Phase II Research Proposal

A. PROJECT TITLE	Understanding and communicating the various implications of scale for EBM
"SHORT" TITLE	Scale and EBM
B. THEME / PROGRAMME	Theme 4: Enabling EBM Practices

C. PROJECT KEY RESEARCHERS (CVs for all listed to be provided in SharePoint container using template provided in SharePoint)

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Researcher	Assoc Prof Karen Fisher	University of Auckland	
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Researcher	Assoc Prof Elizabeth MacPherson	Canterbury University	
Researcher	Dr Erica Williams	NIWA	
Researcher	Eric Jorgensen	Ocean Bay Farm	
Researcher	Dr Ani Kainamu	NIWA	

D. CO-DEVELOPED WITH

Name	Role	Organisation / company / agency	Level of partnership
David Taylor	Co-development partner	Aquaculture NZ	Project review and suggestions for S2 and S3, will be on advisory panel
Hannah Jones	Co-development partner	Waikato Regional Council	Project review and suggestions for S2 and S3, will be on advisory panel
Carolyn Lundquist	Co-development partner	NIWA / UoA	Input to proposal
Shaun Awatere	Co-development partner	Land Care Research	Input to proposal/ CLT Tangaroa
Conrad Pilditch	Co-development partner	University of Waikato	Input to proposal/ CLT Theme 1
Drew Lohrer	Co-development partner	NIWA/SS	Project lead S7 Ki uta ki tai
Stacey Faire/Josie Crawshaw	Co-development partner	Bay of Plenty Regional Council	Preparing a section of work on cumulative effect assessments and barriers
FUTURE CO-DEVELOPMENT PARTNERS will be discussed in section O			

E. ABSTRACT

Ecosystem Based Management (EBM) is a dynamic process, focussed on understanding and managing ecosystems across a range of organisational, spatial and temporal scales. Despite the importance of scale, only rarely is scale-dependency in different disciplines and the interactions between them explicitly stated and bought into play as affecting both the decision-making process and its success. While some research in the Challenge explicitly focusses on producing results for different scales, other research does not, leaving gaps in our ability to fully understand how EBM can be achieved across a variety of scales. Questions of scale also influence components that may have to change if jurisdictional boundaries or management resolutions are changed. Our project will produce new knowledge to better understand and communicate scale-dependencies for EBM. The work has three sections: S1) A review of existing knowledge of scale dependencies from other Sustainable Seas projects, S2) Analysis of scale-dependencies, specifically in the legal-policy, ecological, socio-psychological, mātauranga Māori and economic realms, and S3) Creating visual summaries to aid understanding of cross-scale implications and contribute to robust, transparent decision making. Integration of knowledge from these research aims will facilitate the development of decision-making practices that explicitly identify scale and scale-dependencies to increase the success of EBM decision-making processes.

F. RELEVANCE TO CHALLENGE OBJECTIVE

What we observe, how we predict ecosystem response and address unintended consequences is dependent on scale. Social worlds and ecosystems are both scaled in diverse ways, the processes that drive them are scaled, and the way in which we imagine, organise, live in, and manage them are scaled. The concept of scale and the importance of heterogeneity in space and time has been widely recognized as a key issue in ecology for decades (Pielou, 1977; O'Neill et al., 1986; Wiens, 1989; Levin, 1992; Schneider, 2001; Thrush et al., 2005). Similarly, concepts of scale exist within Te Ao Māori, such as atua, whakapapa, waka, ki uta ki tai and cultural differences

in the scales at which people experience and perceive environmental issues exist. Law, policy and planning at present dictate the boundaries, structures, rules, and processes within which governmental or policy action takes place, and in doing so become one of the focal points for analysis of barriers to adaptation for better environmental management (Cosens et al., 2017). However, despite widespread recognition that what we observe and feel, and how an ecosystem responds to stressors, is dependent on scale, we lack the tools and visualisations to easily understand and communicate the consequences of scale-dependency on the outcomes of decision-making processes. There is also a lack of understanding of how scale propagates through social and governance systems to create indirect effects on ecological health, economic health and social and cultural values. A central objective of the *Scale and EBM* project is therefore to explicitly identify and address scale-dependencies between ecological, social, economic and governance levels. This knowledge is directly relevant to the Challenge in increasing transparency of how and why decisions may be made, and it ideally results in improved marine management practice, actions and policy advancement.

Outputs: Here we describe plans to provide uptake that apply generally to most outputs. Please note that scientific papers are still required in some sections of work to provide international evidence of quality and that we will not include in this section uptake plans and outputs from other projects.

G. OUTPUTS	This project will produce the following Outputs:	Linked to which Theory of Change Outputs:	Explain briefly your plan to ensure uptake by iwi and stakeholders:
	Output 1: list of scale-dependencies of tools, models and guidelines from other Challenge projects	Social-cultural-ecological knowledge that supports the development of understanding and tools that underpin EBM developed	Results of this survey will be passed to the Synthesis EBM4 *Guides and toolkits* project and communicated to our co-development partners, Māori and stakeholder advisory board and Challenge communication team via our 3 monthly news update. Results will also be used in Output 7 and Output 8
	Output 2: report of a review of where mātauranga and tikanga related to recovery of marine areas are impeded by present management scales in the marine environment	Traditional, local and other cultural knowledge that supports EBM is captured/understood/recognised	The results of this analysis will be disseminated through wānanga with project leaders, Māori and stakeholder advisory board members and other interested parties. The results will also be used in Outputs 7 and 8
	Output 3 (Scales of Justice): an analysis of legal approaches to managing issues of scale in marine contexts, backed by peer reviewed manuscript.	Governance and policy practices that support EBM identified, evaluated and packaged for targeted decision makers	The results of this analysis, conducted in conjunction with Project 1.1 and 4.2, will be disseminated through wānanga and letters as well as Project 4.2 SAB (advisory group of lawyers)
	Output 4 (Scaling the Challenge and Challenging the Scales): policy briefing and one scientific paper on frameworks for assessing the risk of unintended outcomes of management actions generated by scale mismatches. This will include guidance on whether some decisions are best made at particular scales, and -crucially- how those decisions connect with smaller and larger scales	Governance and policy practices that support EBM identified, evaluated and packaged for targeted decision makers. Scales of management and place-based strategies that reduce environmental risks are identified and demonstrated	We will work closely with our institutions' outreach and communications facilities, and those of the Challenge, to engage and reach a wider audience than can be achieved through the workshops and wānanga/hui, held by our partner projects, including the use of audio-visuals and internet platforms. This Output will also be part of Output 8
	Output 5: one scientific paper on the development of spatial and temporal scaling rules in the context of accumulating impacts related to	Scales of management and place-based strategies that reduce environmental risks are	There is already demand for this information- co-development partners (aquaculture and local government) are requesting tools that require the Output 5 development

	cross scale interactions of differing intensities and durations Output 7: standard methodologies to assess and display scale mismatches and effect changes with temporal and spatial changes in intensity developed	identified and demonstrated Tools for predicting and managing cumulative and multiple stressors developed, assessed and demonstrated	For both Outputs 5 and 7, we will work closely with our institutions' communications facilities, and those of the Challenge, to engage and reach a wider audience, than can be achieved through the involved iwi, stakeholders and advisory board alone, including the use of internet platforms
	Output 6: one scientific paper investigating how framing and psychological distancing at various scales impact on policy-makers' strategies and selection of policy priorities and/or community members' reactance to these policies and their behavioural intentions Output 8: a set of visual summaries demonstrating cross-scale implications or barriers related to cumulative effects and recovery actions, from the view point of different end-users/sectors	Social-cultural-ecological knowledge that supports the development of understanding and tools that underpin EBM developed Pathways for knowledge, understanding and skills developed by the Challenge to be understood by iwi and stakeholders are developed	Visual summaries will be developed, tested and refined in conjunction with our Māori and stakeholder advisory board, and other interested parties as well as other Challenge Project partners (particularly, Projects 1.1, 3.2, 4.2, T1, T3, T5 and synthesis projects (*EBM3 Scenario testing*, *EBM4 Guides and Toolkits,* TAM1 *He Taura Here* and TAM2 *He Waka Taurua*)). Project dissemination pathways of the contributing projects and co-development partners will be used to further disseminate outputs

H. OUTCOMES

This project will contribute to the following Theory of Change Outcomes:

- Increased understanding of alignments and mismatches of ecosystem, social, cultural, business and management scales so that narratives of EBM processes at various spatial and temporal scales can be achieved.
- Decision-making processes explicitly identify scale-dependencies in a way that increases the success of EBM and improves ecological, social, cultural and economic decisions and wellbeing.
- Knowledge from the Challenge (science and mātauranga) is used in decision making to improve ecological health and influences Aotearoa New Zealand's marine management practice and policy.
- Researchers, iwi and stakeholders involved during the life of the Challenge continue to actively promote, co-design research in, and use knowledge from the Challenge.

I. INTRODUCTION

Ecologically, the problem of scale has two components. First, pressing problems in environmental management and ecology often exist at the scale of decades and large ecosystems, while most observations and experiments can only be undertaken in small areas, over short periods of time. Second, patterns measured at small scales do not necessarily hold at larger scales and processes generally vary in their importance with scale (Schneider, 2001). Consequently, pressing environmental problems cannot be automatically addressed by scaling locally measured variables or studies, directly to larger management areas, longer time-scales or more holistically-derived ecosystems (Ellis and Schneider, 2008; Tipa et al., 2017). Socially, there are cultural differences in both the scales at which people experience - expect to interact with - the environment, and psychological barriers limiting individuals' ability to transcend spatial and temporal scales (Liberman and Trope, 2008). All these scale aspects pose challenges to successful management, including EBM.

In addition to ecological, psychosocial and cultural scaling issues, the dominating neo-liberal approach to our utilisation of natural 'resources' in Aotearoa has been anthropocentric and hierarchical. In a relatively short time, we have witnessed and scientifically documented the failure of this approach and the adverse impacts on place and people. Temporally, law and policy typically follow the election cycle, although we are increasingly seeing reference to the importance of intergenerational equity in law. Despite all the

resources dedicated to knowledge generation, management, legislation, regulation, and policy, outcomes for people and nature are poor (PCE 2020). Notably we are seeing a failure of law and policy to manage the marine environment across scale. This is a core problem of 'environmental law' and currently a focus for legal scholars.

Te Ao Māori and science have never driven the design of administrative, legal and policy arrangements in a post-colonial context. Scale-dependent interactions occur in ecology (see van de Koppel et al., 2006; van Wesenbeeck et al., 2008), for example, as a system approaches a phase shift, large-scale structures may appear despite the fact that the system is driven by local interactions (Pascual and Guichard, 2005). There is no "right" scale in nature emphasising the importance of cross-scale interactions, the need to work at multiple scales and to consider indirect non-hierarchical feedbacks in ecology. Concepts of scale and hierarchies of scale in space and time exist within Te Ao Māori (e.g., atua, whakapapa, waka, ki uta ki tai, wāhi tūpuna, wāhi tapu) (Te Rūnanga o Ngāi Tahu, 2003; Buizer et al., 2010; McCormack, 2021; Walker et al., 2021). Furthermore, the past is a very important reference for Māori, for example, as expressed in the whakataukī – "Kia whakatōmuri te haere whakamua" (My past is my present is my future, I walk backwards into the future with my eyes fixed on my past) (Rameka, 2016) and historical information sources are important to inform contemporary management contexts (Tipa, 2013). Mātauranga Māori is a holistic perspective encompassing all aspects of knowledge, seeking to understand the relationships between all component parts (living and non-living) and their interconnections to gain an understanding of the whole system. Past research has confirmed a stronger connection Māori have with the natural environment compared to non-Māori in New Zealand (Cowie et al., 2016). Spatial and temporal scales as described within Te Ao Māori are holistic, include concepts such as *Ka mua, ka muri*, and encompasses a duty to leave the environment in as good as or even better condition than received from tūpuna for the benefit of generations that are yet to come (Ngāi Tahu ki Murihiku, 2008). Conversely, Aotearoa New Zealand management of the marine environment is compartmentalised, separated artificially by different pieces of legislation and short-term planning processes. These conflicts in spatial and temporal scales are a barrier for whānau/hapū/iwi decision making and implementation.

The issue of scale between ecosystem elements, society and governance structures has also been identified as an important next step for applying EBM in marine systems internationally (Ruckelshaus et al., 2007). Recently the Parliamentary Commissioner for the Environment recommended that an ecosystem-approach to managing estuaries be implemented (PCE, 2020). However, there can be mismatches between the scales of management and the scale of the elements being managed. Such questions are even more critical when considering individuals' tendency to display biased judgement about the severity of environmental threats (i.e., environmental issues tend to be perceived as more severe "there" than "here"; Schultz et al., 2014). Because socio-political and ecosystem variation and feedbacks may occur at smaller spatial scales than those over which large-scale ecological processes operate (Hutton and Leader-Williams, 2003; Adger et al., 2005) scale should be explicitly considered when addressing ecosystem management efforts (Ruchelshaus et al., 2007).

This project therefore aims to create credible and rigorous visual summaries that explicitly demonstrate scale-dependencies and interactions and the way they impact on how decisions are made. These summaries will prepare communities, whānau and hapū to navigate present pathways used by environmental managers, aid environmental managers and businesses in dealing with changes in scale and cumulative effects and highlight present scale-based barriers to solving environmental problems. We will do this by focussing on actions that prevent further degradation in the face of cumulative impacts, increase recovery of ecological health, promote blue economy businesses and increase Māori and Pākeha involvement in both management and knowledge respect/generation. We will investigate the scales at which these actions (environmental solutions and positive interventions/ opportunities) need to take place, and identify present barriers, bottlenecks and the gate keepers at various scales.

While the project will collate and interpret data from many of the other Sustainable Seas projects, it is particularly strongly linked to research into cumulative effects (Project 1.1), risk (Project 3.2), and legal and policy barriers (Project 4.2). For these reasons, the project team includes researchers from all three of these projects.

J. AIMS

Our aims address three overarching questions:

1. What are the alignments and mis-matches between scale-dependencies for different disciplines, cultures and sectors and how do scale-dependencies and interactions affect decision-making outcomes and success.
2. What are the best visual summaries or tools that explicitly enable scale-dependencies and interactions to be visualised and are readily communicated to researchers, Māori and stakeholders?
3. How do scale-dependencies and interactions affect decision-making outcomes? In particular, what are the scales at which actions that result in environmental solutions need to be taken and what are the scale-dependent barriers to these actions?

K. PROPOSED RESEARCH

The proposed research will focus on three work sections. These work sections are not completely sequential, but will overlap, allowing iteration between them.

S1. Collation of existing knowledge of scale dependencies from other Sustainable Seas projects. We will survey each Sustainable Seas project to collect information on which ecological, social, organisational scales the project's objectives are tested, how these scales interact to aid/hinder actions and solutions, the type of information needed/used, and the barriers identified. This information will be grouped into categories related to managing cumulative effects, managing for recovery and management structures used by government and Māori institutions. Special emphasis will be placed on:

i) scales of environmental variability and ecological responses. This will include: ecological footprint analysis; spatial and temporal dynamics of ecological responses to cumulative effects; recovery dynamics of key species; scales of measurements for ecosystem services; scales of monitoring of key taonga species; mātauranga Māori definitions of degradation, recovery and risk; and the effect of cumulative impacts on risk and uncertainty (see section M for projects).

ii) scales of business and investment activities and information requirements. This will include: community restoration activities; national and local investment and risk in the paua industry; restorative economy investment; mātauranga Māori and katiaki-driven organisational, spatial and temporal economic strategy scales; whānau-owned aquaculture farms; and strategy scales for the seaweed and blue tourism sectors (see section M for projects).

iii) shifts in ecological, social and cultural understandings, values and risk practices when presented with different space and time scales. This will include: community and individual understandings on perceptions of risk and uncertainty related to Mangrove removal and dredge dumping; business and investment solutions to risk (fisheries and banks); and small-scale management solutions to threats to a taonga species (see section M for projects).

iv) shifts in generally utilised space and time scales by whanau, hapū, communities, iwi, local and national government and the knowledge types available or thought sufficient for use at different scales. This will include: urban development scenarios; local and central government interactions on costal strategies and planning; iwi organisations and local government interactions; maramataka knowledge and practices; cultural assessment frameworks; community and business level restoration; and national and regional spatial planning (see section M for projects).

Information will be analysed by ordination and clustering techniques (e.g., social network analysis) to order and display relationships across scale. This survey will be conducted in conjunction with Ewa Siwika's Project 1.3 survey and the results passed to Tranche 1 of the Synthesis EBM strand and to our co-development partners to help us select specific components to be analysed in S2 and S3 (see Figure 1).

S2: Analysis of scale-dependencies, within 3 focus areas.

1. Internationally the importance of legal and policy frameworks that support relationships between people and place that are flexible and tailored to context is being recognised (Macpherson et al., 2021). However, it is unclear how relational governance models should be scaled in time and place. For example, are regional councils or national agencies best placed for marine regulation and further what are the timeframe/s that planning should operate at? Research conducted in project 4.2 will be further developed by investigating the drivers of strategies with scale, and the hooks and anchors that can be used, related to positive environmental and blue economy actions.

2. The scales at which different end-users apply present tools for management or assessment (local to national, community to government) will be documented (using information from S1, co-development partners and EBM2). We will conduct an analysis for scale mismatches between these scales, environmental/ecological events and economic, social and cultural objectives (see point 3 below). Some of these mismatches will form part of the scenarios used in EBM3 *Scenario testing* and the results of that project will allow us to finetune our outputs. We will generate scaling rules (including non-linearities and thresholds) to allow accumulation of effects across space, time and ecosystems. For example, development of return periods of events for management, creation of spatial and temporal accumulation rules for consenting, and prediction of impacts from cross scale interactions (local-global, quick-slow processes). This work will emphasise the different effects that different business sectors, with their differing intensities of use, spatial scales and durations may have in terms of ecological responses.

3. A review, that also draws on freshwater experiences, will explore how kaitiakitanga and the use of mātauranga and tikanga to initiate recovery of marine areas, are impeded by present management scales in the marine environment. There is enormous potential for mātauranga Māori to improve the management of aquatic ecosystems (Clapcott et al., 2018). Historically indigenous knowledge has been marginalised (Hikuroa, 2017) with Māori having to work within the constraints of a western science and policy system (Mercier et al., 2011). Findings of this review will be integrated with information from S1 to understand where barriers to action occur and possible ways to navigate the restrictions. Findings will also be passed to TAM1 *He Taura Here* and 2 *He Waka Taurua*. This section of work will also test, on Challenge

Project leaders, a previously developed method to engage different disciplines/sectors in discussing their assumptions around spatial and temporal scales.

S3: Creating visual summaries of scale alignments and cross-scale implications. This section will integrate the findings from S1 and S2 to communicate more clearly scale dependencies and how to navigate scale for the benefit of ecosystems (and thereby people) to support EBM decision making.

As a starting point, any scale-dependencies of tools, models and guidelines from other Challenge projects will be made explicit (likely via an overlay) and communicated to the Synthesis project EBM4 *Guides and toolkits* and the Challenge communication team. This analysis will include identifying whether some decisions are best made at particular scales, and critically, how those decisions connect with smaller and larger scales.

In many cases the visual summaries of scale alignments and cross-scale implications will rely on us developing analyses that provide/predict the underpinning flows and changes. Of necessity these analytical methods will need to be generalisable, yet able to deal with details, a balance that is difficult but able to be achieved. During development we will also include guidance to structure processes that embrace the power of knowledge from multiple scales rather than ignoring scale.

The summaries themselves are intended to be static, although utility of a game will be investigated. As the type of visualisation will depend on who we (project partners, advisory board) envisage using it, a range of visualisation types will be developed for a selected set of uses, with this set selected by co-development partners (including those from the synthesis projects). Examples in this set will be targeted to community groups, hapū, regional councils, industries and environmental lawyers. For example, regional council and aquaculture co-development partners have expressed interest in visual summaries that demonstrate temporal changes in the intensity of past, present and intended activities and how this varies with spatial scale and business sector. We will utilise commercial communication/art companies to produce the final visualisations.

Finally, we will investigate how knowledge can impact policy and behaviour, through the experimental testing of our visual summaries. Scenario-based and framing-based research designs will be employed to generate information on how the presentation of information at various scales impact on policy-makers' strategies and selection of policy priorities, as well as community members' acceptance/reactance to these policies and their behavioural intentions. It will draw from S1 and S2, as well as from knowledge about how scales act as psychological barriers (Liberman and Trope, 2008), and how framing can impact people's attitudes and behaviours (e.g., Thomas et al., 2020; Vinnell et al., 2019). These results will be used to refine the visual summaries.

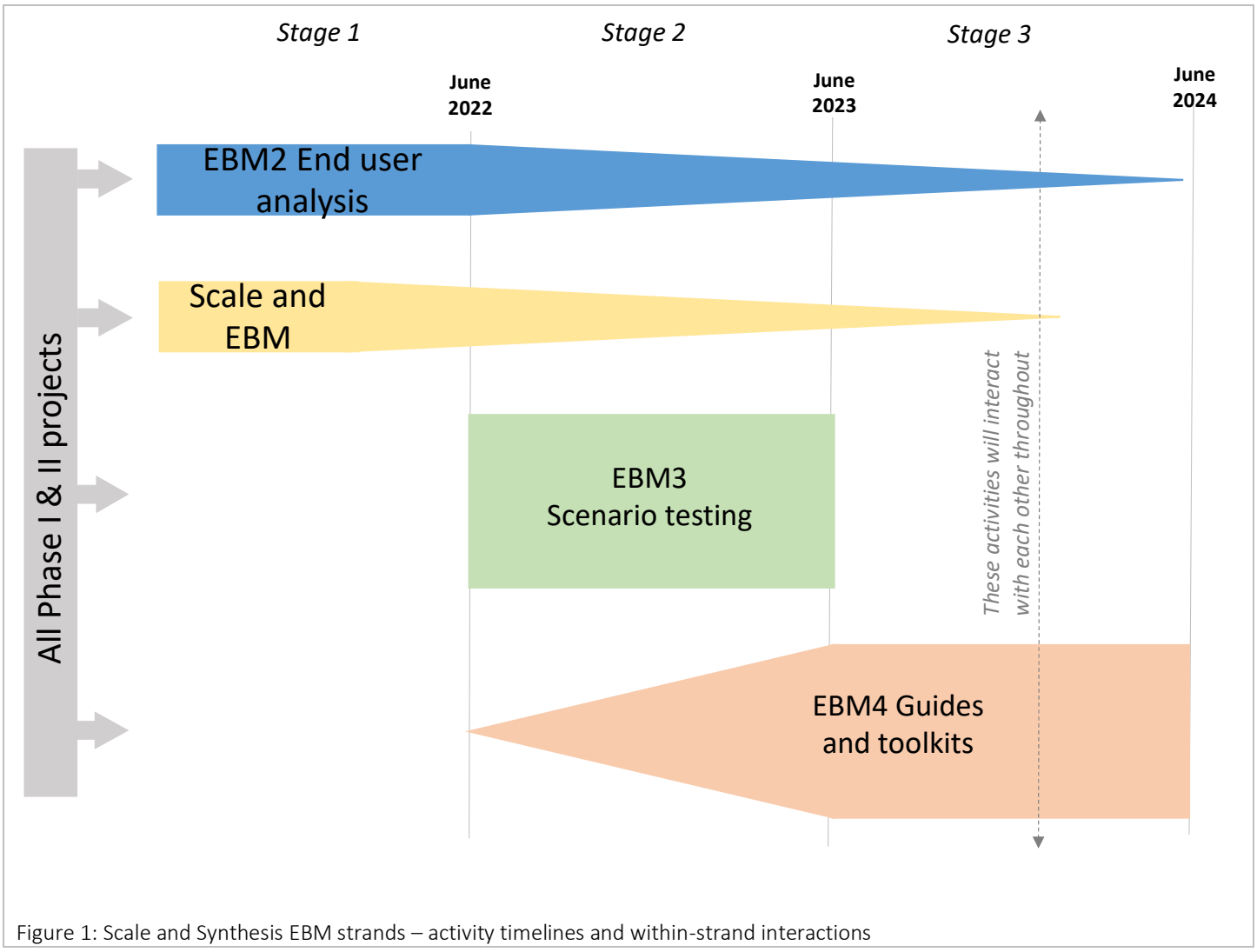

Figure 1: Scale and Synthesis EBM strands – activity timelines and within-strand interactions

L. LINKS TO PHASE I RESEARCH

1.2.2 Navigating marine socio-ecological systems & IF1.3.2 Navigating the implementation impasse: enabling interagency collaboration on cumulative effects – building on best practice guidelines and collaborations formed in cross-institutional and cross-cultural workshops to address decision making issues raised by cumulative effects.
4.2.1 Tipping points in ecosystem structure, function & services – availability of datasets for robust scenario testing of scale in the context of 'tipping points' (e.g. when rapid transformations occur, and an ecosystem loses its capacity to cope with change).
5.1.2 Spatially explicit decision support tools – Lessons learnt using decision support models. Further developments of these tools to assess climate change measures.
5.1.4 Interactive tools for enabling participation and knowledge exchange – Network analyses to inform management decisions affecting the marine environment and the scallop fishery.

M. LINKS TO & INTERDEPENDENCIES WITH PHASE II RESEARCH PROJECTS

The work must be highly integrated with key projects in the challenge to be successful. In particular,
Project 1.1 *Understanding ecological responses to cumulative effects* - ecological footprint analysis; spatial and temporal dynamics of ecological responses to cumulative effects and recovery dynamics of key species, and mātauranga definitions of degradation, recovery and risk.
Project 4.2 *Options for policy and legislative change for EBM at different scales* - local and central government interactions on costal strategies and planning; environmental law and scale thinking.
Project 3.2 *Communicating risk and uncertainty* - the effect of cumulative impacts on risk and uncertainty, national and regional risk assessments.
Project 3.1 *Perceptions of risk and uncertainty*- community and individual understandings on perceptions of risk and uncertainty related to mangrove removal, urban developments and dredge dumping.
Project T1 *Awhi Mai Awhi Atu: Enacting a kaitiakitanga-based approach to EBM* - recovery dynamics and monitoring of key species, mātauranga definitions of degradation, recovery and risk; small-scale management solutions, community restoration activities,

mātauranga - and kaitiaki-driven organisational, spatial and temporal economic strategy scales; iwi organisations and local government interactions.
Project 2.15 *Thinking outside the can: engineering a sustainable future for toheroa aquaculture* - spatial and temporal dynamics of toheroa.
Projects 2.3 *Indigenising a blue economy* and 2.14 *Whakaika te moana* - mātauranga - and kaitiaki-driven economic strategies
Project 2.16 *A novel approach to aquaculture in Aotearoa NZ: Growing community wellbeing with Pātiki totara* - whānau-owned aquaculture farms.
Project 2.2 *Encouraging restorative economies* - scales of measurements for ecosystem services; restorative economy investment.
Project T5 *He Kāinga Taurikura ō Tangitū: Treasured Coastal Environment* - scales of monitoring of key taonga species; cultural assessment frameworks.
Project 1.2 *Tools for incorporating ecological responses to cumulative effects into management action* - national and regional spatial planning.
Project 1.3 *Modelling the social-ecological outcomes of community-based interventions* - community restoration activities, economies and barriers.
Project 3.3 *Co-developing a risk management model for the NZ Pāua Industry* - national and local investment solutions to risk.
Projects 2.4 *Growing eco-tourism* and 2.5 *Building a blue economy sector* - strategy scales for the seaweed and blue tourism sectors.
Project T3 Ngā Tohu o te Ao: Utilising maramataka as a framework for marine management - maramataka knowledge and practices.
Project T2 *Huataukina o hapū e! Prosperous moana; prosperous people* - cultural assessment frameworks.

N. VISION MĀTAURANGA (VM)

This project seeks to contribute to Vision Mātauranga, not only by recording indigenous knowledge/usage of scale concepts but also the intersection (convergences and differences) with other disciplines/knowledge systems. Further, it contributes to Taiao and Hauora/Oranga by identifying barriers to management and actions to recovery by waka/iwi/hapū /marae.
We emphasise that jointly defining the scale required to overcome a particular implementation barrier to realise an outcome for a waka/iwi/ hapū /marae, whether it be spatial and/or temporal, should be a common attribute to the beginning of any research with iwi/ hapū. However, we see understanding each other as a two-way interaction, we also hope to improve Pākeha (western modelling, management strategists and practitioners, politicians, investment agencies and communities) knowledge on "scale" considerations in mātauranga, tikanga and kaitiakitanga.

Vision Mātauranga Deliverables

Partnerships:

VM P1. The proposed co-benefits of this project will be socialised with established Challenge relationships driven by 2.15, 2.16, T3, T5 and 4.3. We anticipate that this project will add value to existing workstreams by providing additional support and expertise in the visualisation of information to strengthen understandings of the outcomes that iwi/hapū are seeking.
VM P2. New relationships will be developed in conjunction with the *Ki uta ki tai* project and, once it is contracted, the *He Kainga Taurikura o Tangitu* projects. These are likely to include Ngāti Whātua, Ngāti Whakahemo, Maungaharuru-Tangitu hapu via Maungaharuru-Tangitu Trust). Through EW we will also draw on the experiences of iwi/hapū partnerships involved in freshwater co-management. Wānanga/workshops with Tangaroa program leaders and Māori researchers in the *Ki uta ki tai* and *Perceptions of risk and uncertainty* projects will provide opportunities to evaluate appropriate communication tools for assessing scale from a mātauranga Māori perspective which can be used in predicting consequences of decisions with, for and by Māori.
VM P3. New relationships will also be developed in collaboration with projects *He Taura Here* and *He Waka Taurua.* Notably, Synthesis strand 3 project *He Taura Here* (TAM1) aims to develop a framework that draws on the findings from across the Challenge to support greater understanding of Māori ways of knowing, thinking, and doing. We will work closely with *He Taura Here* researchers to understand scale dependencies implicit in Maori ways of knowing. We will also work closely with Synthesis strand 3 project *He Waka Taurua* (TAM2) to consider how principles for guiding our relationship with the moana through a Te Ao Māori lens can most appropriately be considered in our visualisations of scale dependencies.
VM P4. We will establish a Māori advisory group to facilitate cross project experiences and learnings including interested iwi and hapū representatives as opportunities arise but specifically Māori researchers from *Wao Atua, Te Ara o Te Ao Turoa* (TAM3), *Awhi Mai Awhi Atu, ki uta ki tai* (T1), Perceptions of risk and uncertainty (3.1) and *He Kāinga Taurikura ō Tangitū* (T5). We will also collaborate with the *Mana Motuhake* (TAM5) strand of the Synthesis program. This will ensure both input from the Māori advisory group as well as pathways for transferring learnings into the Roadmap for Indigenous Marine Governance.

Distinctive Contribution:

VM D1. Early and ongoing co-development processes will be run to ensure the contribution of mātauranga Māori to the selection of examples, design, development and testing of the visual summaries.
VM D2. This project offers the opportunity to leverage the relevant experiences of hapū and iwi engaging in the freshwater co-management space into the marine space, ensuring Ki uta ki tai is more widely understood and easily navigated into the future.

Meaningful Outcomes:
VM M1. Māori researchers within the project (EW, AK) will facilitate the appropriate delivery and dissemination of research outputs on scale within Te Ao Māori to enable this perspective to be better understood and taken up by other Challenge projects.
VM M2: Fit-for-purpose visualisations will be co-developed with hapū/iwi partnerships in aligned Challenge projects to strengthen internal and external communication processes regarding outcomes that require components of scale to be addressed.

O. ENGAGEMENT REQUIRED WITH IWI AND STAKEHOLDERS

At present co-development with iwi has been limited to input from Challenge project leaders and the research team. Similarly, co-development with stakeholders has been limited to representatives from local management and aquaculture.

During S1 (review of present Challenge projects), engagement will spread from project leaders to their Māori co-development partners and team members (whanau, hapū and iwi levels) and their stakeholder partners and end-users. For example, through interactions with the *Ki uta ki tai* project, we will build in links with MfE but extend them past the present freshwater interest (Alice Bradley) to the marine interest (Pierre Tellier *Policy and legislation for EBM* project). The *Ki uta ki tai* project also links us to Ngāti Whātua , Ngāti Whakahemo (Kura Paul-Burke), Auckland Council (Megan Carbines) and MPI (Ian Tuck). The *Policy and legislation for EBM* project will also be highly useful, creating access to DoC (Kris Ramm), FNZ (Jodi Milne) and a range of lawyers through their SAB. The *Spatially Explicit Cumulative Effect Tools* and *Communicating risk and uncertainty* projects allow us to extend access to DoC at a different level (Shane Geange) and MPI (Shelton Harley). Note that we already have Aquaculture NZ as a co-development partner and have also actively engaged with Dr Josie Crawford and Stacey Faire (Bay of Plenty Regional Council) who intends to provide input as a co-development partner later in the process.

We will be particularly interested in end-user thoughts and needs but will work through the projects in order not to upset present arrangements and compromise project deliveries. During this work it is likely that extra needs for S2 analyses will be identified.

From this extended group we will elicit names of people that represent different interests to form an stakeholder advisory board that will be used to select extra topics (beyond those developed in S2) for the visual summaries (S3), and to help set up tests for the summaries.

P. PROJECT COMMUNICATIONS

Communication is integral to this project. Although the communications section has been split between the work streams, please note that these work sections are not completely sequential, but will overlap, allowing iteration and ongoing interaction between them.

For S1, we will institute regular (3 monthly) updates to be fed back to projects through their leaders. When S2 is underway, this will be extended to the hopefully growing list of interested project team members and stakeholders, both via the project and through the Sustainable Seas normal communication channels. A simple set of survey questions will be developed that allow people to suggest new topics or register approval.

For S3, specialised communication experts will be engaged (e.g., Indigenous Design and innovation Aotearoa). The Sustainable Seas Communication team will form a vital link between the project and these experts. For example, Desna Whaanga-Schollum will select the firm to be used for Māori communications and provide some guidance to the project team on types of communications and specifications required.

During the course of the project, also through the Sustainable Seas Communications team, we will be weaving our understandings and products with those produced as part of any synthesis projects (most of which are still to be developed).

Q. RISK & MITIGATION

There is some risk to this project as it does require considerable stretch in the research and development of scaling rules and in communications of the differences and similarities in “scale” concepts and issues between different Western Science disciplines (ecology, modelling, statistics, psychology, economics, human geography, management) and cultures. We have assembled a team who are used to working across disciplines and cultures, have some understanding of differences in what “scale” means and are open to different views. In particular, our Māori researchers and co-development partners have experience of working across a range of whanau, hapu and iwi and can appreciate differences across and within these.

R. CONSENTS & APPROVAL required to undertake research	• Most of the research does not require ethics approval. Stakeholder workshops and hui that do require ethics approval will be held in conjunction with other projects who will already be gaining that approval (e.g., experimental scenario-based and framing-based studies).

S. REFERENCES

Adger, W. et al. 2005. Social-ecological resilience to coastal disasters. Science, 309: 1036–1039.

Buizer, M., Arts, B., Kok, K. 2010. Governance, Scale and the Environment: The Importance of Recognizing Knowledge Claims in Transdisciplinary Arenas. Ecology and Society.

Cosens, B., Craig, R., Hirsch, S. et al. 2017. The role of law in adaptive governance. Ecology and Society, 22(1):30. https://doi.org/10.5751/ES-08731-220130

Clapcott, J. et al. 2018. Mātauranga Māori: shaping marine and freshwater futures. New Zealand Journal of Marine and Freshwater Research, DOI: https://doi.org/10.1080/00288330.2018.1539404

Cowie, L., Greaves, L., Milfont, T, Houkamau, C. Sibley, C. 2016. Indigenous identify and environmental values: Do spirituality and political consciousness predict environmental regard among Māori? International Perspectives in Psychology, 5: 228-244.

Ellis, J., Schneider, D. 2008. Spatial scaling in benthic ecology. Journal of Experimental Marine Biology and Ecology, 366: 92-98.

Hikuroa, D. 2017. Mātauranga Māori–the ūkaipō of knowledge in New Zealand. Journal of the Royal Society of New Zealand. 47(1):5–10. DOI: 10.1080/03036758.2016.1252407

Liberman, N., Trope, Y. 2008. The psychology of transcending the here and now. Science, DOI: 10.1126/science.1161958

Levin, S. 1992. The problem of pattern and scale in ecology. Ecology, 73: 1943–1967.

Hutton, M., Leader-Williams, N. 2003. Sustainable use and incentive-driven conservation: Realigning human conservation interests. Oryx, 37: 215.

O'Neill, R., DeAngelis, D.,Waide, J., Allen, T. 1986. A hierarchical concept of ecosystems. Princeton University Press, Princeton, NJ.

Mercier, R.O., Stevens, N., Tia, A. 2011. Mātauranga Māori and the Data-Information-Knowledge–Wisdom Hierarchy: A conversation on interfacing knowledge systems. Mai Journal, 1: 103–116.

Macpherson, E. et al., 2021. Hooks' and 'Anchors' for relational ecosystem-based marine management 2021. Marine Policy, 130 (6352): 104561 DOI: 10.1016/j.marpol.2021.104561

McCormack, F. 2021. Interdependent kin in Māori marine environments. Oceania, 91: 197-215

Milfont, T. L. 2010. Global warming, climate change and human psychology. In V. Corral- Verdugo, C. H. García-Cadena, and M. Frías-Arment (Eds.). Psychological approaches to sustainability: Current trends in theory, research and practice. New York: Nova Science Publishers.

Ngāi Tahu ki Murihiku. (2008) Ngāi Tahu ki Murihiku Natural Resource and Environmental Iwi Management Plan: Te Tangi a Tauira. Invercargill: Te Ao Marama Inc.

Pascual, M., Guichard, F. 2005. Criticality and disturbance in spatial ecological systems. Trends Ecology and Evolution, 20 (2): 88–95.

Pielou, E. 1977. Mathematical ecology. Wiley, New York.

PCE, 2020. Managing our estuaries. Parliamentary Commissioner for the Environment Estuary Report.

Rosenberg, A., McLeod, K. 2005. Implementing ecosystem-based approaches to management for the conservation of ecosystem services. Marine Ecology Progress Series, 300: 241–296

Ruckelshaus, M., Klinger, T., Knowlton, N., Demaster, D. 2008. Ecosystem-based Management in Practice: Scientific and Governance Challenges. BioScience, 58 (1).

Schultz, P., Milfont, T., et al. 2012. Cross cultural evidence for spatial bias in beliefs about the severity of environmental problems. Environment and Behaviour, DOI: https://doi.org/10.1177/0013916512458579

Sissenwine, M., Mace, P. 2003. Governance for Responsible Fisheries: An Ecosystem Approach. Rome, CABI.

Schneider, D. 2001. The rise of the concept of scale in ecology. Bioscience, 51 (7): 545–553.

Te Rūnanga o Ngāi Tahu 2003. Ki Uta ki Tai - Mountains to the Sea Natural Resource Management: A scoping document for developing Mountains to the Sea Natural Resource Management Tools for Ngāi Tahu.

Thomas, A., Milfont, T., Gavin, M. 2020. Scenario-based analyses evaluate potential outcomes of proposed regulatory changes in recreational fishery. ICES Journal of Marine Science, 77: 2333-2343. DOI: https://doi.org/10.1093/icesjms/fsz141

Thrush, S., Hewitt, J., Herman, P., Ysebaert, T. 2005. Multi-scale analysis of species environment relationships. Marine Ecology Progress Series, 302: 13–26.

Tipa, G.T. 2013. Bringing the past into our future-using historic data to inform contemporary freshwater management. Kotuitui: New Zealand Journal of Social Sciences, 8: 40-63

Tipa, G.T., Williams, E.K., van Schravendijk-Goodman, C., Nelson, K., Dalton, W., Home, M., Williamson, B., Quinn, J. 2017. The power of integration – Using environmental report cards to monitor and evaluate implementation of the provisions of iwi plans, including restoration plans. Journal of NZ Marine and Freshwater Research (Special Issue), 51: 21-43.

van de Koppel, J., Altieri, A., Silliman, B., Bruno, J., Bertness, M. 2006. Scale-dependent interactions and community structure on cobble beaches. Ecology Letters, 9 (1): 45–50.

van Wesenbeeck, B., van de Koppel, J., Herman, P., Bouma, T. 2008. Does scale dependent feedback explain spatial complexity in salt-marsh ecosystems? Oikos, 117 (1): 152–159.

Vinnell, L., Milfont, T., McClure, J. 2019. Do social norms affect support for earthquake-strengthening legislation? Comparing the effects of descriptive and injunctive norms. Environment and Behavior, 51: 376-400. DOI: https://doi.org/10.1177/0013916517752435

Walker, D., Hughey, K.F.D., Ataria, J.M. 2021. An Atua framework: Enabling community-engaged, culturally-based environmental monitoring.

Wiens, J. 1989. Spatial scaling in ecology. Functional Ecology, 3: 385–397.