. The goal is to disrupt the authoritative position of scientific and industrial knowledge and create a space for more open conversations about risks associated with activities such as commercial fishing, deep sea mining, oil and gas exploration, sea

level rise and ocean acidification associated with climate change. The artworks and performance pieces developed for this project will be deployed in October 2017 in a range of coastal locations around New Zealand including Auckland, Wellington, and Nelson.

This research will generate a better understanding of the New Zealanders' specific concerns and comfort levels about risk and uncertainty, while also seeking to disrupt these opinions through the introduction of elements of shock and surprise. Themes of cumulative impacts, adaptive governance, and EBM will be embodied throughout the performance of this research.

Trust

EBM requires collaboration across disciplinary boundaries and professional cultures. In responding to complex real-world socio-environmental problems, collaborative research projects provide opportunities for research to be undertaken to co-create knowledge that is scientifically robust and socially relevant³³. While the challenges of engaging in interdisciplinary and transdisciplinary research due to differences in methodologies, concepts, language and worldviews are increasingly acknowledged^{34,35}, research that focuses on incentives and disincentives to collaboration and which considers how trust is built in collaboration is less well understood³⁶. Building trust has consistently been identified as necessary to the establishment of management and governance approaches that address complex problems³⁷, primarily because trust enables collaboration⁹, and research indicates that people often find truth in trusted social networks³⁸. Additionally, the opportunity to improve the welfare of all parties involved is a critical element of trust building³⁹. For these reasons, successful co-management invariably involves long periods of relationship and trust building^{9,40}.

This project component will evaluate the efficacy of a range of methodologies for doing science and their capacity to build and maintain trust in the knowledge produced and inform decision making, and the extent to which trust is developed, and how it is developed, between research actors. Efforts will specifically be made to explore issues of trust across knowledge cultures, with a focus on mātauranga Māori and scientific knowledge spheres of influence. This will be undertaken using a dual approach: the first will evaluate the trust-building capacity of the Sustainable Seas Challenge both among the research partners involved and external partners, especially Treaty partners, while the second will more broadly seek to understand how trust is developed and maintained (or not) across a range of scientific methods and methodologies. This dual approach will allow the many projects operating within the Challenge to serve as de-facto trust experiments, operating in real time, which this project will monitor and evaluate for a range of possible trust results/responses.

Mixed methods with an emphasis on qualitative methods will be utilised to undertake this research (Harris and Lyon 2013). A literature review will be conducted and an evaluation framework for collaborative processes that co-produce knowledge will be developed. A baseline will then be established in the first 6 months of the Challenge to determine the levels of trust across the Sustainable Seas project teams and any established external partners. This will require the dissemination of a survey to all internal and external research partners and participants involved in the Sustainable Seas Challenge. This survey will be given again at the end of participant involvement with Sustainable Seas. This process will iteratively feed into an exploration of a range of scientific methods and their capacity to establish trust in the knowledge produced, and their uptake into decision making. Focus groups and one-on-one semi-structured interviews will be needed to establish these parameters, and grounded theory analysis of this data will be undertaken to determine results. Surveys and interviews will also be conducted with scientists, representatives from government agencies, non-governmental organisations and industry to evaluate the extent to

which different methods of science (e.g. citizen science, collaborative knowledge production) are trusted by users and communities of interest.

The following five years

Each element of this research project will have further work to do in Phase 2 of the Challenge. The findings from the cumulative impacts component will need to be connected to legislative processes through an enhanced collaboration with the cross-programme research project CP 1.2. The risk and uncertainty component will aim to target specific communities of interest (e.g. youth, Māori, Pasifika, recent immigrant populations) and further develop new methodologies for engagement based on the findings from the art-science collaborative practice undertaken in Phase 1. In Phase 2, the trust component will continue to inform the practice of the Challenge around issues of communication and outreach through ongoing evaluations and by seeking to develop a toolkit that is applicable for collaborative research programmes.

G. ROLES, RESOURCES

Name	Organisation	Contribution
Karen Fisher	UoAuckland	Dr Fisher is a qualitative social scientist with extensive experience in qualitative and transdisciplinary research. She will provide overall leadership to the research project and takes primary responsibility for the cumulative impacts and trust components and co-responsibility with Dr Longley for the risk and uncertainty component. Dr Fisher will take the lead in preparing the manuscript relating to the trust component of the research.
Kate Davies	NIWA	Dr Davies has extensive experience in interdisciplinary and transdisciplinary research. She will work closely with Dr Fisher on each of the research components and will take the lead in preparing the manuscript relating to the cumulative impacts component.
Carolyn Lundquist	NIWA/UoAuckland	Dr Lundquist has expertise in ecological modelling and experience in transdisciplinary research. As the leader of Our Seas, she provides important linkages to all other projects in Our Seas as well as Managed Seas
Alys Longley	UoAuckland	Dr Longley has extensive experience with undertaking transdisciplinary arts-science collaborative research practice and practice-led research. She will take the lead in developing the public performance as part of the risk and uncertainty component of the research in conjunction with Dr Fisher. Dr Longley will take the lead in preparing the manuscript for the risk and uncertainty component of the research.
Will Allen	Will Allen & Associates	Dr Allen has extensive experience in collaborative research projects focused on knowledge integration, and project evaluation. He will lead the trust component of the research, which will involve developing a methodology to evaluate trust.
Richard Le Heron	UoAuckland	Prof. Le Heron has extensive experience in social science and transdisciplinary research focused on knowledge production processes across a range of

		different social, economic and environmental domains. He brings highly valuable expertise and insight to all aspects of the project.
Alison Greenaway	Landcare Research	Dr Greenaway has research experience in processes that enable and facilitate the co-production of knowledge using a range of methods to suit diverse audiences. In particular, she will provide critical insights into co-design and co-production for the cumulative impacts and trust components, and facilitation and stakeholder engagement skills to the cumulative impacts component.
Kelly Ratana	NIWA	Ms Ratana is a marine scientist with skills in mātauranga Māori and experience in developing and working with cultural and environmental indicators. Ms Ratana will provide a critical Māori perspective across the project to ensure Māori interests and values are adequately reflected in the work.
Jim Sinner	Cawthron	Mr Sinner has research experience in the management of natural resources and in social license. As the project leader of 1.2.1, Mr Sinner will assist in developing the research agenda for all three themes, in line with concurrent projects on social license that are dependent on outputs of 1.2.2.
Katie Cartner	NIWA	Ms Cartner will assist in planning the workshop and art performance by providing logistical support.
TBD	UoAuckland	A PhD candidate will work on developing their own interdisciplinary research project in alignment with the work conducted as part of the risk component of the project. Preference will be given to selecting a Māori candidate or candidate who has engaged in Māori/interdisciplinary performance arts.
Darcel Rickard	Waka Huia	Ms Rickard has extensive experience in science communication, television production and communication and dissemination of mātauranga Māori. She will provide useful insight into the development of workshops and performances that accommodate Māori values and perspectives, and also in communicating to Māori (and non-Māori) audiences.
TBD	TBD	With the assistance of James Whetu and Linda Faulkner, we will seek to identify a Māori researcher with the capacity to advise on economic interests of Māori as well as kaitiakitanga. Their role will include advising on the work done on cumulative impacts, risk and trust. This researcher will play a key role in ensuring Māori values and interests are adequately reflected in the project.
TBD	TBD	We will seek to engage a social media researcher who has experience in social media communication and knowledge of app development. This researcher will play a critical role in developing the online platform

		for data collection and knowledge exchange as part of the risk component of the research.
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H. LINKAGES AND DEPENDENCIES

There is a need to identify a researcher with available capacity to assist with providing economic interest of Māori as kaitiaki in the earliest possible stages of this research. However, this position would ideally align with the work being undertaken in *Vision Mātauranga Project 1.1* (Iwi preparedness for a blue economy). An RfP for this project will be undertaken in February 2016 and therefore the researcher who can fill this role is unlikely to be identified prior to that time.

Cumulative Impacts

Data from this project component will be used to inform work being undertaken in *Dynamic Seas* and *Managed Seas*; the workshop is therefore planned as early as possible (April 2016). Work in this project component also connects to *Cross Programme Project CP 1.1* (EBM within New Zealand's existing framework) and feeds into CP 1.2 (Future EBM frameworks for New Zealand). Linkages with cumulative impacts frameworks developed elsewhere in the Challenge and previously (MBIE Marine Futures programme) will be provided through involvement of Judi Hewitt (Programme Leader, *Valuable Seas*) and Simon Thrush (Project leader, *Dynamic Seas 4.2.1* Tipping points and thresholds) in pre-workshop development.

Risk and uncertainty

There are strong linkages in this project to *Valuable Seas* and *Tangaroa*, as work from these projects will be needed to help guide the understandings of how values (monetary and otherwise) shape conceptions of risk and uncertainty. There are also linkages to *Dynamic Seas*, and data from this project will be used to inform the development of the other projects in *Our Seas* (Project 1.1.1 Review existing Māori and stakeholder engagement in marine science and marine governance participatory processes; Project 1.1.2 Determine suite of participatory processes for application in multi-use environments; Project 1.2.1 Frameworks for achieving and maintaining social licence). In particular, a workshop to be held in conjunction with the Annual Meeting in April 2018 will be held jointly with Project 1.2.1 to present the initial findings from the performances and stimulate further discussion on how these findings might inform social license in NZ.

Trust

This project component links to *Valued Seas* and *Tangaroa*, as different cultural and value contexts will inform trust relationships. Data from this project will be used to inform the development of the other projects in *Our Seas* (Projects 1.1.1, 1.1.2, and 1.2.1), and in evaluating the participatory framework developed for the case study area. In particular, a baseline assessment of levels of trust within the participatory process in Project 1.1.2 will be taken when it begins in early 2017, and findings from this research component will inform further development of Project 1.1.2 (to be presented at the Annual Meeting in April 2018).

I. COLLABORATIONS

This project will rely on a substantial number of national collaborations to achieve its objectives. In particular, contributions from The University of Auckland, NIWA, Landcare Research, Cawthron Institute, AgResearch and two private consultants are needed to ensure that this research aligns with the work being undertaken in several other programmes within the Sustainable Seas Challenge.

J. INTERNATIONAL LINKAGES

Megan Mach, Melissa Foley, Centre for Ocean Solutions, Stanford University and USGS. These collaborators have extensive experience in the incorporation of socio-ecological resilience into ocean management. Stakeholder workshops will be developed with their involvement on the development of cumulative impacts, risk and uncertainty, and building trust in science.

K. ALIGNED FUNDING AND CO-FUNDING

This project will use ongoing work in NIWA Coasts and Oceans Centre core funding from Programme 5, and builds on past research funded by the Coasts and Oceans Research Programme 3 which contributed to the development of the scenario planning methods that will be further refined through this research. The project will also build on the innovative scenario planning methods developed in the Marine Futures programme.

The PhD student will be supervised by University of Auckland staff as part of their academic position. Supervision represents a significant time cost, as each student involves 200 hours of work. Resources and logistical support will be provided to the PhD student by the University of Auckland. Other costs that will be met through the University of Auckland are meeting facilities and outreach. These can be monetized.

L. VISION MĀTAURANGA (VM)

As partners in the management of New Zealand’s environment, the inclusion of Mātauranga Māori is essential to this project. VM programme tasks and anticipated results associated with this project are shown in Table 1. As kaitiaki of land and sea, Māori have invaluable knowledge and expertise that can enhance environmental decision making. This research provides an opportunity to enable traditional values, principles, and concepts to be incorporated into environmental management and decision making frameworks to ensure the wellbeing of Māori. This research addresses the desired outcomes of Taiao and Mātauranga in the Vision Mātauranga framework.

VM Programme Task	<i>The concept of social licence for the Challenge and the task for Our Seas is inclusive of seeking licence from iwi, an “iwi licence”, to sustainably manage and develop the marine/ocean environment.</i>	
	<i>Appropriate engagement, communication and outreach methods are key to ensuring tangata whenua are actively involved in the Challenge. It is important to the Challenge that tangata whenua/iwi Māori are aware that a key outcome is social licence. It is important that any potential social licence is not in conflict with aspirations and existing approaches of tangata whenua/iwi Māori. Participation in the Challenge will ensure that their mātauranga, culture and experiences are reflected in new frameworks.</i>	
Anticipated Results	<u>Discover</u>	<ul style="list-style-type: none"> • <i>Distinctive processes, systems and services as a result of Māori knowledge and its people</i> • <i>Approaches (distinctive and/or successful) to environmental sustainability</i> • <i>Mātauranga Māori</i>
	<u>Outcome</u>	<i>Māori confidence in social licence, and Framework that supports:</i>

		<ul style="list-style-type: none"> • <i>Māori businesses and other enterprises to uplift productivity and performance</i> • <i>The role of Māori as tangata whenua and kaitiaki</i> • <i>The use and application of mātauranga Māori</i>
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The incorporation of mātauranga in the research process and co-production of knowledge between tangata whenua, Māori researchers, and other researchers involved in this project, will also enhance understanding of the multiple values associated with New Zealand’s marine environment. The research will build Māori capabilities in social and ecological sciences that will allow economic and other opportunities to be identified while also enhancing social and environmental sustainability.

M. COMMUNICATION AND OUTREACH

Engagement with iwi and hapū and incorporation of mātauranga and tikanga Māori into the design of the research are integral to the long-term success of the project and for enacting EBM. As kaitiaki of the sea, mana whenua have invaluable knowledge and expertise that can enhance environmental decision making. The dual responsibility of Māori as kaitiaki and as partners in emerging co-governance and co-management arrangements requires collaborative engagement to allow knowledge sharing and the co-development of appropriate management tools. This research builds Māori capabilities in social and ecological sciences and environmental decision making that will have beneficial effects at the local level and as partners in environmental management.

There are a wide range of additional stakeholders, end-users, and members of the general public who will be expected to engage with this project. Those that will directly benefit from the knowledge produced range from the regional to national level and include MfE, MPI, DoC, Maritime NZ, EPA, Councils and Industry, but it is anticipated that some members of the general public will also gain knowledge from this research about marine industries and associated risks and uncertainties. The Our Seas programme is exploring an online communications platform for social scientists in the Challenge, which could provide another vehicle for outreach and connectivity.

N. CAPACITY BUILDING

This transdisciplinary research project will involve researchers, practitioners, managers, stakeholders and decision makers across a range of backgrounds and disciplines. Designed to build trust and enhance co-learning, the project will establish new networks crossing traditional institutional boundaries, enabling new partnerships. Work with students and a focus on building partnerships with Māori will ensure that this capacity building will be transferred to future generations of decision makers. In particular, at least one student research assistant will be needed to contribute to the cumulative impacts literature review and scenario development, and several arts and science students, including if possible, one with Māori cultural performance interests and/or one interdisciplinary PhD student who will be funded with a scholarship, will be included in the development of the risk and uncertainty theme. Researchers with a wide range of experience will be involved in this work, allowing for mentoring of early and mid-career researchers by those with more experience.

O. ETHICS APPROVAL

Ethics approval for this research will be sought from The University of Auckland’s Human Research Ethics Committee, as this is the host organisation for this project. Investigators based at other institutions will comply with their own ethics policies as required.

Q. REFERENCES

- 1 Berkes, F., Colding, J. & Folke, C. in *Navigating Social-Ecological Systems: Building Resilience for Complexity and Change* (eds F. Berkes, J. Colding, & C. Folke) Ch. 1, (Cambridge University Press, 2003).
- 2 Berkes, F. & Folke, C. in *Linking Social and Ecological Systems: Management practices and social mechanisms for building resilience* (eds F. Berkes, C. Folke, & J. Colding) Ch. 1, (Cambridge University Press, 1998).
- 3 Davies, K., Fisher, K., Dickson, M., Thrush, S. & LeHeron, R. Improving Ecosystem Service Frameworks to Address Wicked Problems *Ecology and Society* **20**, 37, doi:http://dx.doi.org/10.5751/ES-07581-200237 (2015).
- 4 Fulton, E. A., Smith, A. D. M., Smith, D. C. & van Putten, I. E. Human behaviour: the key source of uncertainty in fisheries management. *Fish and Fisheries* **12**, 2-17 (2011).
- 5 Le Heron, R. *et al.* Non-sectarian scenario experiments in socio-ecological knowledge building for multi-use marine environments. *Marine Policy* (Forthcoming).
- 6 Owen, J. & Kemp, D. Social licence and mining: A critical perspective. *Resources Policy* **38**, 29-35 (2013).
- 7 Cook, B. R. & Spray, C. J. Ecosystem services and integrated water resource management: Different paths to the same end? *Journal of Environmental Management* **109**, 93-100, doi:http://dx.doi.org/10.1016/j.jenvman.2012.05.016 (2012).
- 8 Cote, M. & Nightingale, A. J. Resilience thinking meets social theory: Situating social change in socio-ecological systems (SES) research. *Progress in Human Geography* **36**, 475-489, doi:http://dx.doi.org/10.1177/0309132511425708 (2012).
- 9 Olsson, P., Folke, C. & Berkes, F. Adaptive comanagement for building resilience in social-ecological systems. *Environmental Management* **34**, 75-90 (2004).
- 10 Olsson, P. *et al.* Shooting the Rapids: Navigating Transitions to Adaptive Governance of Social-Ecological Systems. *Ecology and Society* **11**, 18 (2006).
- 11 Carpenter, S. R. & Folke, C. Ecology for transformation. *TRENDS in Ecology and Evolution* **21** 309–315, doi:http://dx.doi.org/10.1016/j.tree.2006.02.007 (2006).
- 12 Folke, C. Resilience: The emergence of a perspective for social-ecological systems analyses. *Global Environmental Change* **16**, 253–267 (2006).
- 13 Folke, C., Hahn, T., Olsson, P. & Norberg, J. Adaptive governance of social-ecological systems *Annual Review of Environment and Resources* **30**, 441–473, doi:http://dx.doi.org/10.1146/annurev.energy.30.050504.144511 (2005).
- 14 Castree, N. *et al.* Changing the intellectual climate. *Nature Climate Change* **4**, 763-768 (2014).
- 15 AAU *et al.* Leiden Statement: The Role of the Social Sciences and Humanities in the Global Research Landscape. (2014).
- 16 Scheffer, M. & Carpenter, S. R. Catastrophic regime shifts in ecosystems: linking theory to observation. *Trends in Ecology and Evolution* **18**, 648-656 (2003).
- 17 Hughes, T. P., Carpenter, S., Rockström, J., Scheffer, M. & Walker, B. Multiscale regime shifts and planetary boundaries. *Trends Ecol. Evol.* **28**, 389-395, doi:http://dx.doi.org/10.1016/j.tree.2013.05.019 (2013).
- 18 Lundquist, C. *et al.* Prioritising marine science needs in New Zealand: a focus on multi-user management and policy to address cumulative impacts. *Frontiers in Marine Science* (Forthcoming).
- 19 McKenzie, E. *et al.* Developing scenarios to assess ecosystem service tradeoffs: Guidance and case studies for InVEST users. . (World Wildlife Fund, Washington, D.C., 2012).
- 20 Peel, J. *The precautionary principle in practice: environmental decision-making and scientific uncertainty.* (The Federation Press, 2005).
- 21 Balint, P. J., Stewart, R. E., Desai, A. & Walters, L. C. *Wicked Environmental Problems: Managing Uncertainty and Conflict.* (Island Press, 2011).

- 22 Tallis, H. *et al.* The many faces of ecosystem-based management: Making the process work today in real places. *Marine Policy* **34**, 340–348 (2010).
- 23 Li, G. in *Tackling Wicked Problems: Through the Transdisciplinary Imagination* (eds V.A. Brown, J.A. Harris, & J.Y. Russell) (Earthscan, 2010).
- 24 Schneider, S. H. Climate change: do we know enough for policy action? *Science and Engineering Ethics* **12**, 607-636 (2006).
- 25 Wynne, B. Elephants in the rooms where publics encounter “science”? A response to Darrin Durant, “Accounting for expertise: Wynne and the autonomy of the lay public”. *Public Understanding of Science* **17**, 21-33 (2008).
- 26 Robinson, P. A. *et al.* Responsible scientists and a citizens’ panel: new storylines for creative engagement between science and the public. . *The Geographic Journal* **180**, 83-88 (2014).
- 27 Gibbs, L. M. Arts-science collaboration, embodied research methods, and the politics of belonging: 'SiteWorks' and the Shoalhaven River, Australia. *Cultural Geographies* **21**, 207-227 (2014).
- 28 Rogers, A. Geographies of the Performing Arts: Landscapes, Places and Cities. *Geography Compass* **6**, 60-75 (2012).
- 29 Fitzpatrick, K. & Longley, A. Embodiment and affect in research collaborations. *Emotion, Space, Society* (2013).
- 30 Longley, A. *et al.* Imagining a Fluid City. *Qualitative Inquiry* **19**, 736-740 (2013).
- 31 Longley, A., Šunde, C., Fisher, K. & Mathewman, S. Fluid Pixels. *HyperRhiz* (2015).
- 32 Šunde, C. & Longley, A. in *Animation of Public Space through the Arts: Towards More Sustainable Communities* (ed N. Duxbury) (Alemedina Press, 2014).
- 33 Romero-Lankao, P. *et al.* ADAPTE: A tale of diverse teams coming together to do issue-driven interdisciplinary research. *Environmental Science and Policy* **26**, 29-39 (2013).
- 34 MacMynowski, D. P. Pausing at the Brink of Interdisciplinarity: Power and Knowledge at the Meeting of Social and Biophysical Science. *Ecology and Society* **12**, 20 (2007).
- 35 Bracken, L. J. & Oughton, E. A. ‘What do you mean?’ The importance of language in developing interdisciplinary research. *Transactions of the Institute of British Geographers* **31**, 371-382 (2006).
- 36 Harris, F. & Lyon, F. Transdisciplinary environmental research: Building trust across professional cultures. *Environmental Science and Policy* **31**, 109-119 (2013).
- 37 Lebel, L. *et al.* Governance and the Capacity to Manage Resilience in Regional Social-Ecological Systems. *Ecology and Society* **11**, 19 (2006).
- 38 Carolan, M. S. Social change and the adoption and adaptation of knowledge claims: Whose truth do you trust in regard to sustainable agriculture? *Agriculture and Human Values* **23**, 325–339 (2006).
- 39 Ostrom, E. & Ahn, T. K. in *Handbook of Social Capital: The Troika of Sociology, Political Science, and Economics* (eds G.T. Svendsen & G.L. Svendsen) (Edward Elgar Publishing, 2009).
- 40 Pretty, J. & Ward, H. Social Capital and the Environment. *World Development* **29**, 209-227 (2001).