

Tipping Points – soft sediments

Candida Savage



Tipping Points Team

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Post-docs: Rebecca Gladstone-Gallagher, Teri O'Meara

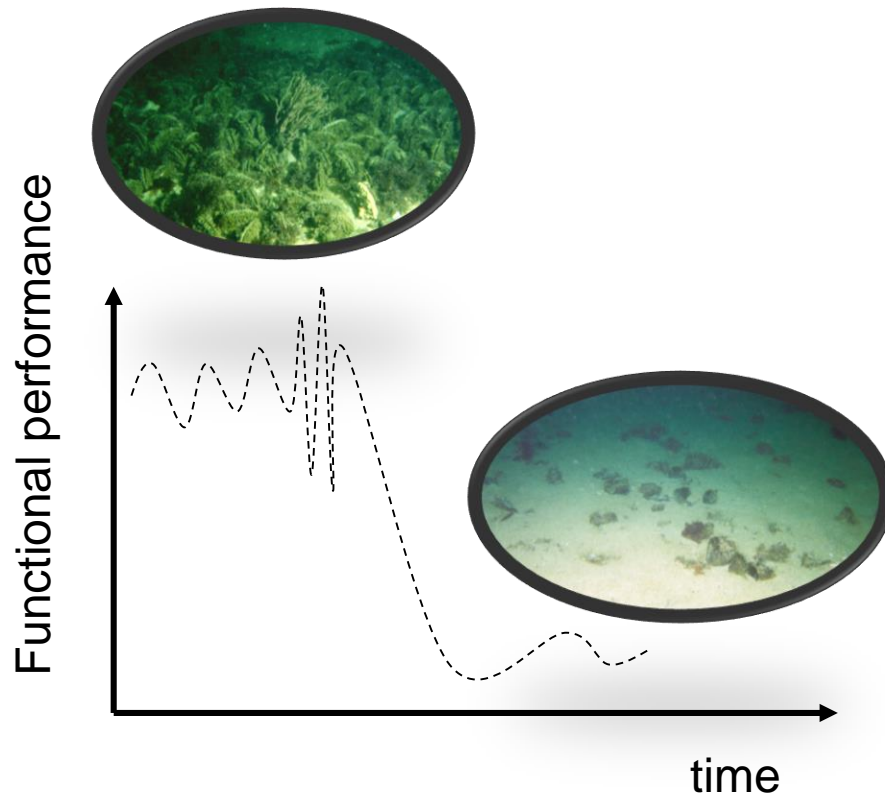
PhD students: Steph Mangan, Dana Clark, Samuel Thomas, Mareike Babuder, Amanda Veillard

Posters and Art Exhibit on Tipping Points project

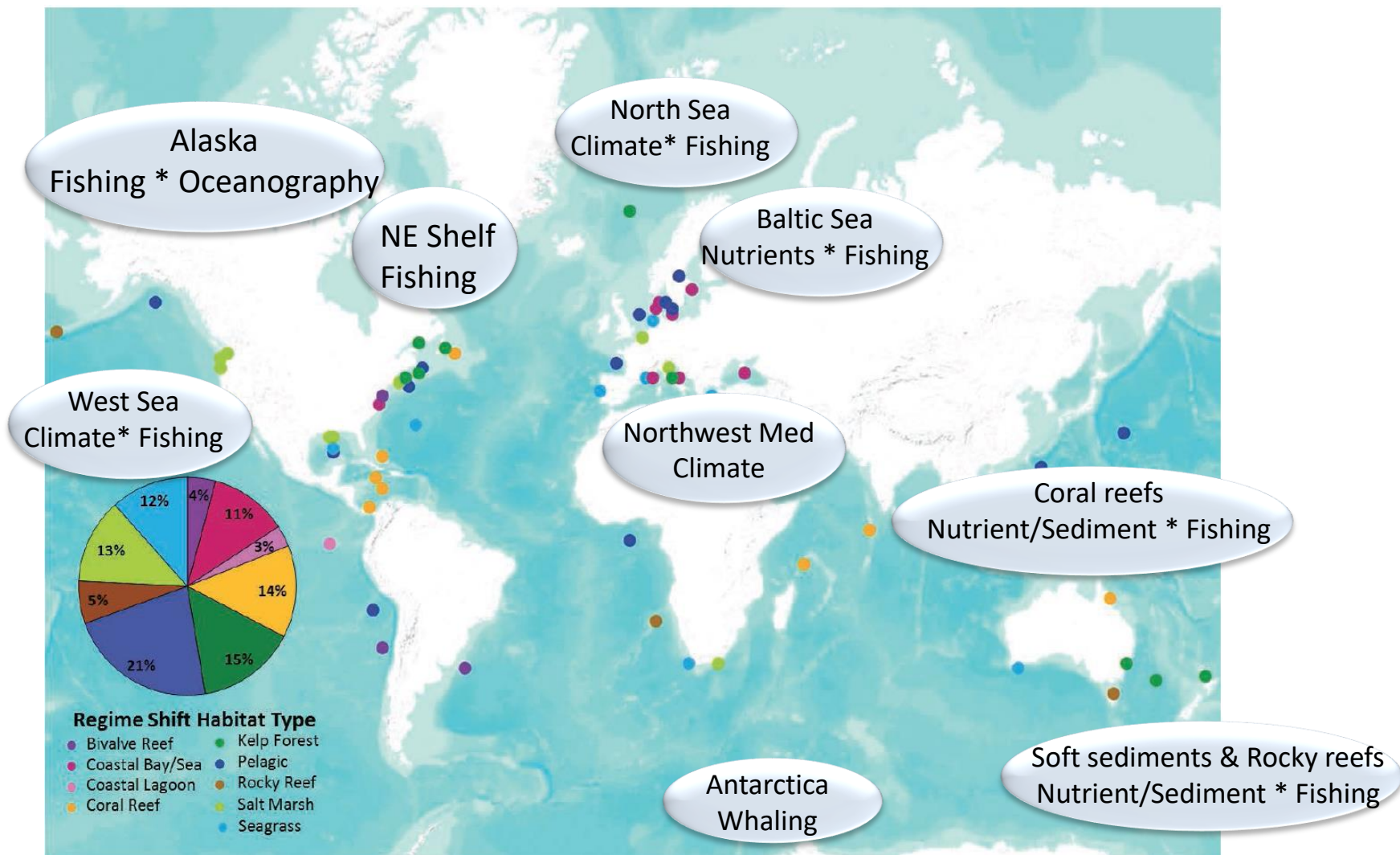


What are tipping points?

- Abrupt, surprising change in function
- Small changes that matter because they alter intrinsic dynamics

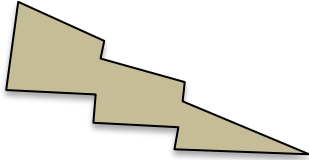


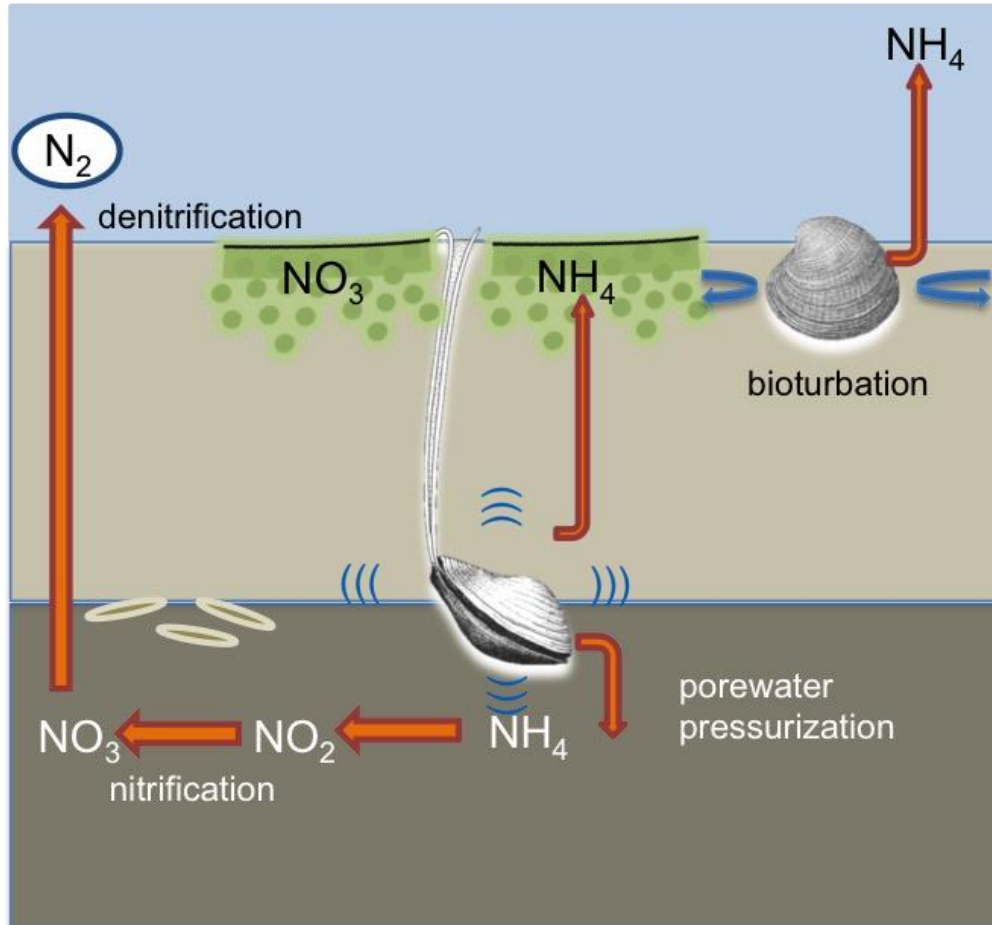
Tipping points in marine ecosystems are common




Kappel et al. in prep. Source: Ocean Tipping Points Guide

Tipping points are difficult to predict...to assess the risk of a loss of resilience, need to understand how the system works

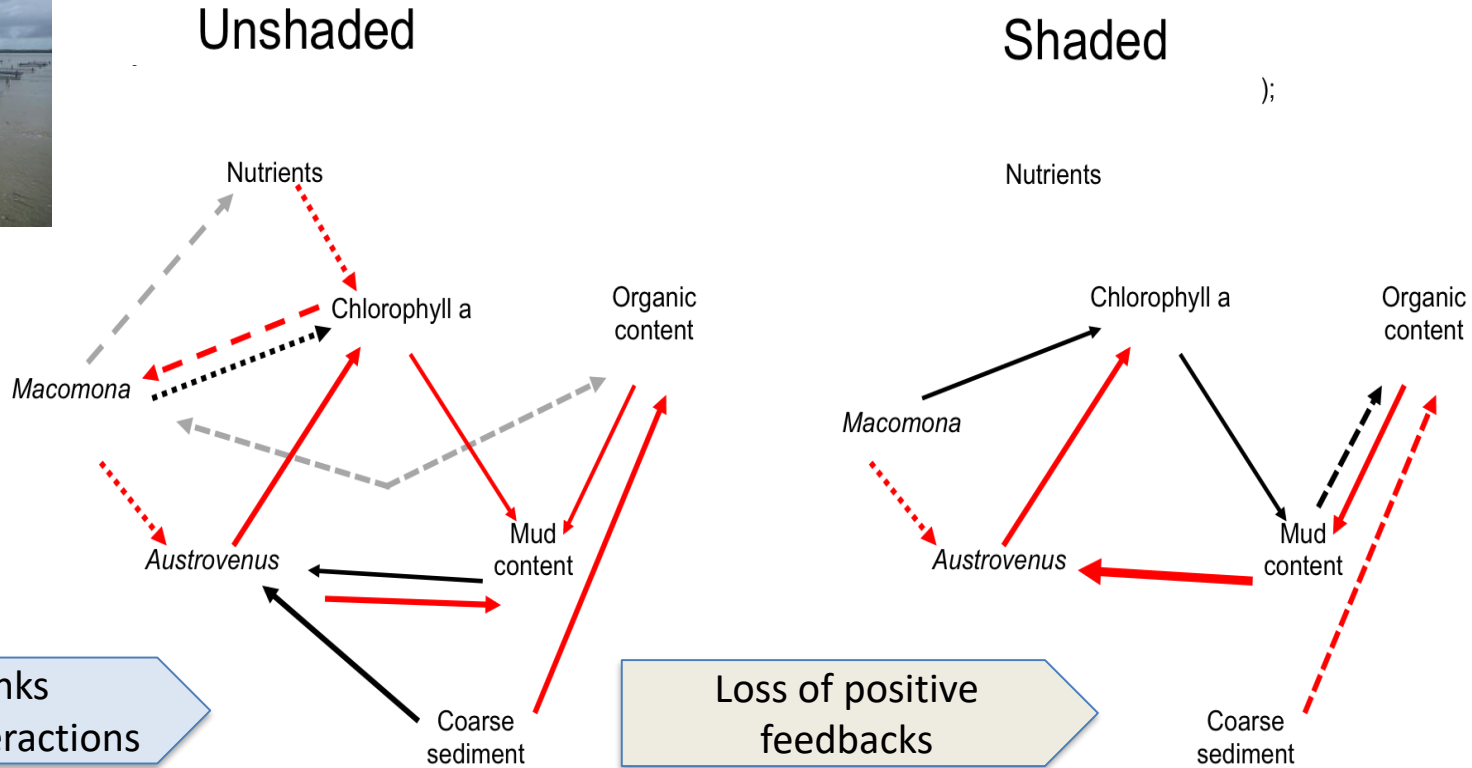

Sediment
inputs




Nutrient
inputs

Turbidity as a stressor breaks links between species

(Manukau experiment)



Thrush, SF, JE Hewitt, S Parkes, AM Lohrer, CA Pilditch, SA Woodin, DS Wethey, M Chiantore, V Asnagli, S De Juan, C Kraan, I Rodil, C Savage and C Van Colen. 2014. Experimenting with ecosystem interaction networks in search of threshold potentials in real-world marine ecosystems. *Ecology* 95:1451-1457

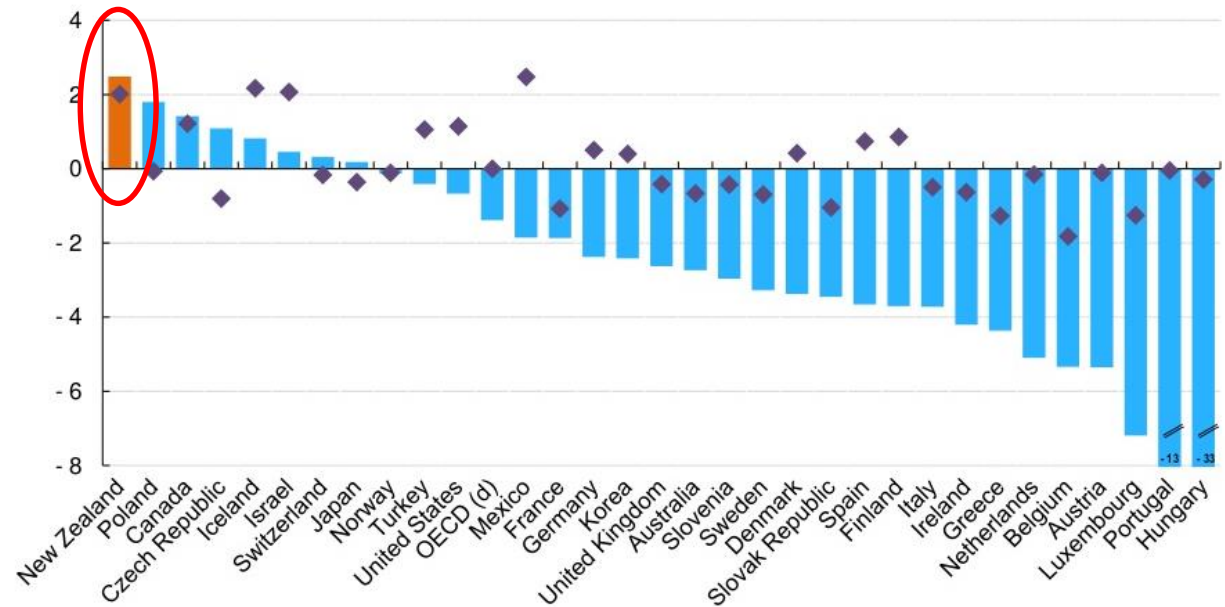
Cumulative stressors and when effects of stressors are not merely additive



interactions



Changes in nitrogen balance (bars) and agricultural production (diamonds), 1998-2000 and 2007-09



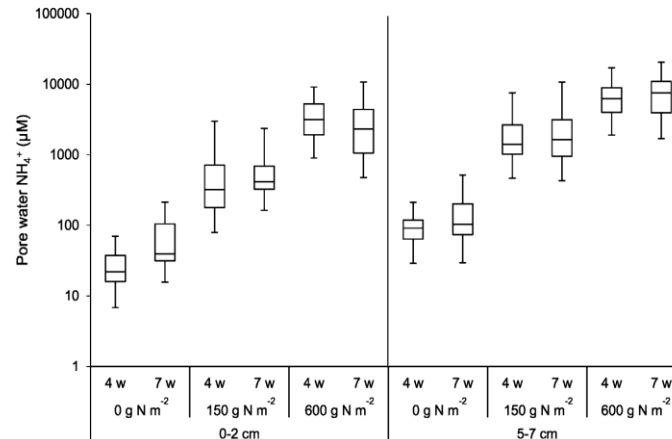
Assessing the risk of crossing thresholds in soft sediment ecosystems exposed to multiple stressors

National Experiment from Northland to Southland

- Iwi consultation across NZ
- 22 sites in 15 estuaries
- Gradient in turbidity
- *Macomona* presence



At each site, 3 control, 3 medium N (150 g.m^{-2}), 3 high N (600 g.m^{-2}) 9m^2 plots were created with slow release nitrogen fertilizer



Biodiversity and ecosystem functioning measures to provide mechanistic evidence for threshold responses

ECOSYSTEM PROCESSES

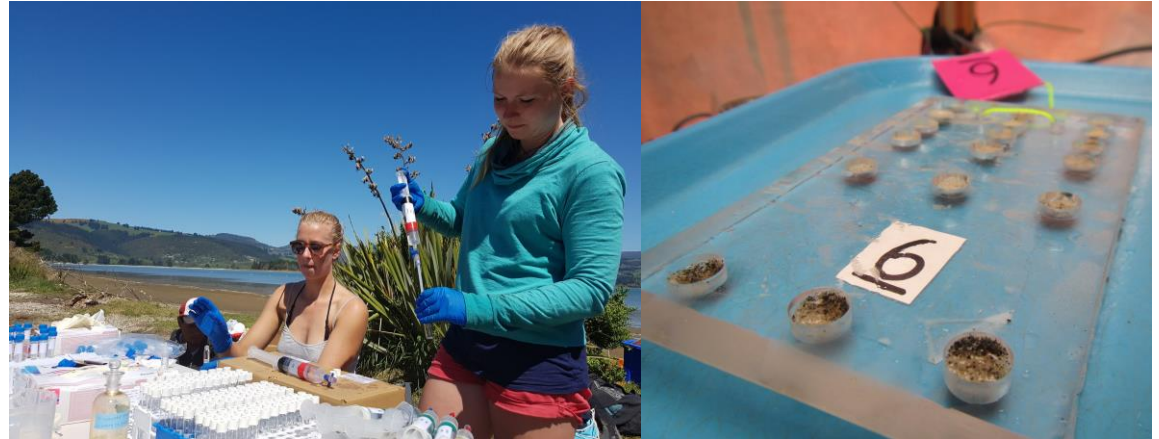
- Primary production
- Nutrient fluxes
- Denitrification

BACTERIAL COMMUNITY & RATES

- Meta-barcoding
- Microbial enzyme activity rates
- Rapid organic matter assay (ROMA) plates

BIOLOGICAL COMMUNITIES

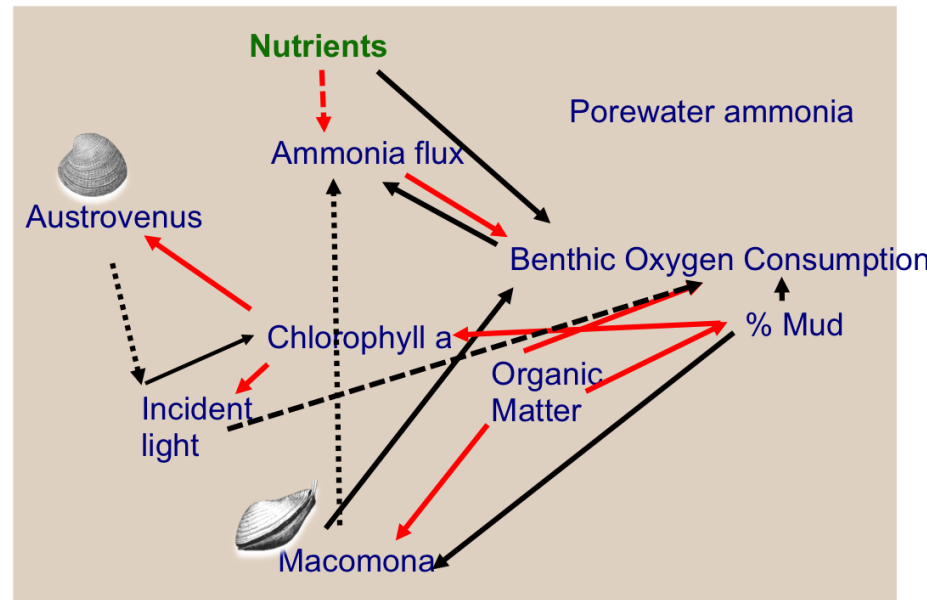
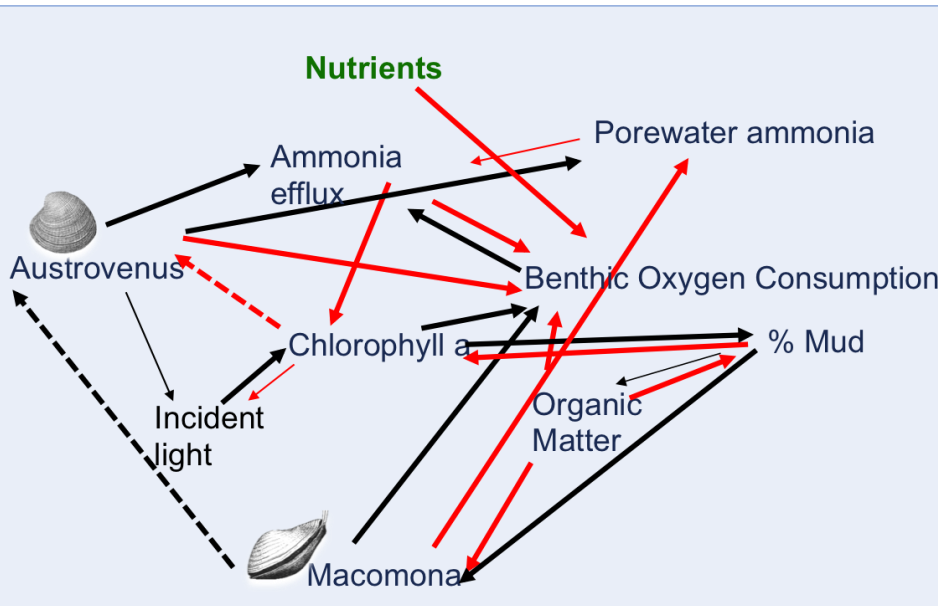
- Composition, abundance & diversity
- Niche breadth
- **Interaction networks**



Clear and turbid estuaries are fundamentally different in their connections and processes

Clear estuaries (n=7)

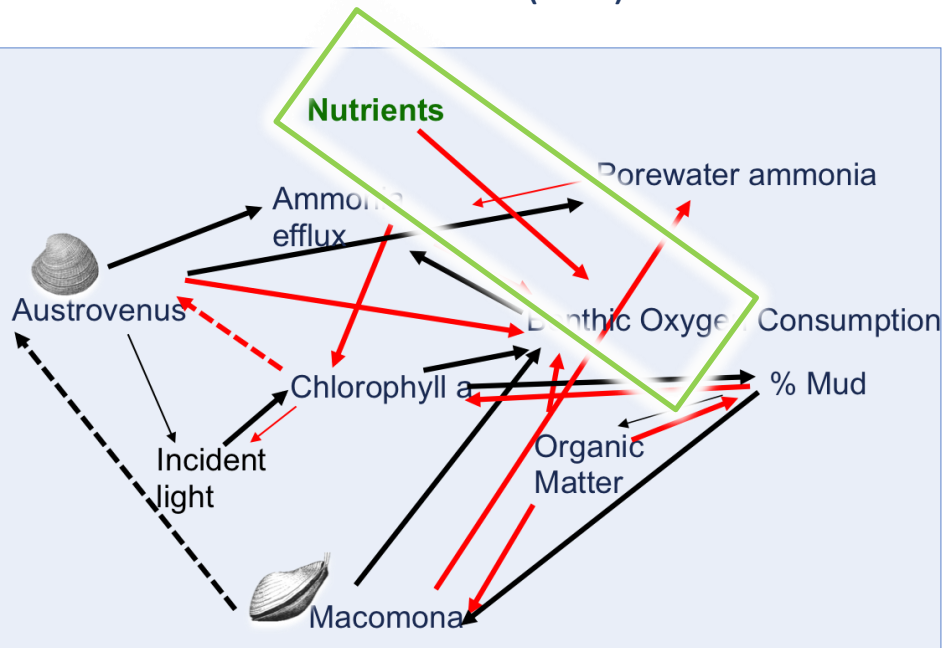
Turbid estuaries (n=8)



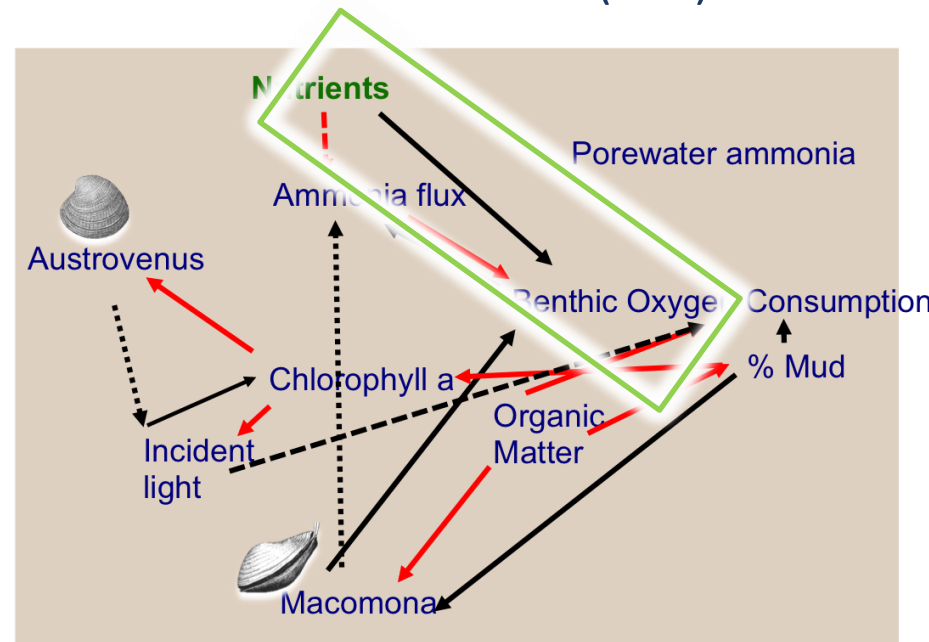
- Positive
- Negative

Clear and turbid estuaries are fundamentally different in their connections and processes

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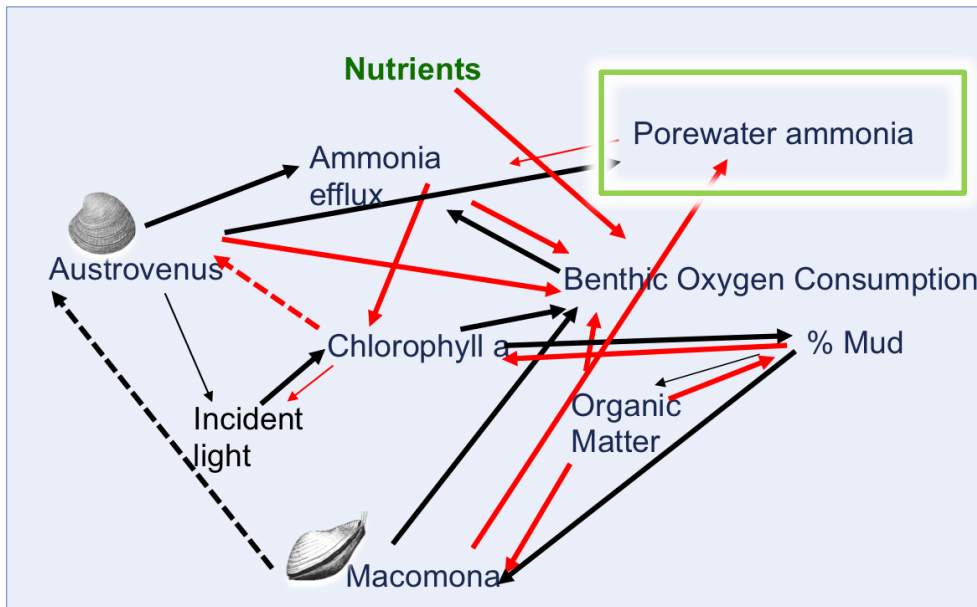
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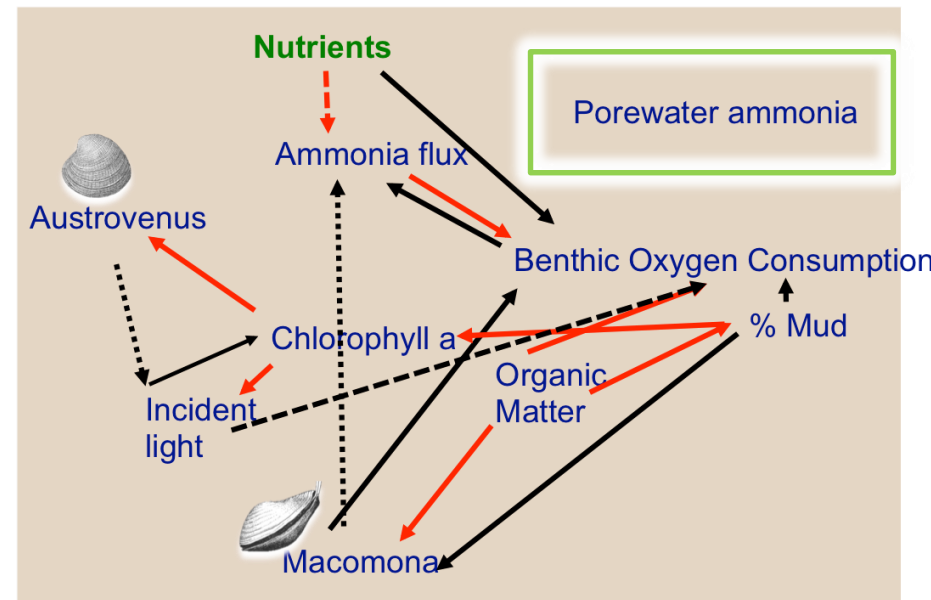
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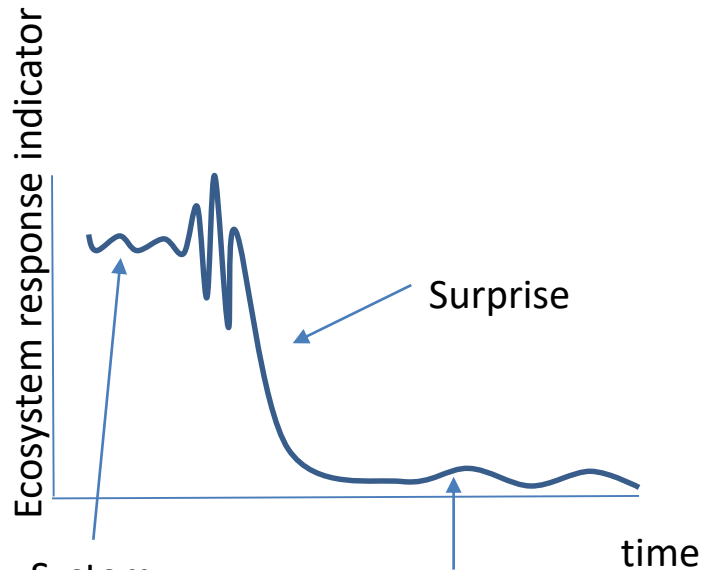


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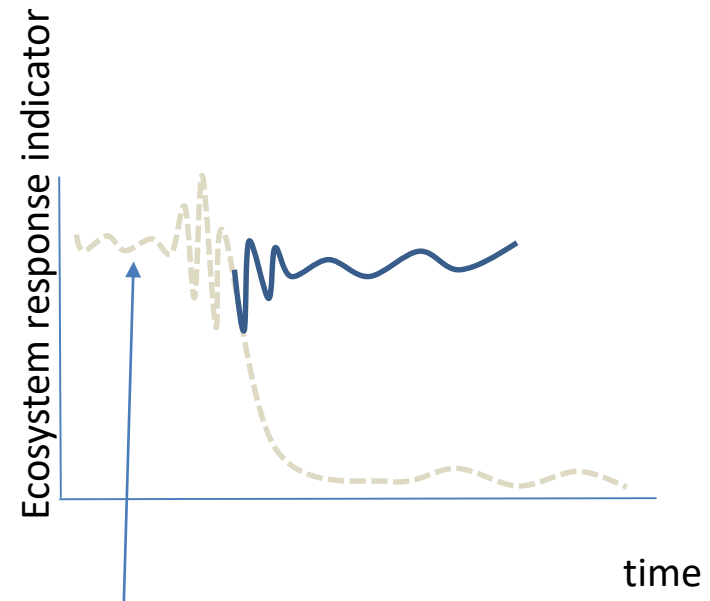
- Positive
- Negative

EBM and building capacity to adapt to change



System appears resilient to stress. Push it harder?

A new state is established, recovery is difficult and ecosystem values and benefits must change



Managing to enhance resilience and limit cumulative impacts

Understanding the dynamics of non-linear responses to **multiple stressors** that lead to threshold changes is essential to build **resilience** and understand **recovery**

Multi-organisational Tipping points project was funded by the Sustainable Seas National Science Challenge



National
Science
Challenges

SUSTAINABLE
SEAS

Ko ngā moana
whakauka