National SCIENCE Challenges

SUSTAINABLE SEAS

Ko ngā moana whakauka

Healthy Seas

Conrad Pilditch

Theme Leader-*Degradation & Recovery*

Introduction

Land



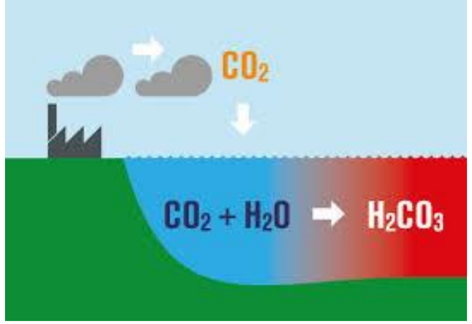


Sea

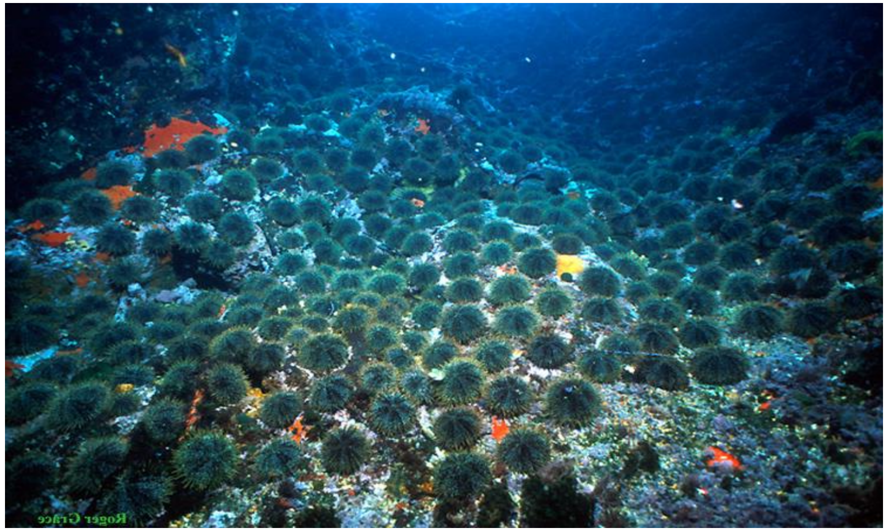




Global

Introduction



Speakers

- **Megan Ranapia** T1 Awhi Mai Awhi Atu
- **Rebecca Gladstone-Gallagher** 1.1 Ecological responses to CE
- **Simon Thrush** 1.1 Ecological responses to CE
- **Joanne Ellis** 3.2 Communicating risk & uncertainty
- **Tom Brough** 1.2 Spatial tools for CE management

Moana degradation and recovery from a hapū/ iwi perspective

Presented by Megan Ranapia

Iwi/ tribal affiliations: Ngāti Awa and Waikato-Tainui

Supervisors: Assoc. Prof. Kura Paul-Burke, Prof. Conrad Pilditch, Dr. Richard Bulmer, Prof. Shaun Ogilvie

Iwi advisors: Wallace Aramoana, Trevor Ransfield, Charlie Bluett, Tuwhakairiora O’Brien

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Ko ngā moana whakauka

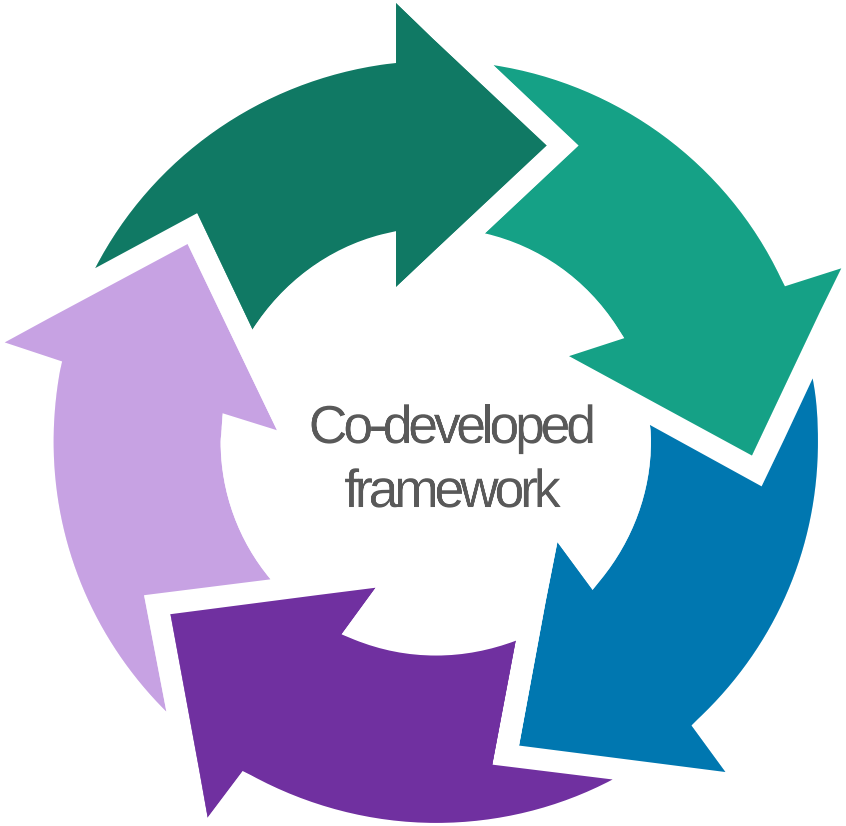
Overview

Working towards a healthy moana through co-development with iwi partners.

Case study: Starfish outbreak in Ōhiwa Harbour.

Co-developing with iwi partners towards a healthy Moana.

Stage 1	ID and engage relevant stakeholders
Stage 2	Research questions
Stage 3	Implementation
Stage 4	Dissemination
Stage 5	Co-creation of new knowledge



Te Awe Kōtuku (1991) kaupapa Māori principles

Co-developing with iwi partners towards a healthy Moana

Stage 1 — ID and engage relevant stakeholders

Stage 2 — Research questions

Stage 3 — Implementation

Stage 4 — Dissemination

Stage 5 — Co-creation of new knowledge

Co-developing with iwi partners towards a healthy Moana

Stage 1	ID and engage relevant stakeholders
Stage 2	Research questions
Stage 3	Implementation
Stage 4	Dissemination
Stage 5	Co-creation of new knowledge

1) **Why are there so many seastars?**

2) **How do we best manage seastars to encourage recovery of the mussel beds?**

Co-developing with iwi partners towards a healthy Moana

Stage 1 – ID and engage relevant stakeholders

Stage 2 – Research questions

Stage 3 – Implementation

Stage 4 – Dissemination

Stage 5 – Co-creation of new knowledge

Image of eleven armed starfish in Ōhiwa Harbour (2019), sourced from MUSA Environmental

Co-developing with iwi partners towards a healthy Moana

Stage 1 — ID and engage relevant stakeholders

Stage 2 — Research questions

Stage 3 — Implementation

Stage 4 — Dissemination

Stage 5 — Co-creation of new knowledge

Co-developing with iwi partners towards a healthy Moana

Stage 1 — ID and engage relevant stakeholders

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Co-developing with iwi partners towards a healthy Moana

Stage 1 — ID and engage relevant stakeholders

Stage 2 — Research questions

Stage 3 — Implementation

Stage 4 — Dissemination

Stage 5 — Co-creation of new knowledge

1) Is it feasible to remove seastars and if so, which removal strategy works best?

2) Would removing seastars improve mussel recovery?

3) Are there potential ‘refuge sites’ for mussels from seastar predation?

Co-developing with iwi partners towards a healthy Moana

Stage 1	ID and engage relevant stakeholders
Stage 2	Research questions
Stage 3	Implementation
Stage 4	Dissemination
Stage 5	Co-creation of new knowledge

Co-developing with iwi partners towards a healthy Moana

Stage 1 — ID and engage relevant stakeholders

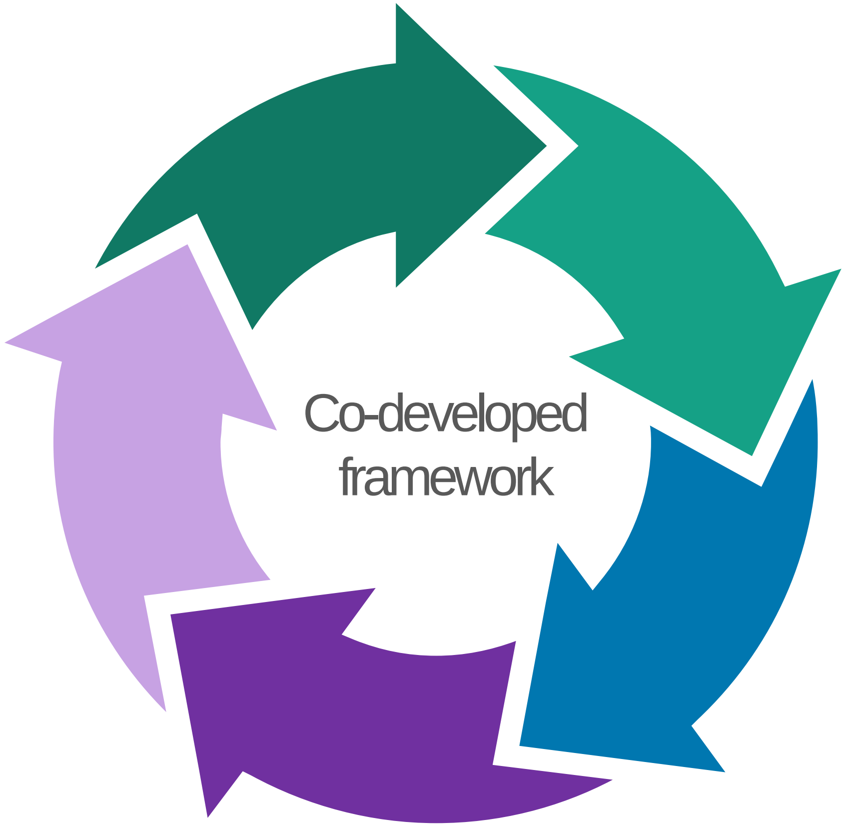
Stage 2 — Research questions

Stage 3 — Implementation

Stage 4 — Dissemination

Stage 5 — Co-creation of new knowledge

Report findings back to our rōpū kairangahau and collectively work on recommendations for seastar management for Ōhiwa Harbour.



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Ko ngā moana whakauka

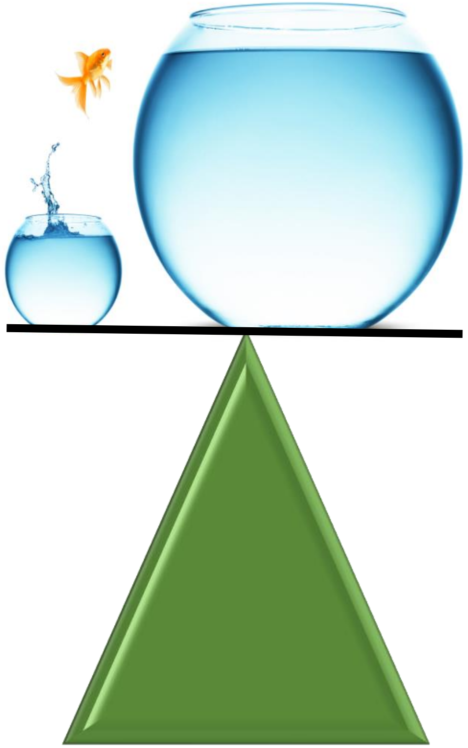
The nature of change in coastal ecosystems

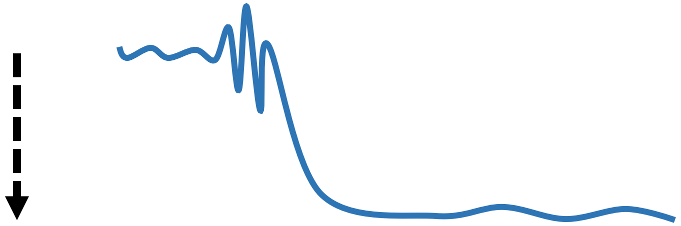
Rebecca Gladstone-Gallagher

University of Auckland

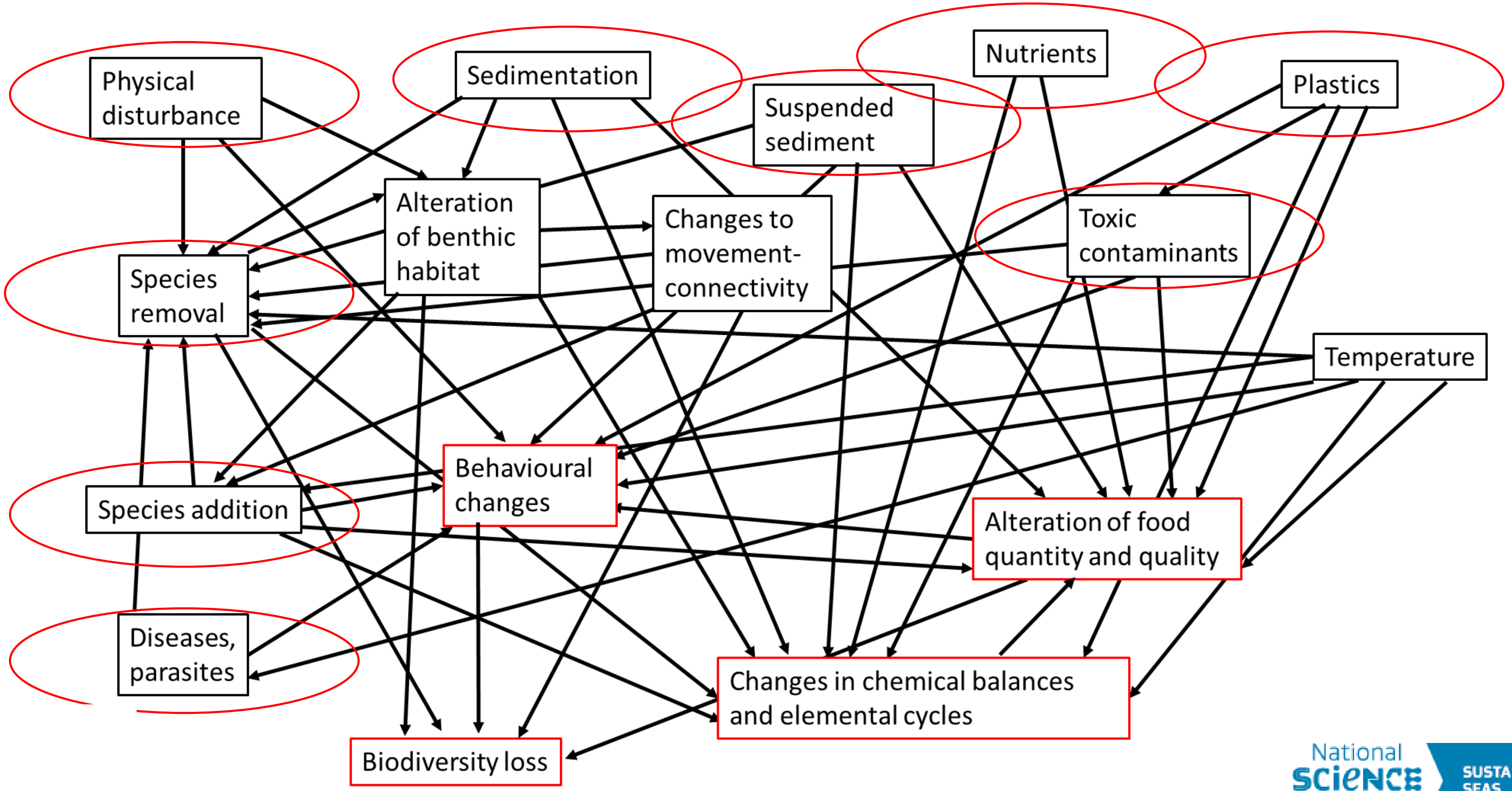
Researcher in Project 1.1 – cumulative effects and Project 3.2 – risk and uncertainty

Cumulative effects & tipping points

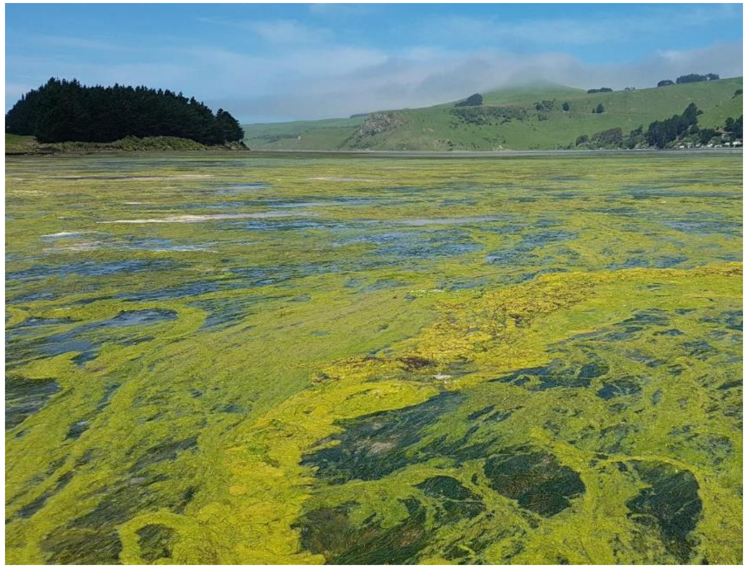




Multiple stressors and multiple effects

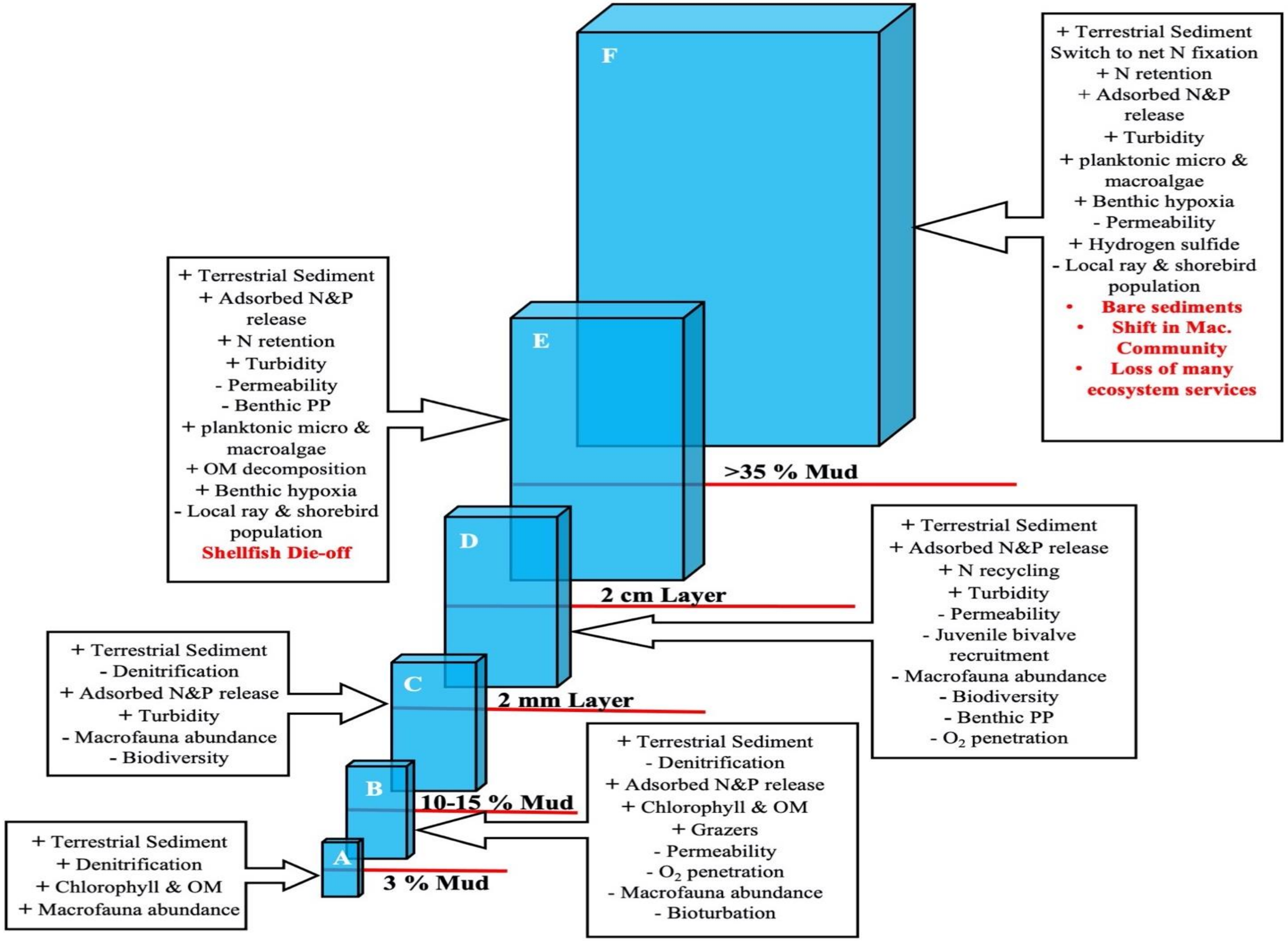


Land-based pollutants



Photos: Simon Thrush, Candida Savage and Drew Lohrer

Tipping points cascade

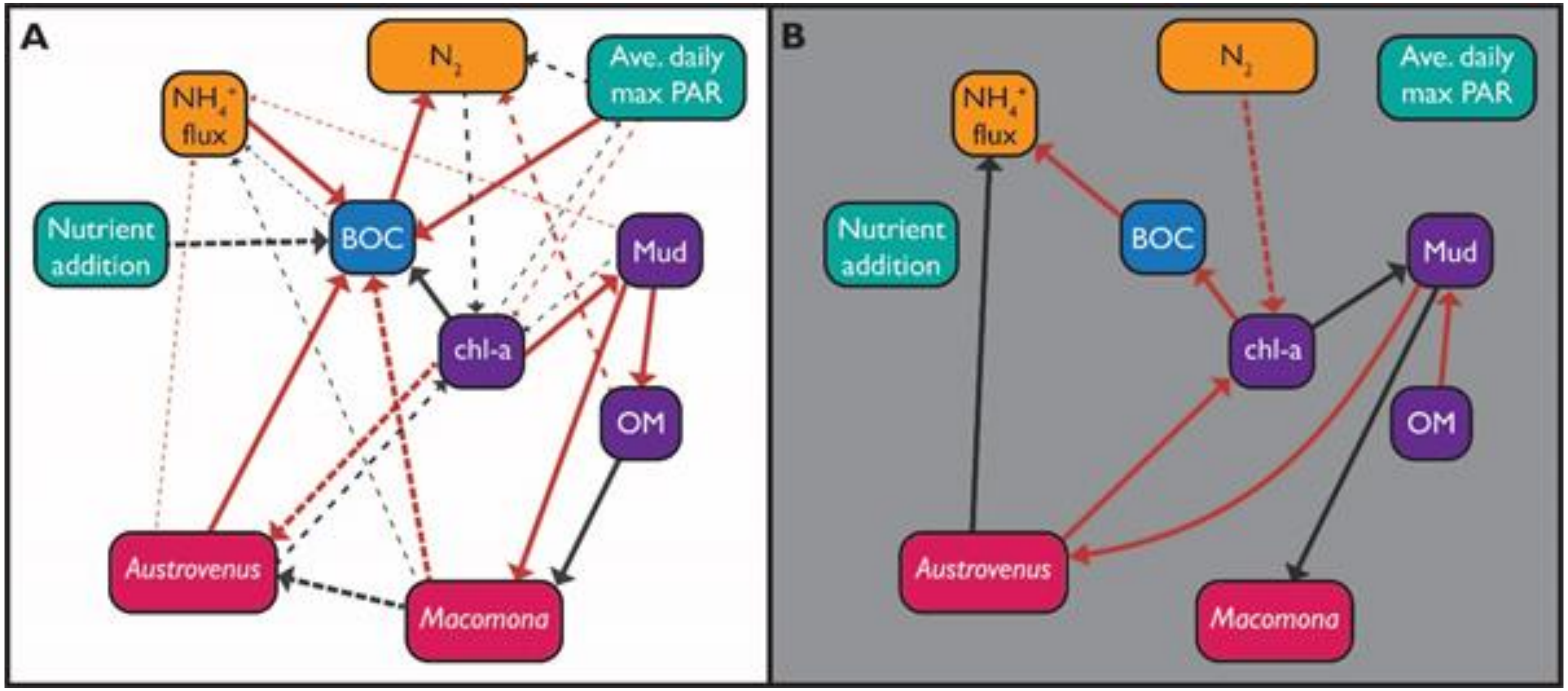


(Amanda Vieillard 2020, UoA PhD)

Ko ngā moana whakauka

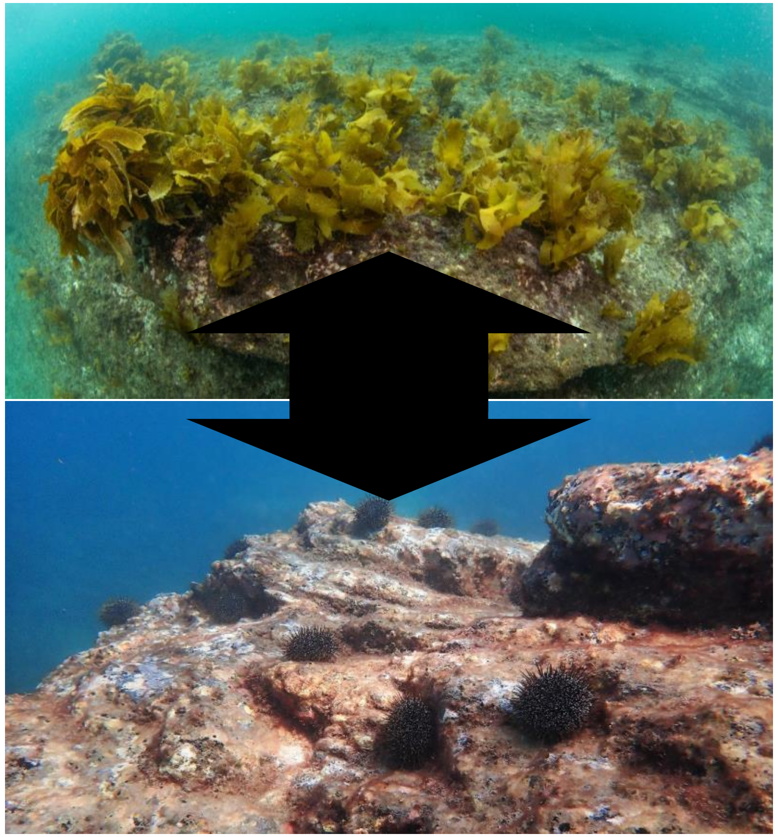
Stressor interactions – interaction networks

Clear estuaries | Turbid estuaries



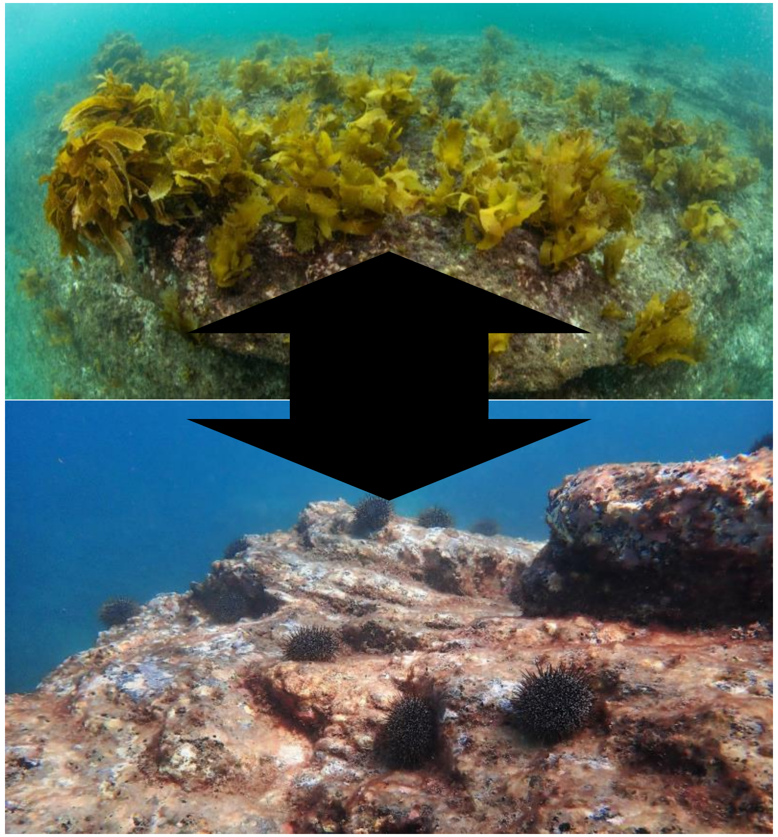
Thrush et al (2021); Ecological Applications

Stressors that remove structure or biomass from the food web



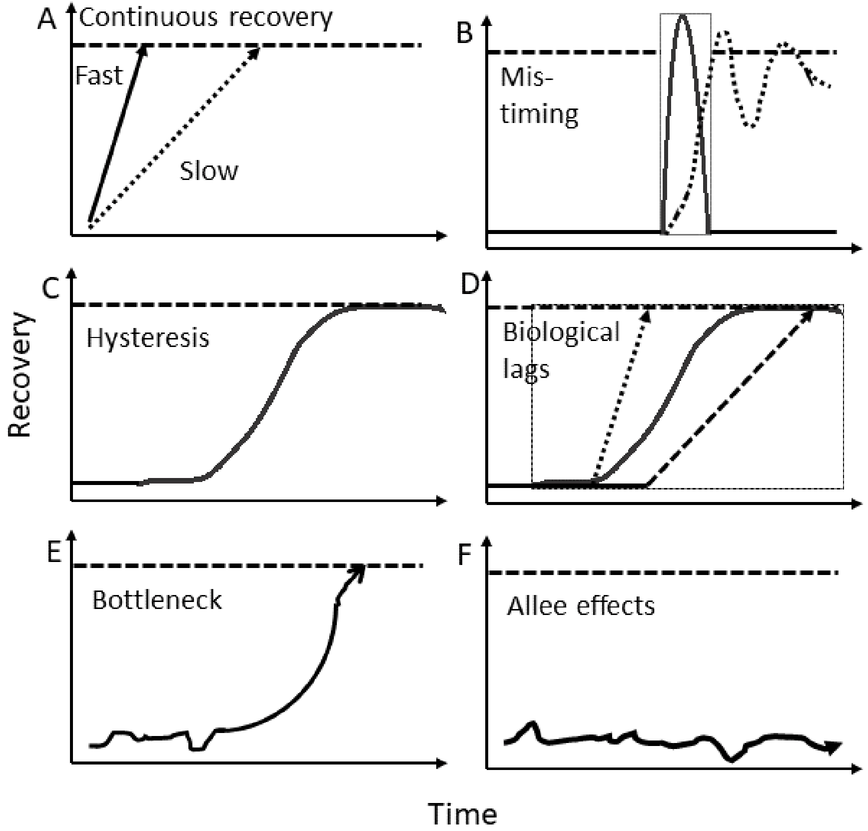
Hewitt et al. 2022; Frontiers in Ecology and Evolution

Feedbacks and recovery lags



Context dependent shifts in kelp ecosystems

Sediment legacies in estuaries



Hewitt et al. 2022; Frontiers in Ecology and Evolution

Different things happen in different places…

Ecological knowledge and opportunity for EBM policy and practice

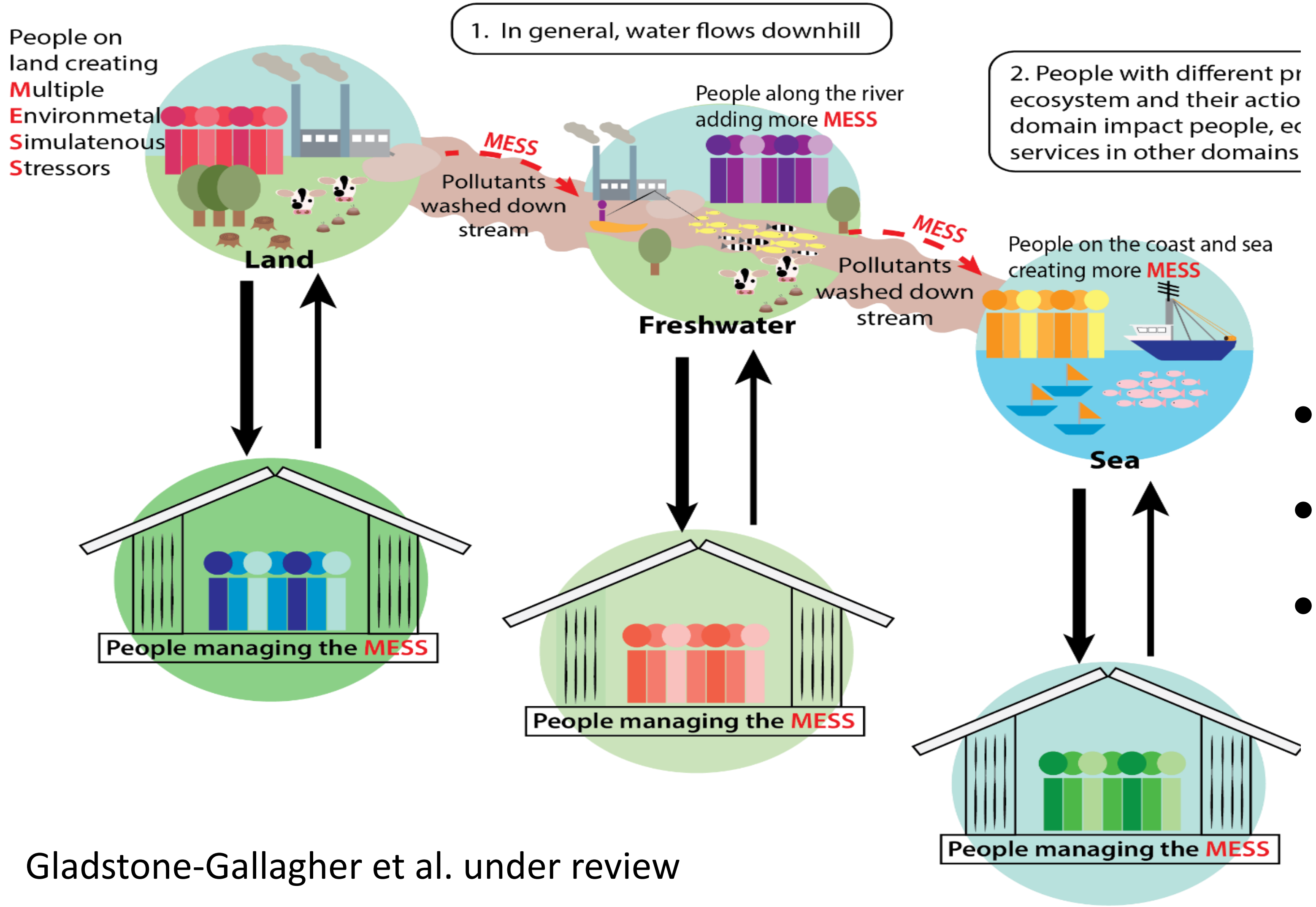
Simon Thrush

Co-leader of Project 1.1 (with Kura Paul-Burke) – Cumulative Effects

&

Director Institute of Marine Science, University of Auckland

Why we worry about the ecology and how this can help with cut through



- Valuing nature
- A shift to a restorative focus
- Democratizing the science

Gladstone-Gallagher et al. under review

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Ecological knowledge does not work in a vacuum

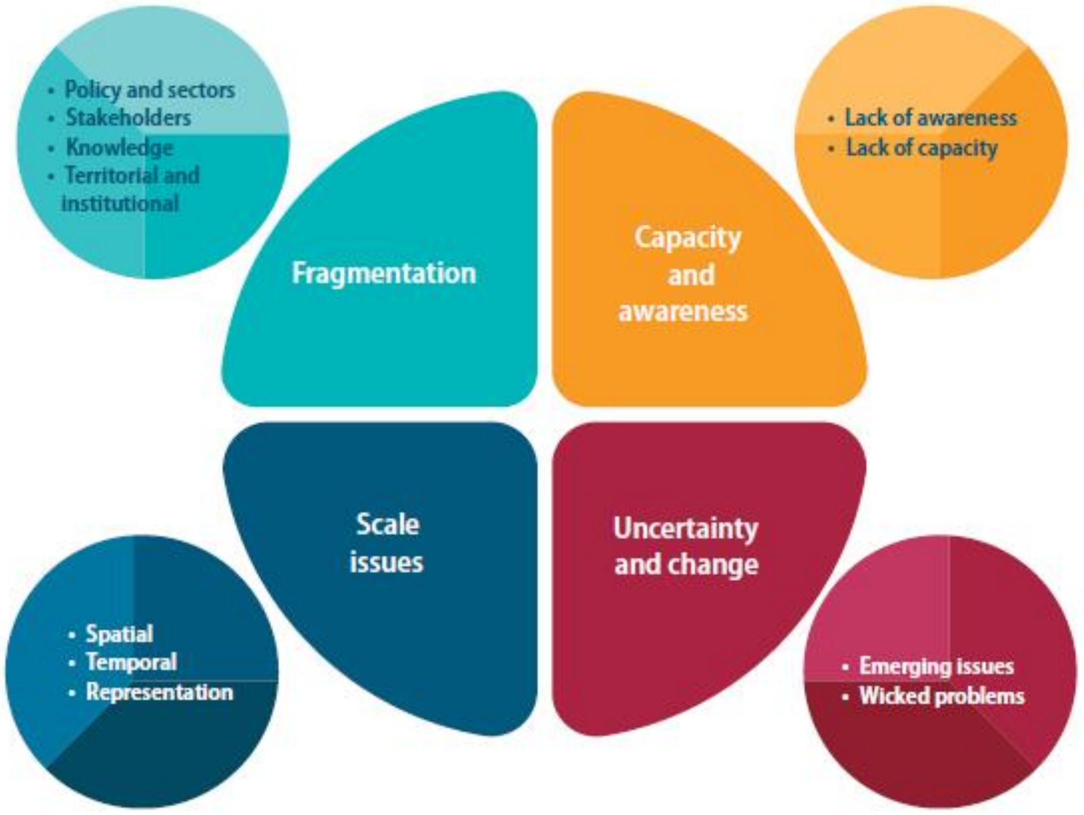


Figure 3.5
Overview of common challenges for ocean governance

UNESCO-IOC/European Commission. 2021

Linking ecological knowledge to opportunity

- Tipping points
- Context dependency
- Ecological networks
- Feedback loops
- Recovery lags
- Multi-scale interactions

SCIENCE →

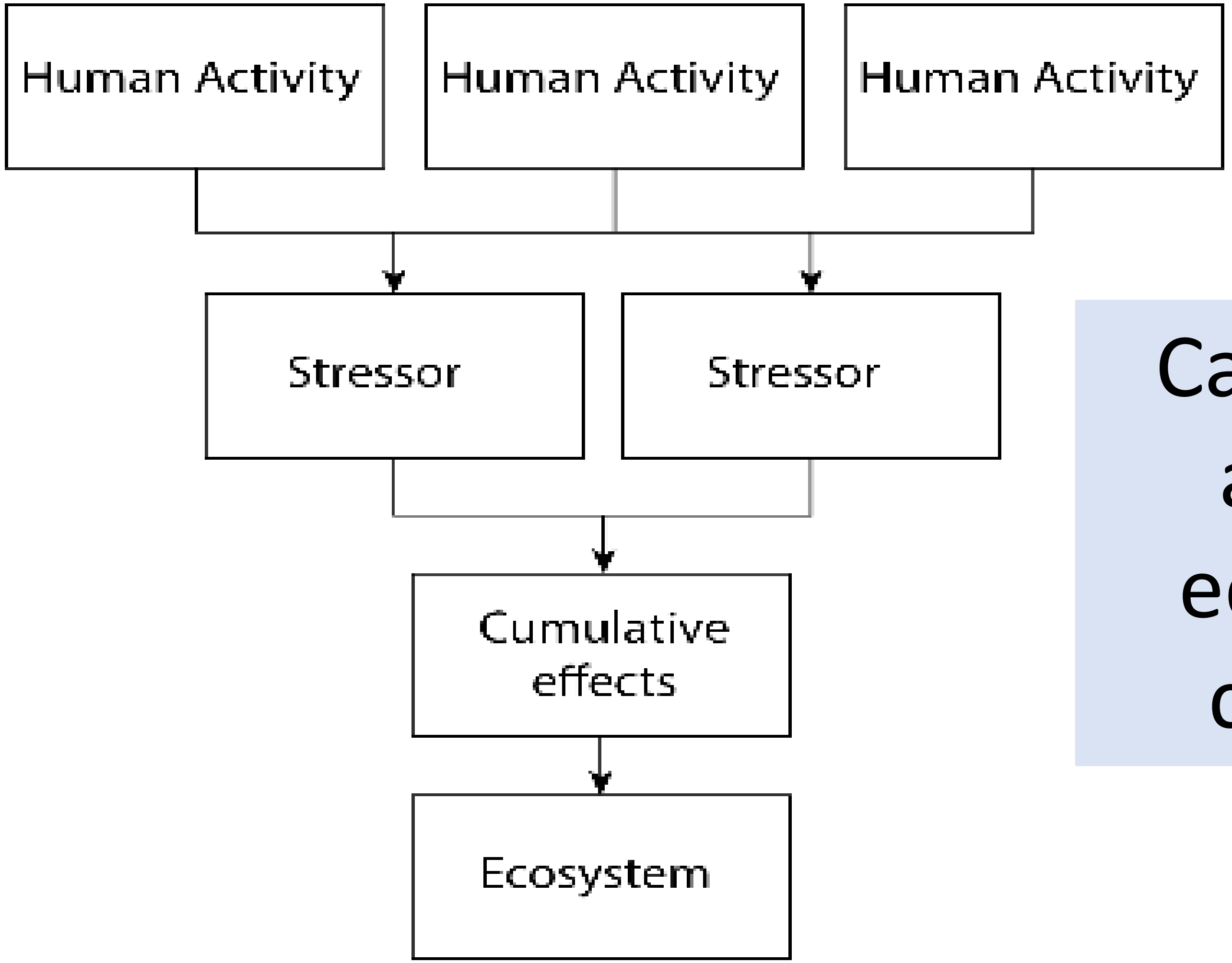
EBM

← IMPACT

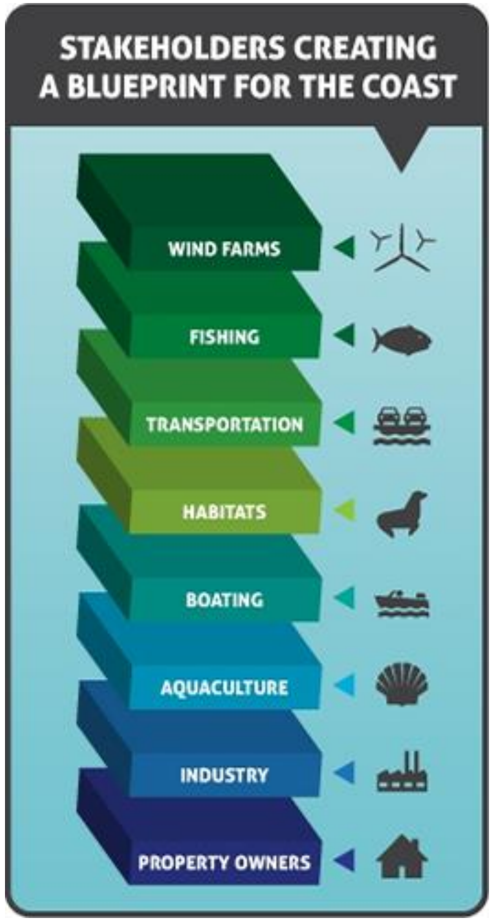
- Shifting from BUA and its path dependency
- Inclusive and forward-looking policy development
- Relevance to response
- Community engagement
- Alignment with Mātauranga and Kaitiakitanga
- Management Actions
- Blue Economies

Stress focus to response focus - MSP

Low et al. submitted



Capacity to address ecological change?



woodsholegroup

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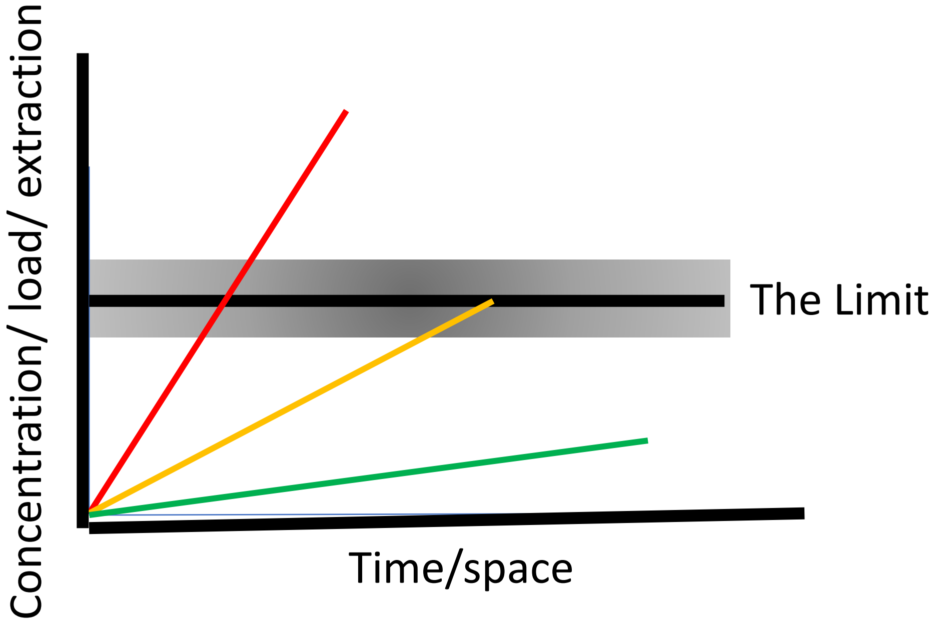
Setting limits ≠ Avoiding risk

- We need to move to managing cumulative effects through knowledge of ecosystem processes
- National guidelines are insensitive to cumulative effects
- One size fits all measures are unlikely to protect against tipping points
- Meaningful action is desperately need to advance integrative management.
- The windows of opportunity to effect change and maintaining critical ecosystem services are closing.



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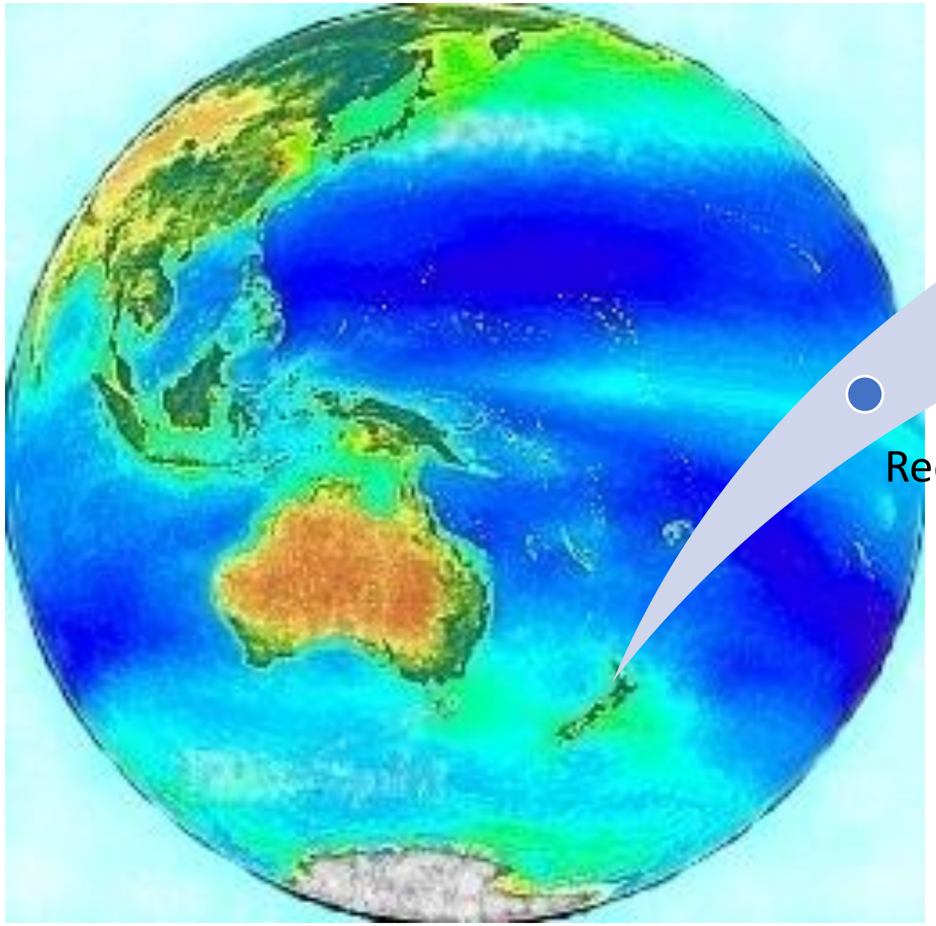
A future focus

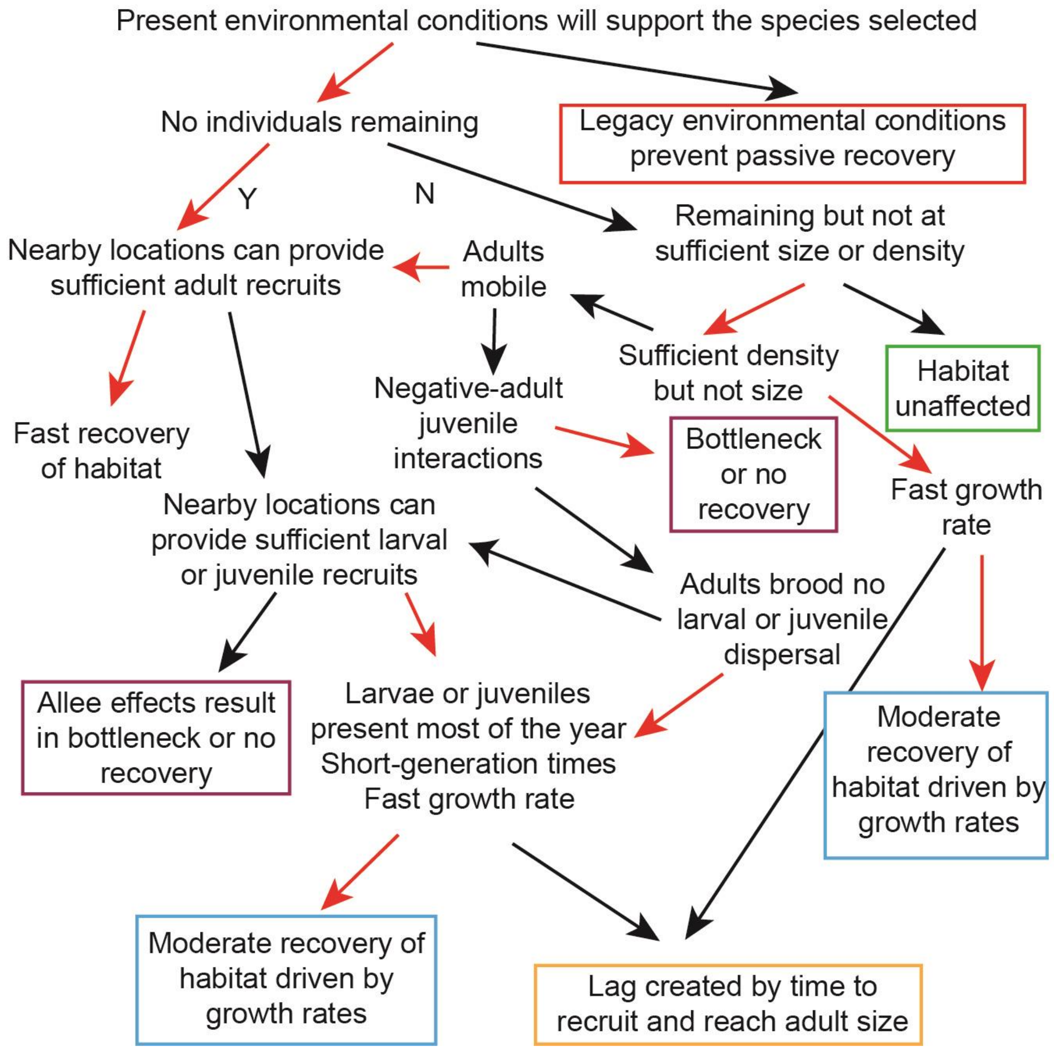


Reducing threats

Restoration

Turning the tide of biodiversity loss
Response to climate change
Pathways to ecological sustainability

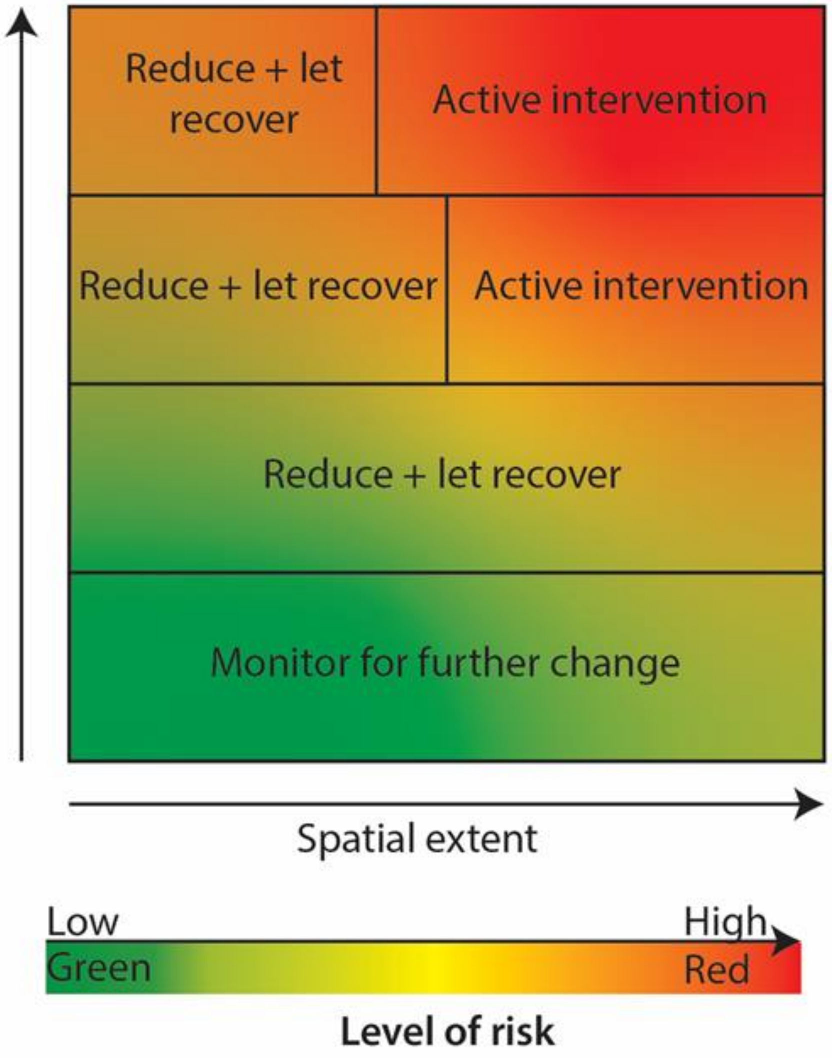
Making decisions on options and opportunities to recover seafloor species and habitats



Hewitt et al in press. Frontiers in Ecology and the Environment

Managing for ecosystem resilience and recovery

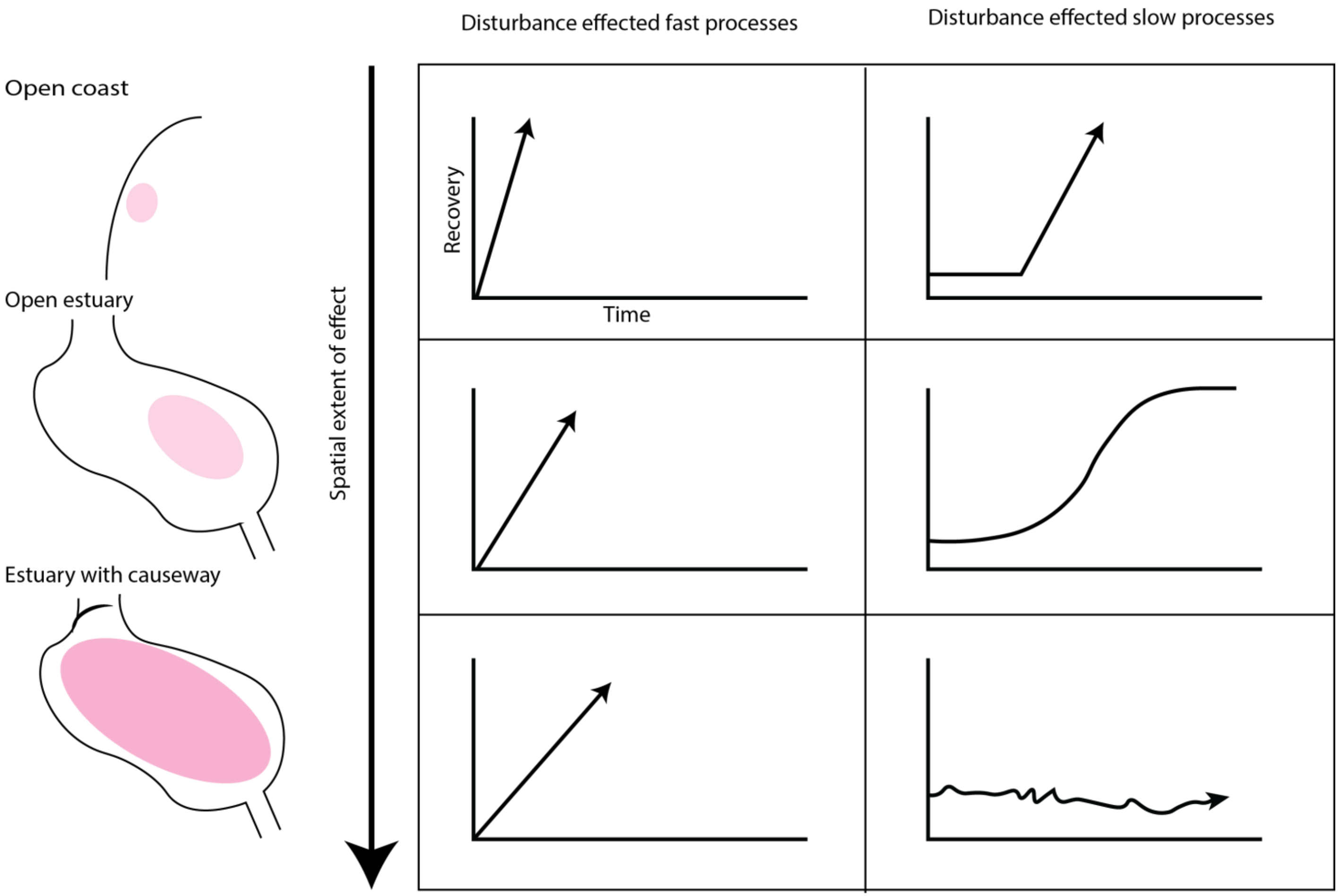
Time scale of ecosystem response and/or duration of stressor



Low, Gladstone-Gallagher et al. in prep

Ecological footprints and recovery time scales

How does the ecosystem recover when the stressor tap is turned off?



Gladstone-Gallagher, Low et al. in prep

Multiple roles for empirical ecology

- Examination with networks is possible but its essential its informed by an understanding of multiple processes
- As cumulative effects inhabit a world of indirect effects and the propagation of effects across networks – long-term observation of natural ecosystems is critical
- Real world examples help to build understanding, reduce uncertainty and focus management actions

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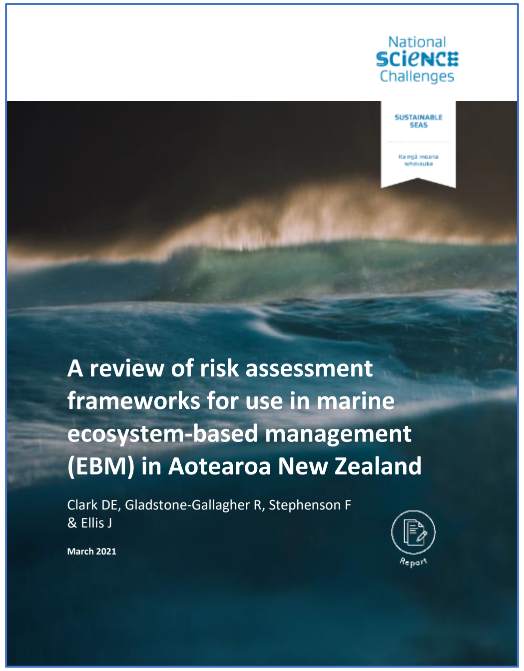
Linking consequences of cumulative effects into risk frameworks

Joanne Ellis

Theme leader:	Judi Hewitt
Program coleader:	Fabrice Stephenson
Team Members:	Maria Armoudian
	Rich Bulmer
	Dana Clark
	Rebecca Gladstone-Gallagher
	Vera Rullens
	Ilze Ziedins

Marine ecosystem risk assessments

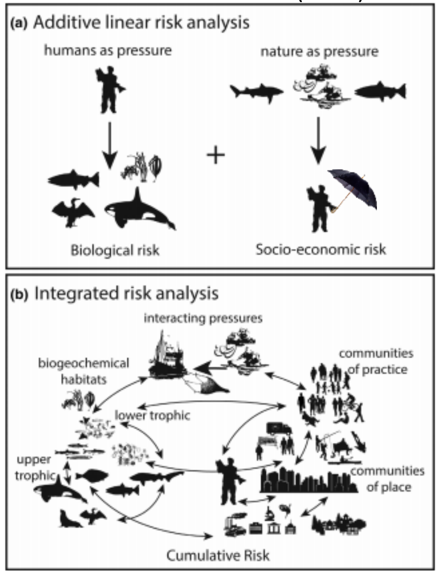
- Generalised Likelihood-Consequence (GLC)
- Ecological Risk Assessment for the Effects of Fishing (ERAEF)
  - Level 1 - Scale Intensity Consequence Analysis (SICA)
  - Level 2 - Productivity-Susceptibility Analysis (PSA)
  - Level 3 - Sustainability Assessment for Fishing Effects (SAFE)
  - Residual Risk Analysis (RRA)
- Management Strategy Evaluation (MSE)
- Spatially Explicit Fisheries Risk Assessment (SEFRA)
- Bayesian Network (BN)



Risk assessments for EBM

- Multiple ecosystem components
- Social, cultural and economic values
- Interactions
- Feedbacks
- Indirect effects

From Holsman et al. (2016)



- Threshold responses
- Spatial outputs
- Recovery
- Different knowledge types
- Estimates of uncertainty

Received: 11 July 2021 | Revised: 26 November 2021 | Accepted: 17 January 2022
DOI: 10.1111/csp2.12636

PERSPECTIVE

Conservation Science and Practice WILEY

Risk assessment for marine ecosystem-based management (EBM)

Dana E. Clark[1] | Rebecca V. Gladstone-Gallagher[2] | Judi E. Hewitt[3,4] | Fabrice Stephenson[4] | Joanne I. Ellis[5]

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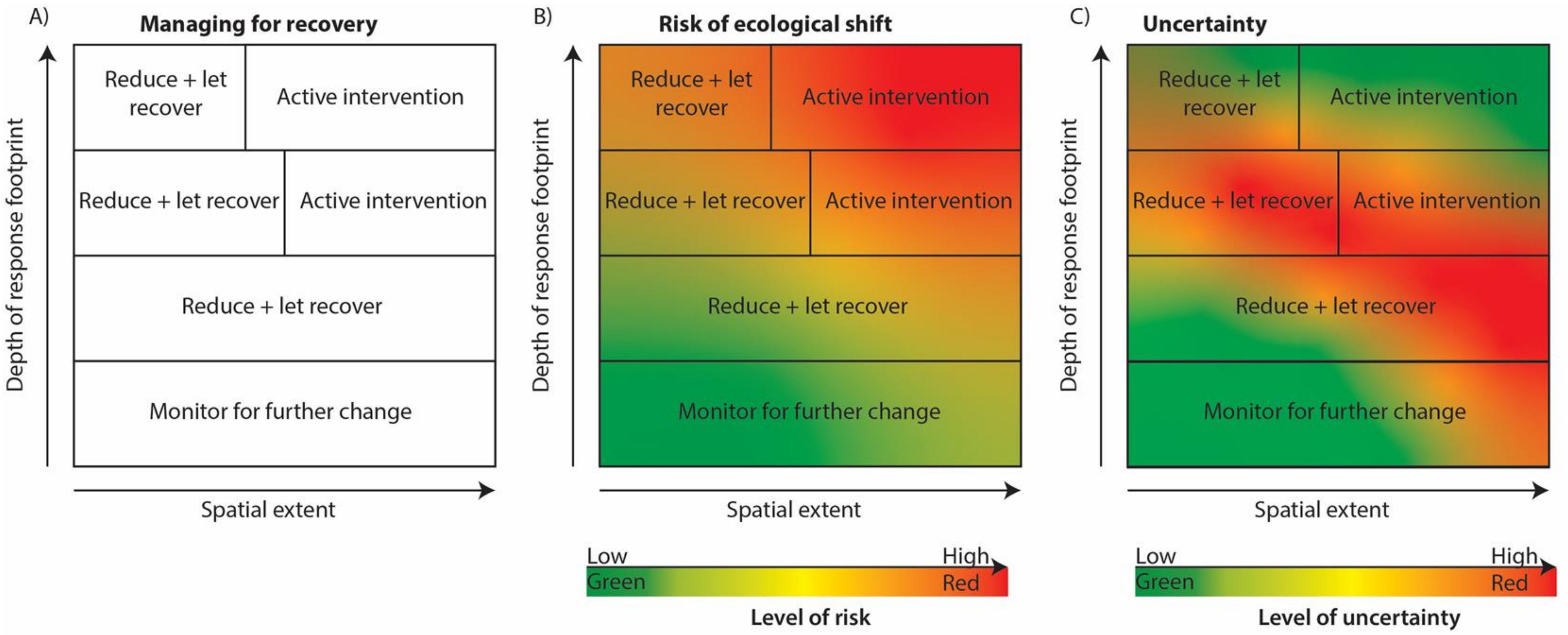
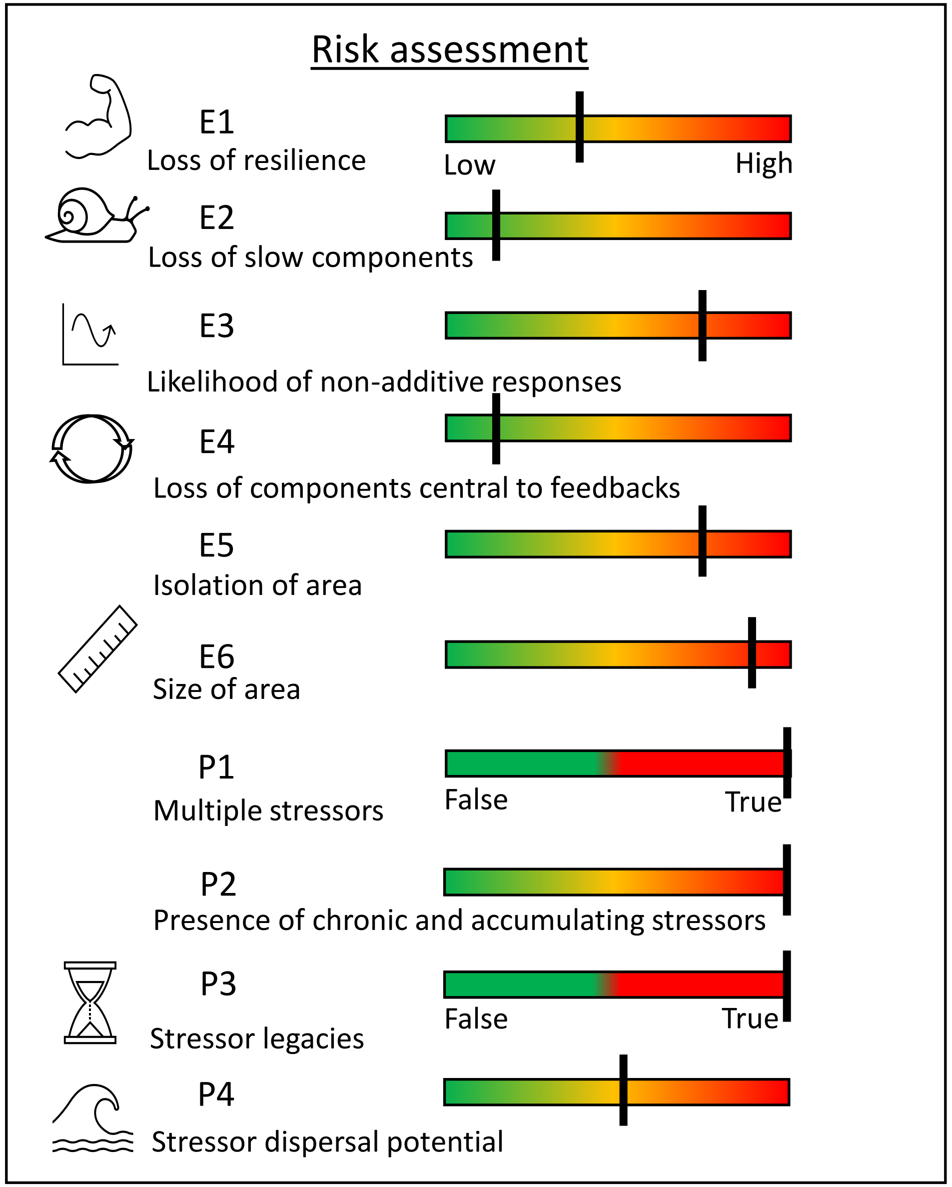
Managing for ecosystem resilience and recovery

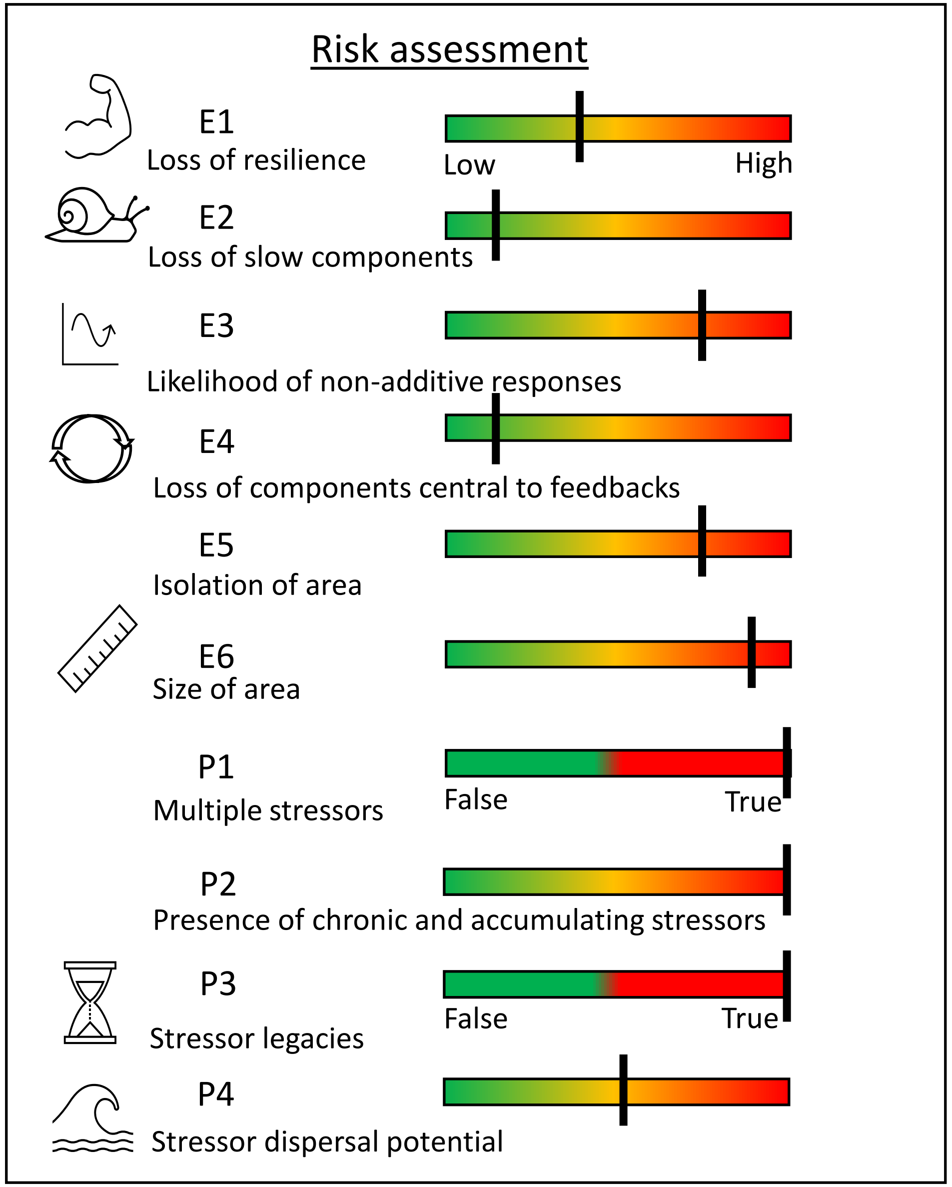


Low, Gladstone-Gallagher et al. in prep

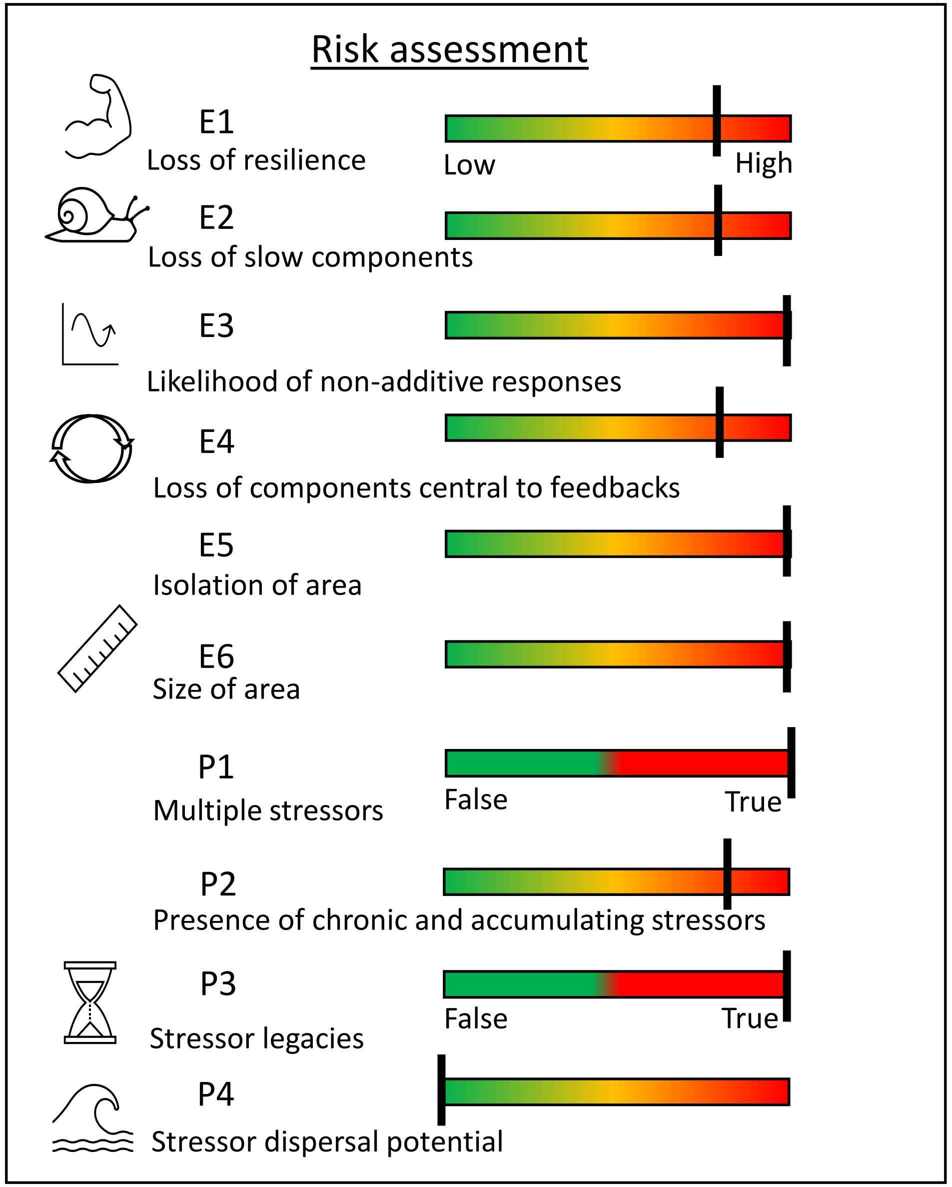


Gladstone-Gallagher et al. in prep

Scenario A: there is increasing cumulative impacts in Whangateau estuary where cockles and Macomona are the dominant structuring organism. The estuary is beginning to experience increasing sedimentation and nutrient from changes in surrounding catchment. Losses in shellfish species and build up of legacy sediments have not occurred yet, but these stressors in other places are known to leave legacies

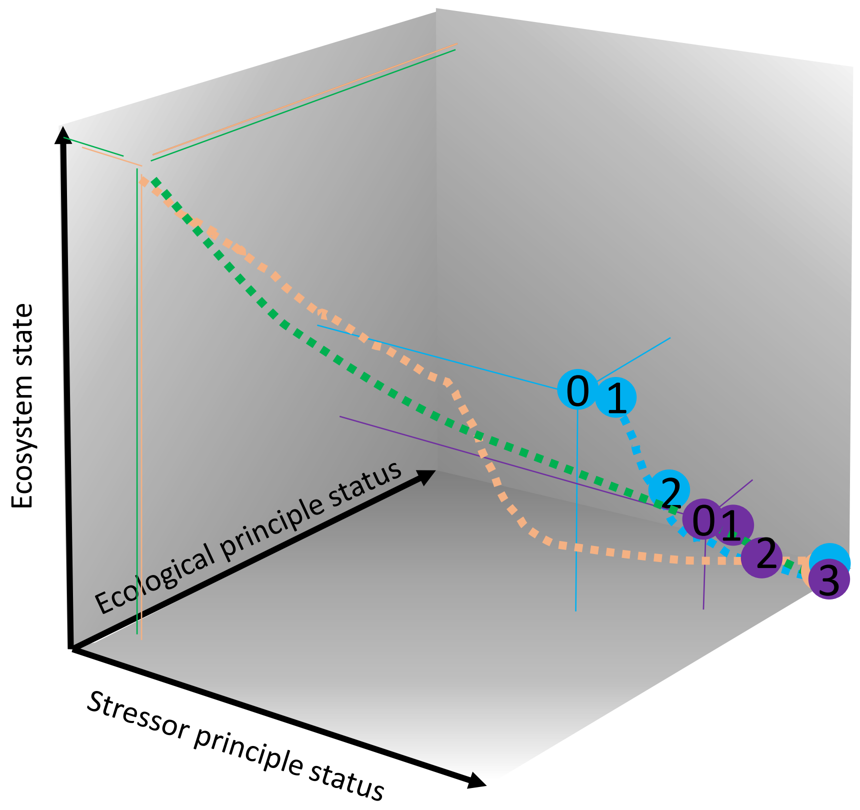


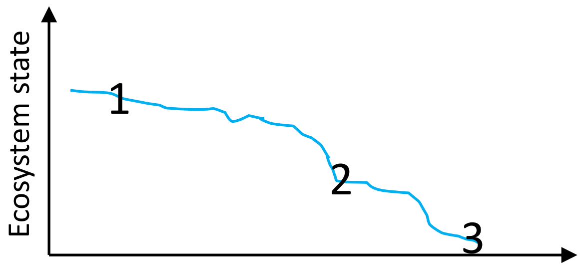
Gladstone-Gallagher et al. in prep



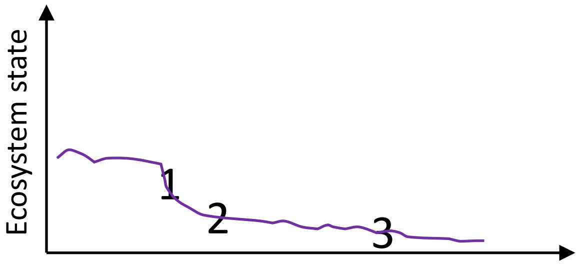
<u>Scenario B:</u> The Manukau estuary has received decades of accumulation of mud, heavy metals and nutrients and in some places the shellfish species have been lost or abundances diminished. In some places there are still good areas of shellfish, but the stressor regimes are predicted to continue to accumulate, and legacies of sediments are not reducing. Further turbidity is reducing resilience of the ecosystem to nutrients

Trajectories through time with **no action**





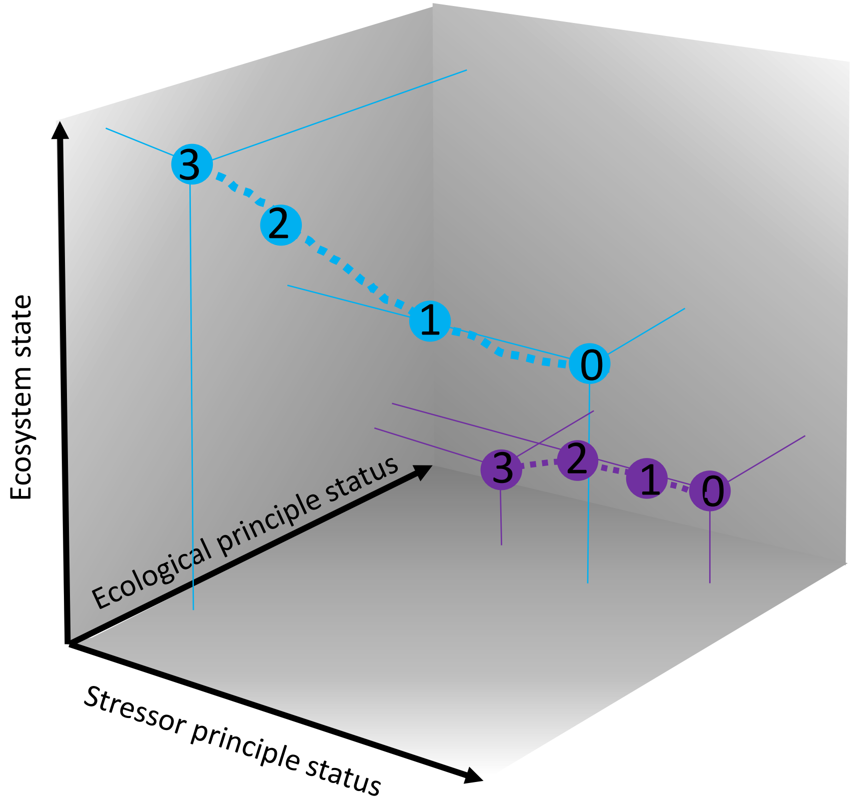
Scenario A Whangateau- No action to mitigate leads to multiple tipping points and degradation through time

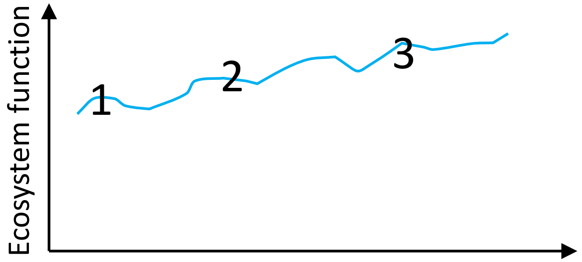


Scenario B Manukau - The ecosystem begins at quite low ecosystem function because a tipping point has most likely already occurred. No action to mitigate results in further tipping points as stressors accumulate

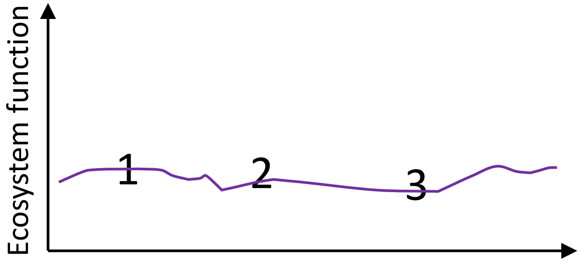
Both scenarios result in decline and end up in the same place eventually, but the number of tipping points and the rate of decline depends on a combination of where the system started from and the stressor regimes they experience

Trajectories through time with **Reduce and let recover**





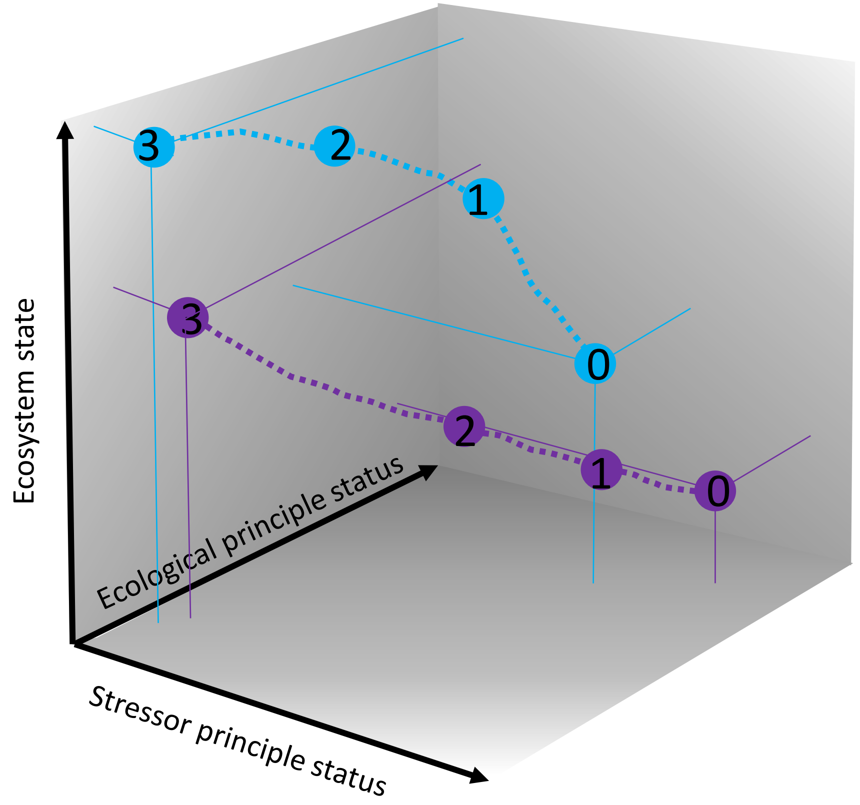
Scenario A Whangateau – Reduction of stressors halted further degradation and because legacies weren't yet a problem, improvement occurred over time

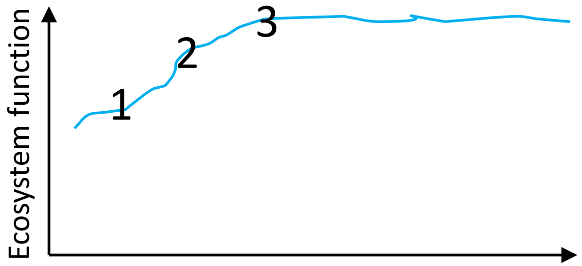


Scenario B Manukau - Reduce and let recover prevented any further tipping points but there was no improvement in ecosystem state due to ecological and stressor legacies

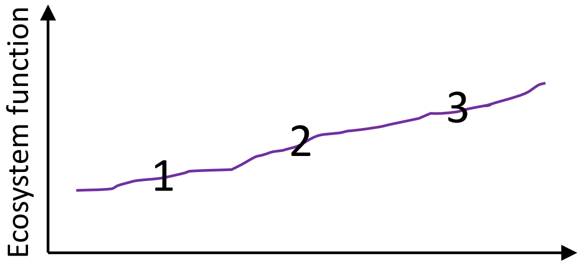
Reduce and let recover prevents further degradation, but only results in improvement in systems where legacy impacts are not blocking recovery – these legacies depend on the historical stressor regimes and also the nature of the ecosystem

Trajectories through time with **Active intervention/restoration**





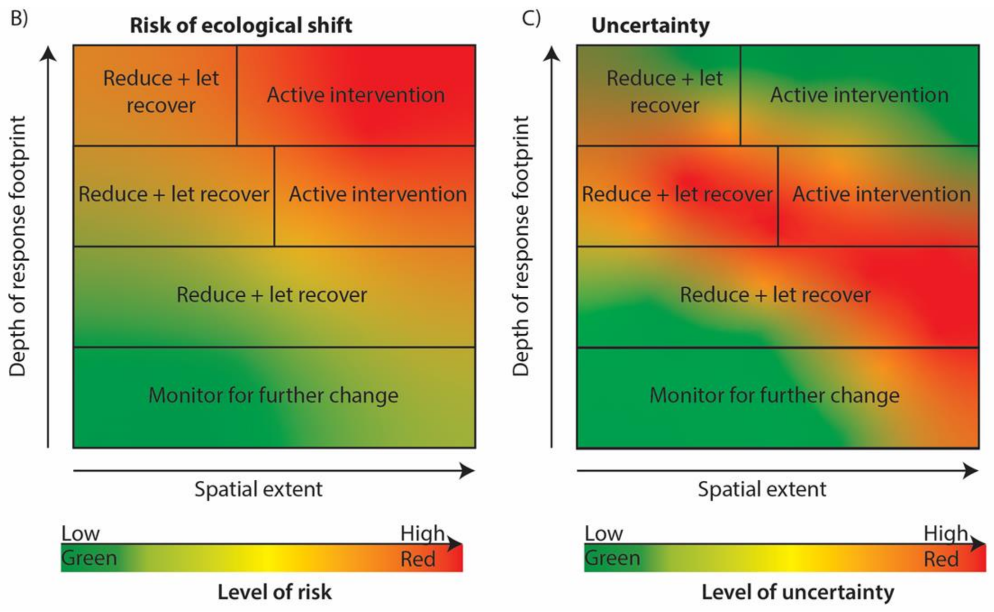
Scenario A Whangateau- Active reseeding of shellfish along with stressor reduction built resilience against future perturbations (like climate change) and sped up improvement



Scenario B Manukau - Active restoration of shellfish beds and reduction of stressors slowly improves things, but high uncertainty due to the efficacy of the restoration methods in an initially highly degraded place

Active restoration is needed to drive improvement in situations where legacies have blocked recovery, however, recovery will be slower and uncertainty higher in areas that were highly degraded

Conclusions



Risk Assessments:

- Consider cumulative effects
- Recognition of ecological complexity
- Application of ecological theory
- Uncertainty & management

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Ko ngā moana whakauka

Te Au o Te Moana | Special webinar series

11:30am, 31 March 2022

Integrating cumulative effects within spatial planning tools

Carolyn Lundquist - NIWA/University of Auckland

Tom Brough - NIWA

James Whetu - Whetu Consulting

Hilke Giles - Pisces Consulting

Amy Whitehead - NIWA

Anne-Gaelle Ausseil - Manaaki Whenua Landcare Research

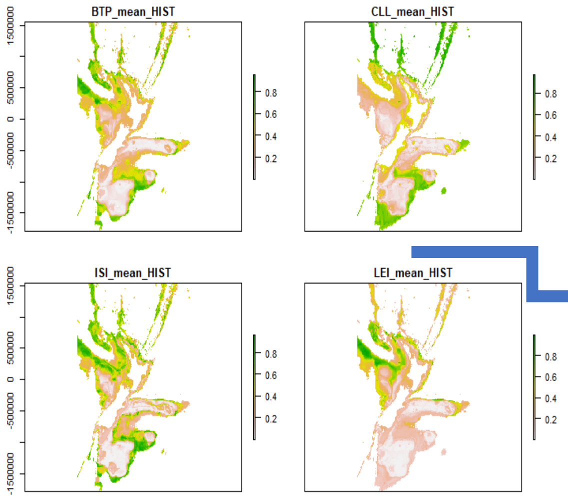
Hugh Simon - Manaaki Whenua Landcare Research

Shane Geange - DOC

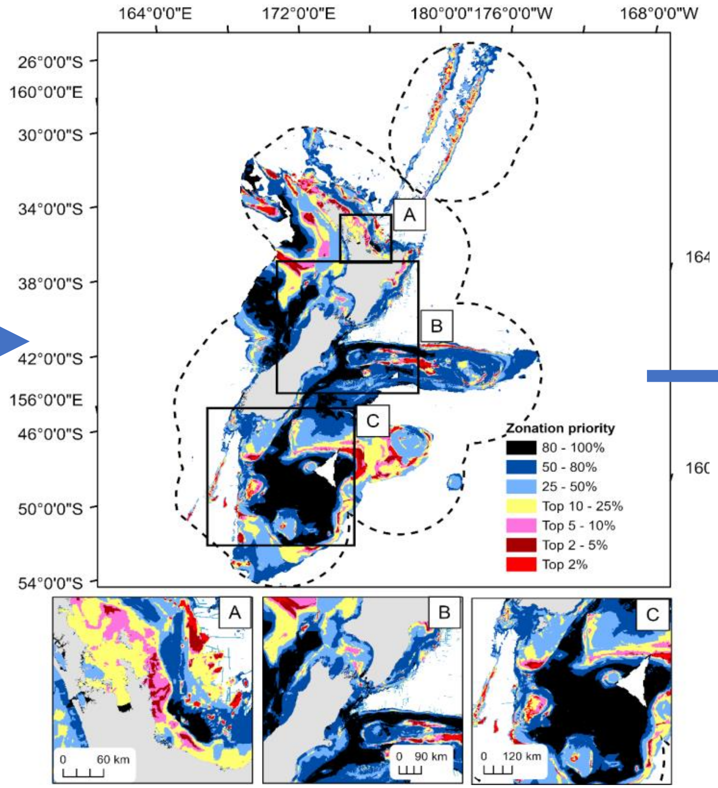
Spatial planning tools

Spatial layers for biodiversity features of interest

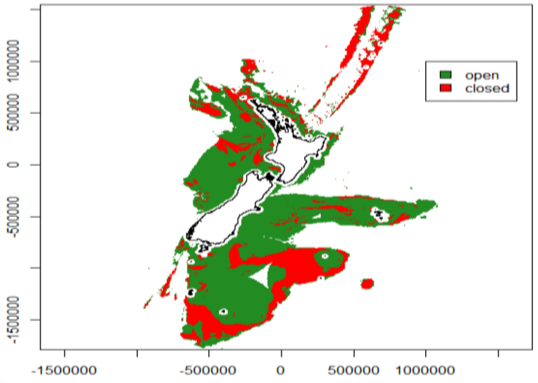
- Species/taxa distribution
- Diversity (e.g., richness)
- Functional groups
- Cultural/industry value



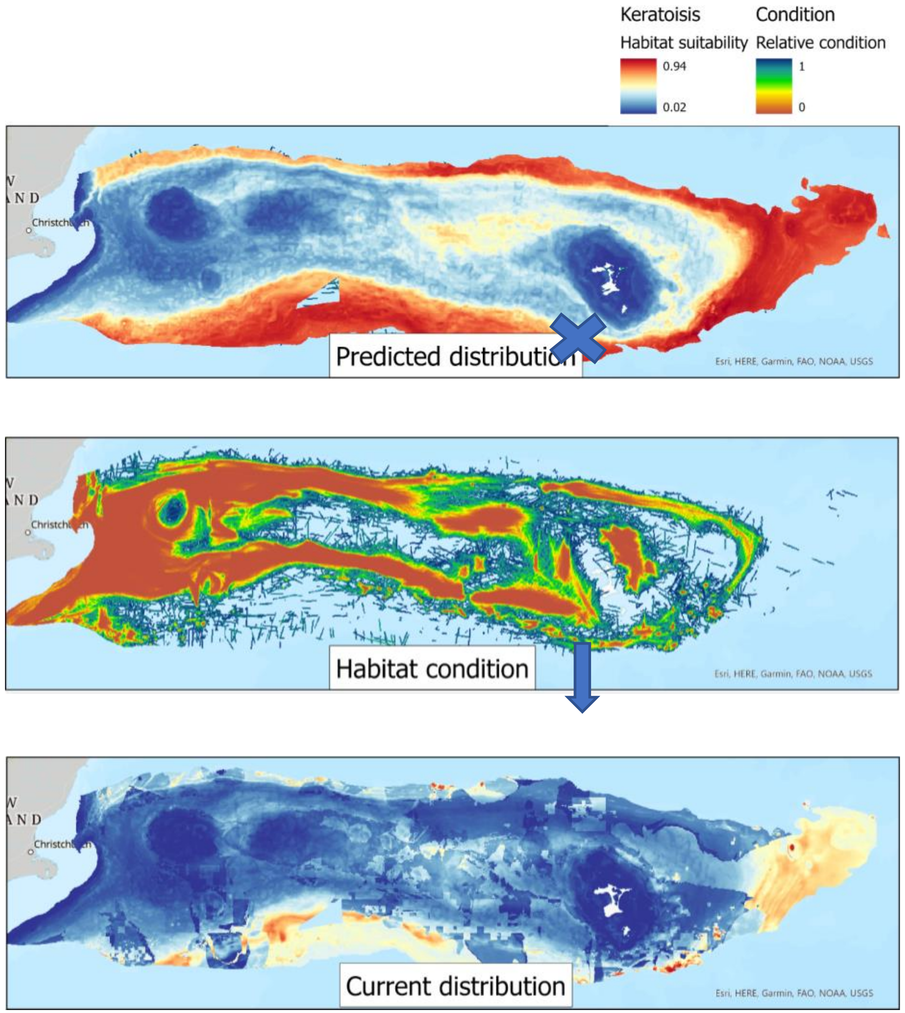
Spatial prioritisation of seascape



Candidate management areas



Accounting for impact of stressors



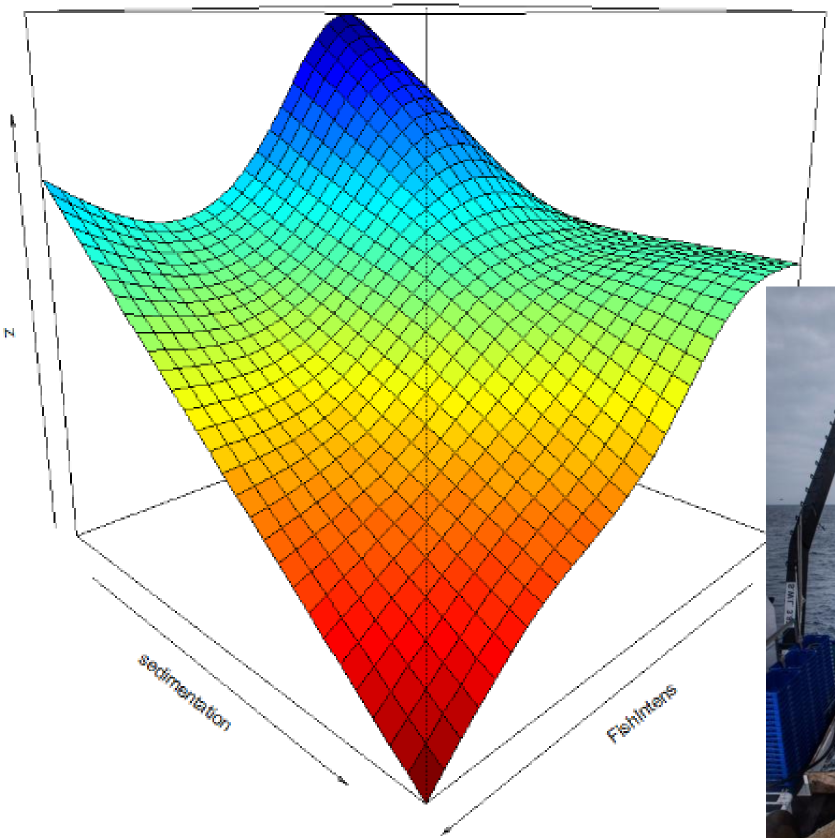
- Applied to discount highly modified areas
  - One layer (stressor) per biodiversity layer
- No accounting for areas lost (e.g., recovery potential)

Multiple and interacting stressors

- Including stressors as descriptors of biodiversity distribution

- Allow stressors to interact based on information from ecological responses
    - No interaction
    - Additive
    - Multiplicative

- Models for function groups allows for transferability among taxa with similar ecology and vulnerability



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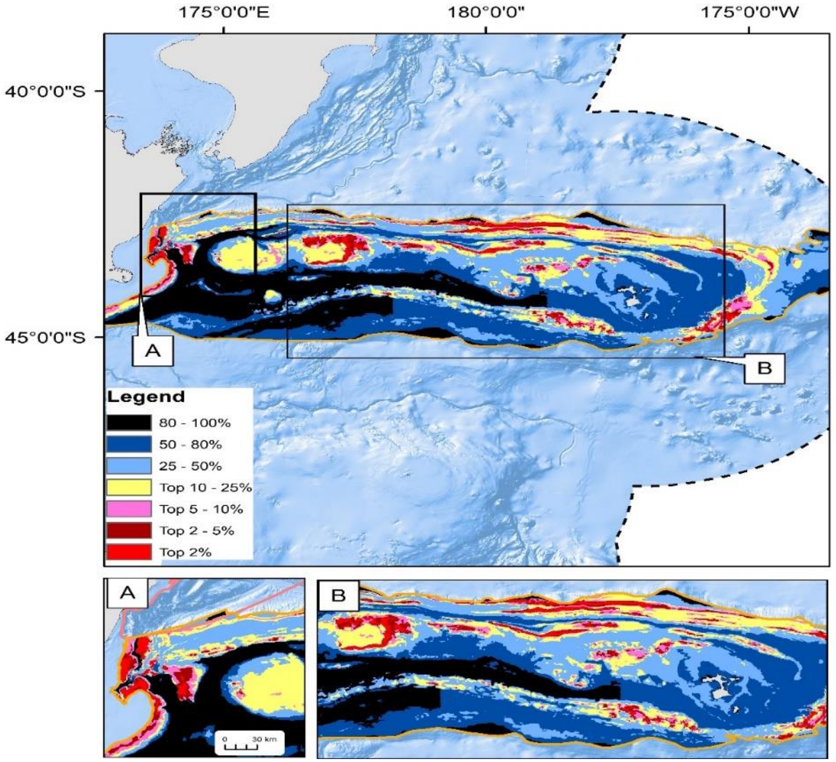
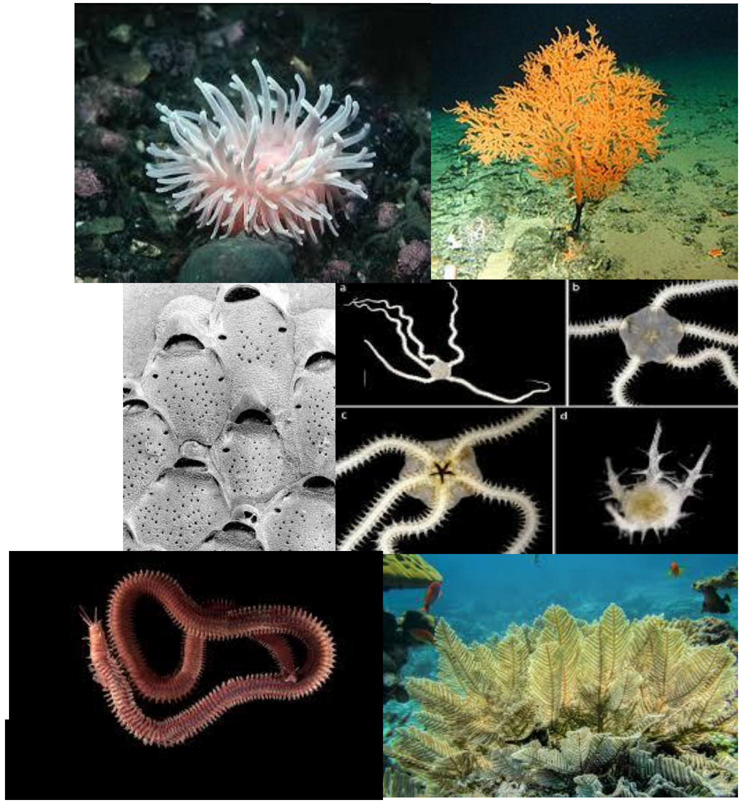
Applications

- SPEXCET 1.2 Case studies
  - National (Chatham Rise)
  - Regional (Hawke’s Bay – framework)
  - Rohe moana (Ohiwa estuary - T1 Awhi Mai Awhi Atu)

- Meeting objectives for spatial management in a multi-stressor context = requires information





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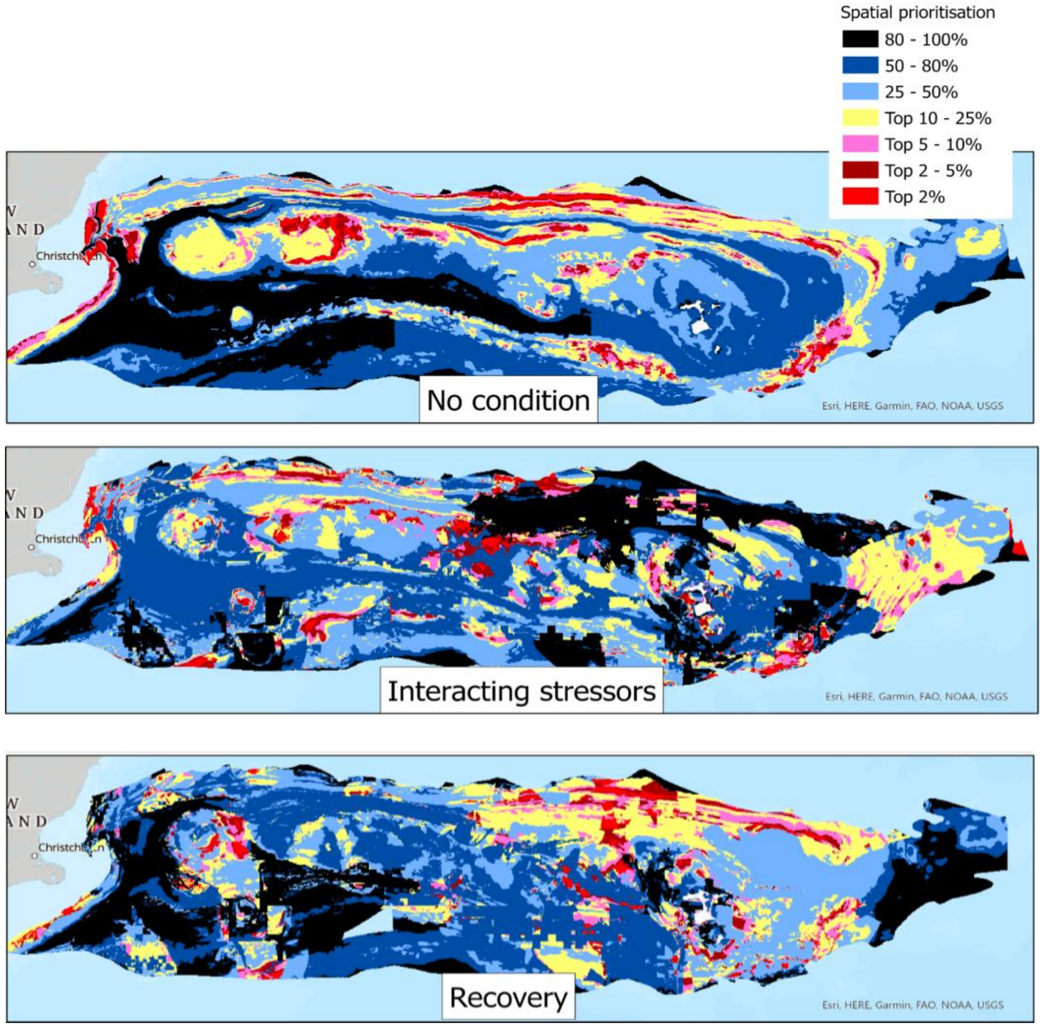
Outputs

- Prioritisation of seascape to protect remaining (impacted) biodiversity value
- Spatial representation of areas to target reduction of single/multiple stressors
- Identification of candidate areas for recovery



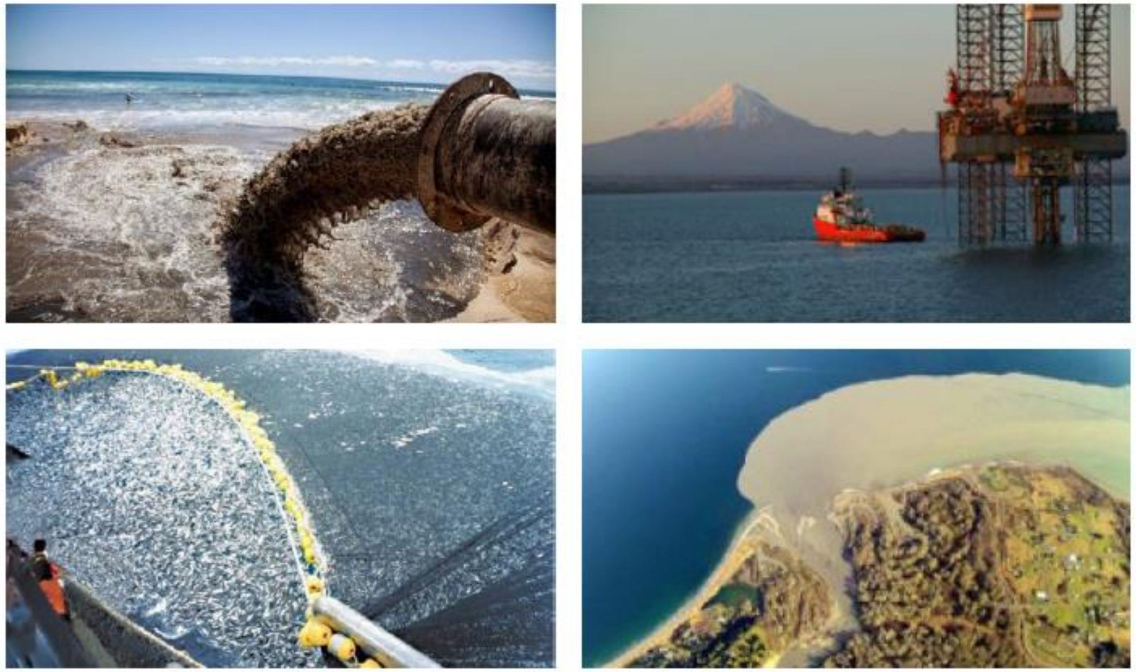
But…

- Key ingredients often not available
    - Biodiversity information
    - Environmental data
    - Stressor footprints

- Model-based assumptions
    - Obscure empirical relationships

- Fine scale and dynamic processes

- Provides ‘spatial’ solution only

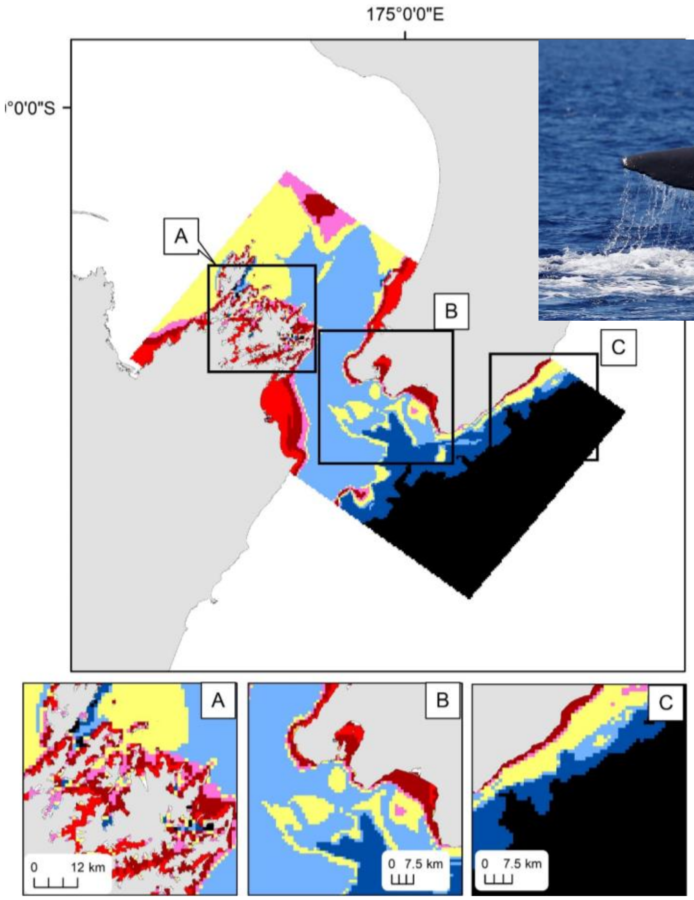


Summary

- New methods for integrating cumulative effects into decision support tools provide powerful means for implementing EBM
    - Incorporation of Mātauranga Maori
    - Ecosystem capacity

- Another tool in the kete that will be highly suited to the needs of some users

- Requires high quality data at the appropriate scales, oftentimes substantial inputs from stakeholders



Lundquist et al. 2020

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Panellists

Co-development partners

- **Ian Shapcott** Te Ātiawa Manawhenua Ki Te Tau Ihu Trust
- **Megan Carbines** Auckland Council
- **Ian Tuck** NZ Fisheries/MPI

Sustainable Seas

- **Kura Paul-Burke**
- **Carolyn Lundquist**
- **Judi Hewitt**