Spatial management of biodiversity in estuaries

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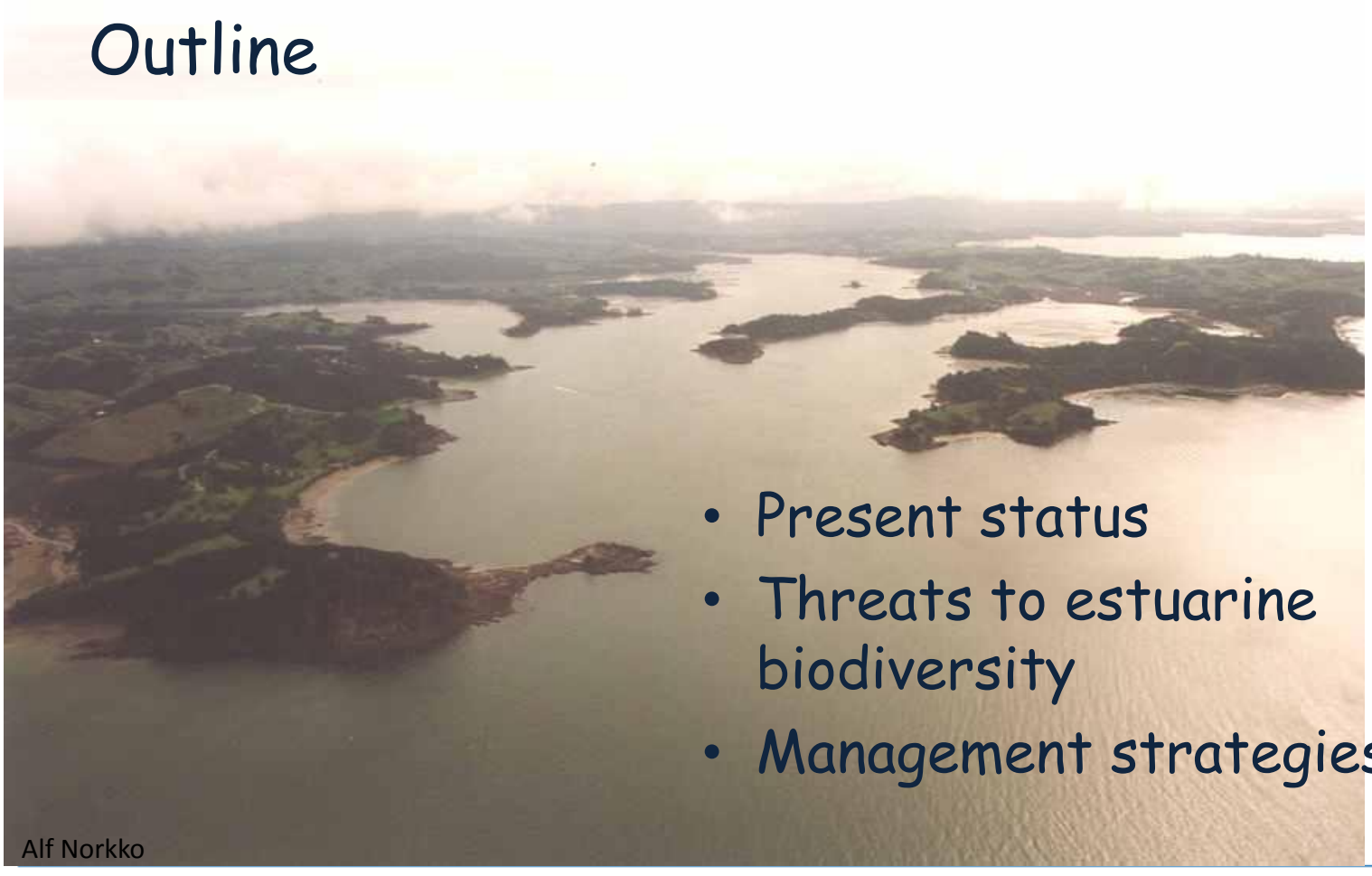
Outline



- Present status
- Threats to estuarine biodiversity
- Management strategies

Alf Norkko

What is biodiversity?

- Used to be number of species or the way abundances are spread between species
  - But most species are rare
- Now focus on biodiversity as it underpins ecosystem health, functioning and resilience
  - Diversity of functions
  - Diversity of habitats
  - Diversity within a function- Number of species representing a function

Present status in the Hauraki Gulf

- Mainly macrofauna
- Why?
  - Diverse in estuaries
  - Multiple trophic levels

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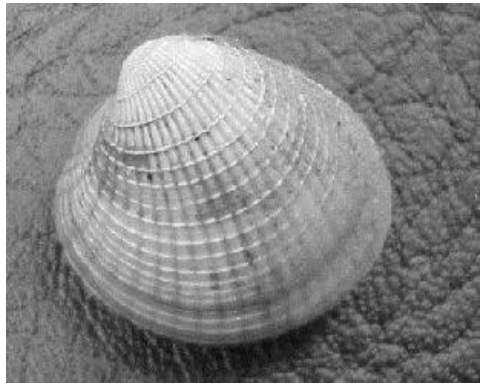

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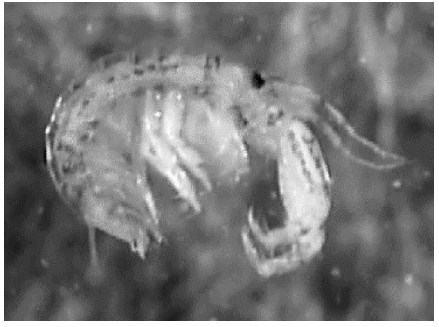
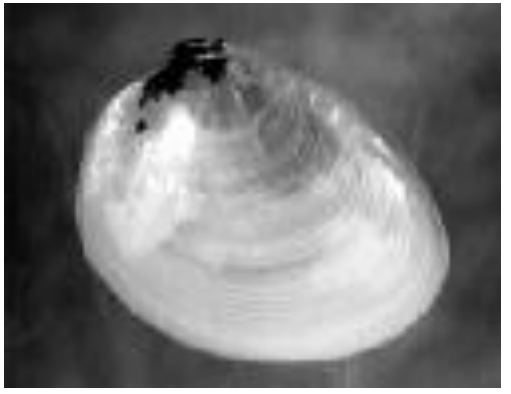




Present status in the Hauraki Gulf

- Also
  - Relatively stationary
  - Food for birds, fish, humans
  - Affect sediment stability
  - Filter sediments and contaminants from the water
  - Drivers of nutrient recycling
  - Drivers of primary productivity in sediment and water
  - Easy to sample, often used overseas as indicators of health

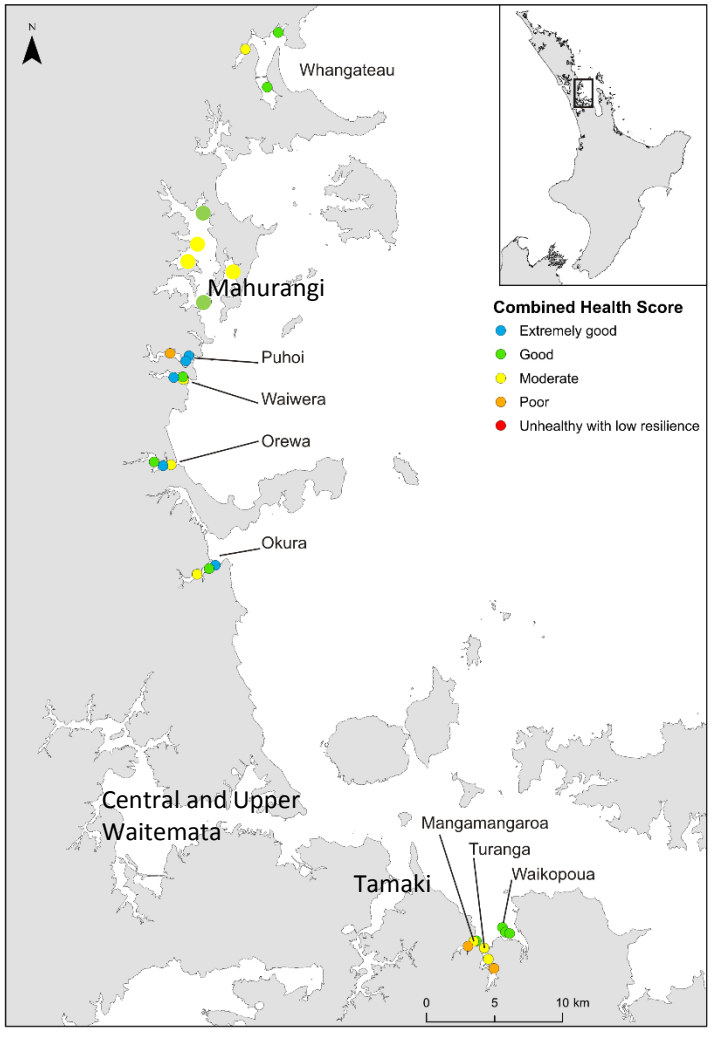
Present status in the Hauraki Gulf

- Where do we have data from?
  - Auckland Council
    - Repeated- Ecological Monitoring programmes and Regional Sediment Contaminant Monitoring Programme
    - Once only- Kawau Bay, Tamaki Strait, Weiti
  - Waikato Regional Council
    - Repeated- Regional Estuaries Monitoring Programme, Firth of Thames, Tairua
  - NIWA marine ecology group sampling
    - Once only- Manaia, Matakana, Whangapoua, Mahurangi

Present status in the Hauraki Gulf

AC report

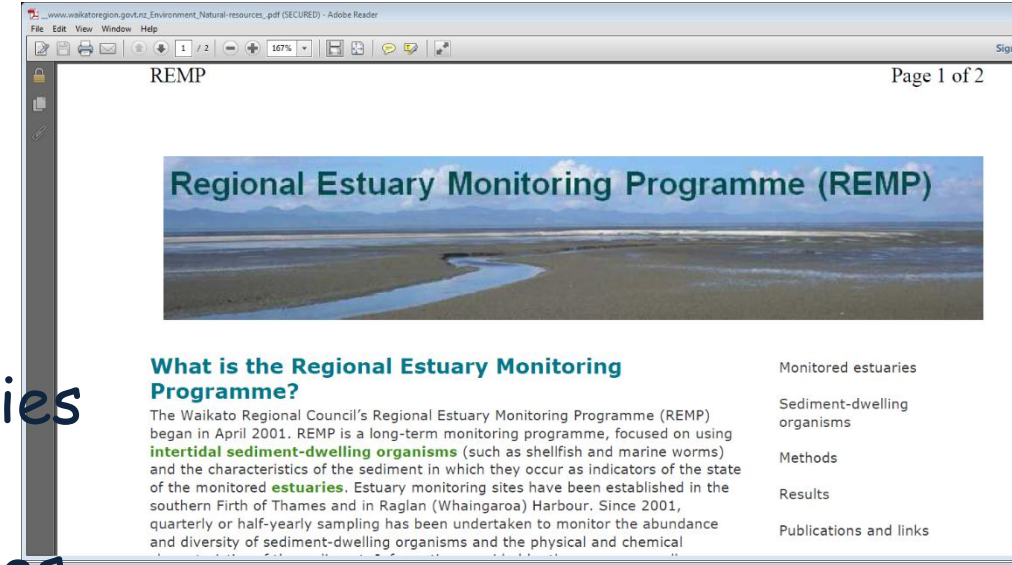
- Trends in individual species abundance
- Trends in community types and diversity
- Overall health related to
  - Heavy metal contaminants
  - Mud content
  - Functional resilience



Present status in the Hauraki Gulf

WRC

- Trends in individual species abundance
- Trends in community types and diversity
- Considering using the same indices for health as AC


REMP

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Regional Estuary Monitoring Programme (REMP)

What is the Regional Estuary Monitoring Programme?

The Waikato Regional Council's Regional Estuary Monitoring Programme (REMP) began in April 2001. REMP is a long-term monitoring programme, focused on using **intertidal sediment-dwelling organisms** (such as shellfish and marine worms) and the characteristics of the sediment in which they occur as indicators of the state of the monitored **estuaries**. Estuary monitoring sites have been established in the southern Firth of Thames and in Raglan (Whaingaroa) Harbour. Since 2001, quarterly or half-yearly sampling has been undertaken to monitor the abundance and diversity of sediment-dwelling organisms and the physical and chemical

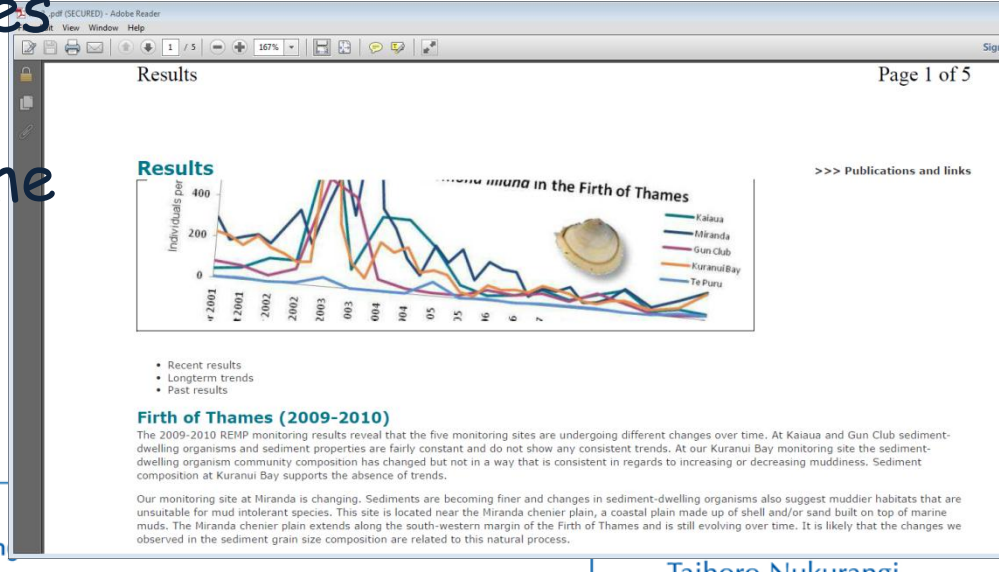
Monitored estuaries

Sediment-dwelling organisms

Methods

Results

Publications and links


Results

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Results

>>> Publications and links

in the Firth of Thames

Individuals per

400

200

0

Kaiaua

Miranda

Gun Club

Kuranui Bay

Te Puru

- Recent results
- Longterm trends
- Past results

Firth of Thames (2009-2010)

The 2009-2010 REMP monitoring results reveal that the five monitoring sites are undergoing different changes over time. At Kaiaua and Gun Club sediment-dwelling organisms and sediment properties are fairly constant and do not show any consistent trends. At our Kuranui Bay monitoring site the sediment-dwelling organism community composition has changed but not in a way that is consistent in regards to increasing or decreasing muddiness. Sediment composition at Kuranui Bay supports the absence of trends.

Our monitoring site at Miranda is changing. Sediments are becoming finer and changes in sediment-dwelling organisms also suggest muddier habitats that are unsuitable for mud intolerant species. This site is located near the Miranda chenier plain, a coastal plain made up of shell and/or sand built on top of marine muds. The Miranda chenier plain extends along the south-western margin of the Firth of Thames and is still evolving over time. It is likely that the changes we observed in the sediment grain size composition are related to this natural process.

Threats to estuarine biodiversity

- From upstream
  - Terrestrial sediment
  - Nutrients
  - Heavy metals and organic contaminants
- Within-estuary
  - Changes to freshwater inputs
  - Pesticides
- From the coast

Threats to estuarine biodiversity

- From upstream
  - Fertilisers, pesticides, sediment entering directly
  - Sewage
  - Stormwater
- Within-estuary
  - Channel maintenance and port activities
  - Engineering structures
  - Reclamation
  - Aquaculture
- From the coast
  - Harvesting
  - Marinas
  - Recreation

Threats to estuarine biodiversity

- From upstream
- Within-estuary
- From the coast

– Invasions
– Oil spills
– Harvesting
– Waves
– Ocean temperature
– Ocean acidification
– Sea level rise
– Upwelling and stratification

Management strategies

Inevitably, these have to

- Consider **Risks to biodiversity** against economic and social benefits
- Be spatially dependent

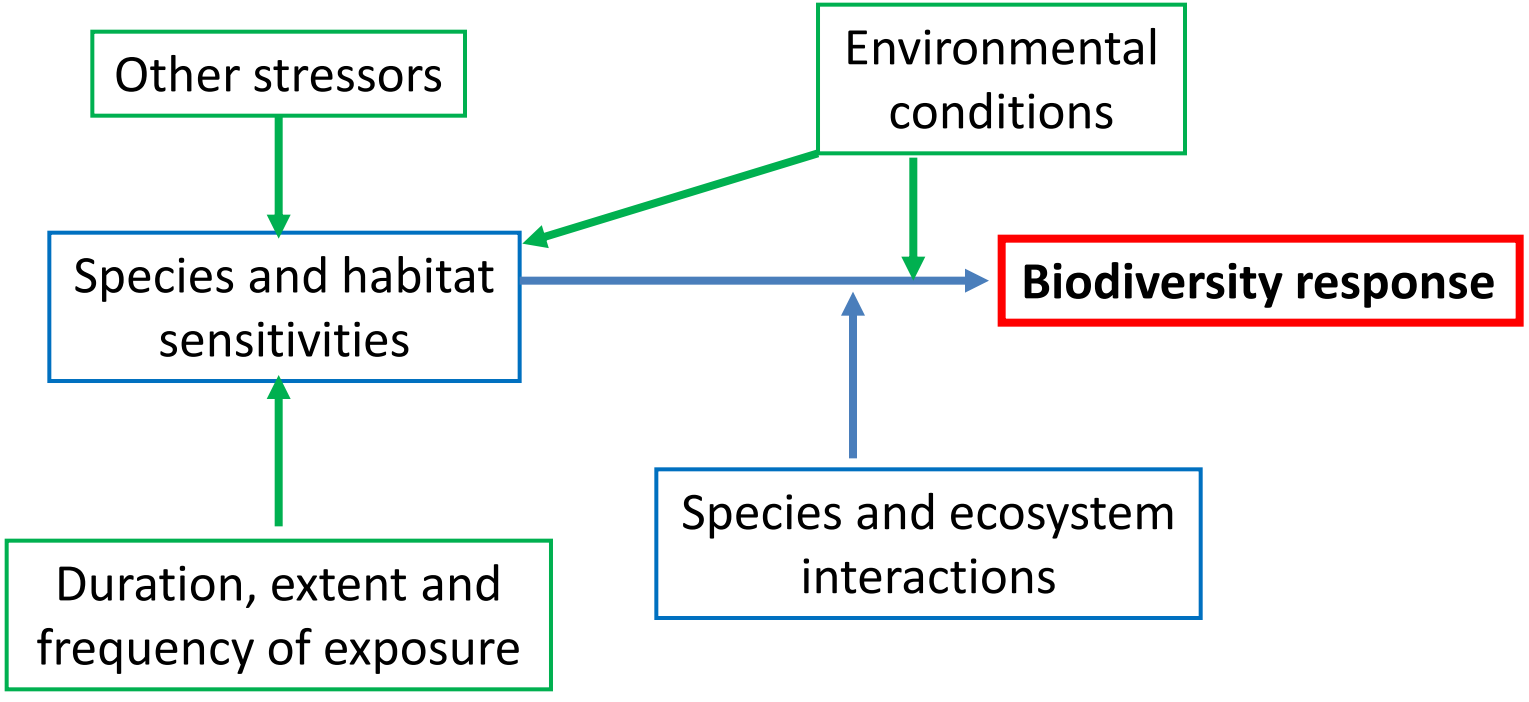
Why spatially dependent?

Risk dependent on

- likelihood of threat occurring (exposure to use)
- the degree of response to the specific threat

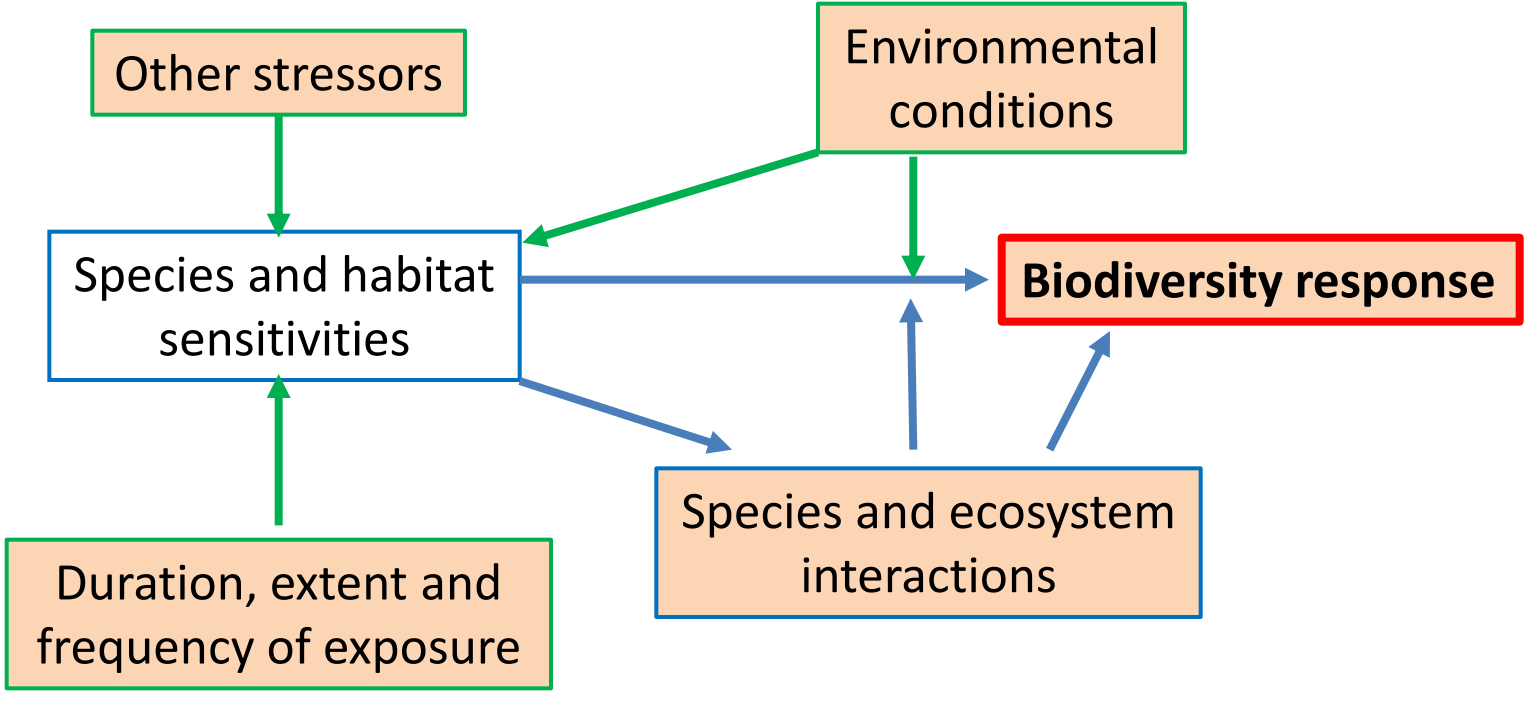
Apart from the threats and uses …..

Management strategies



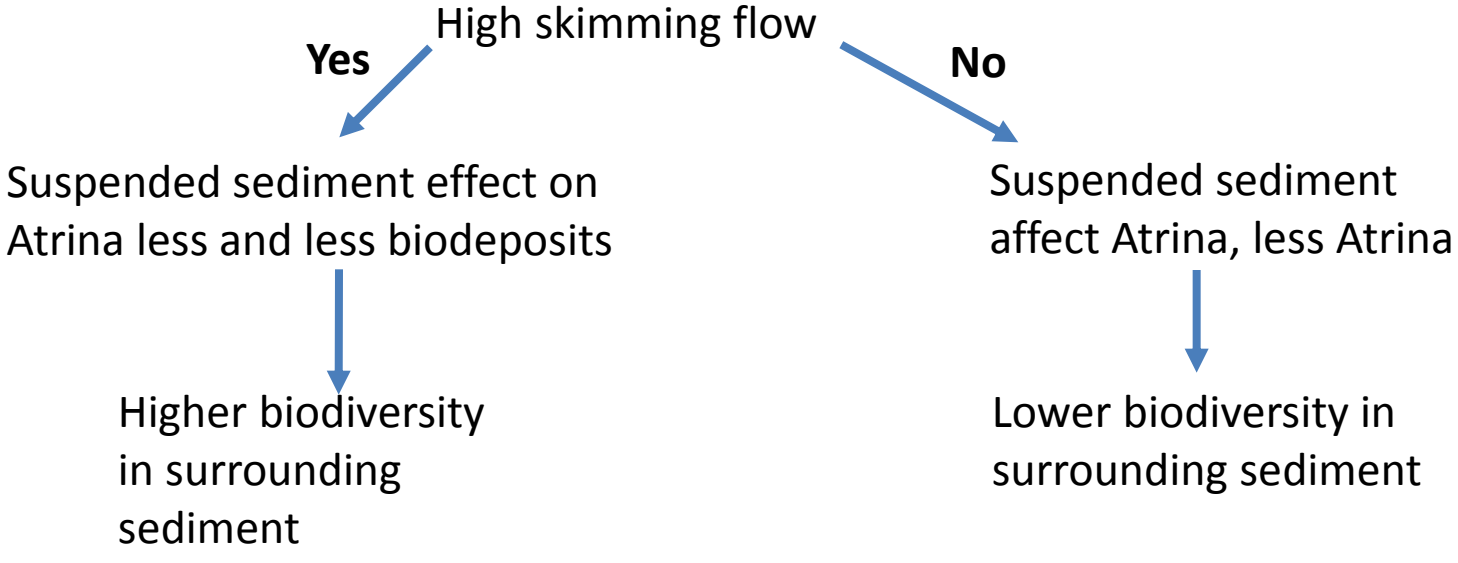
Management strategies

Location specific



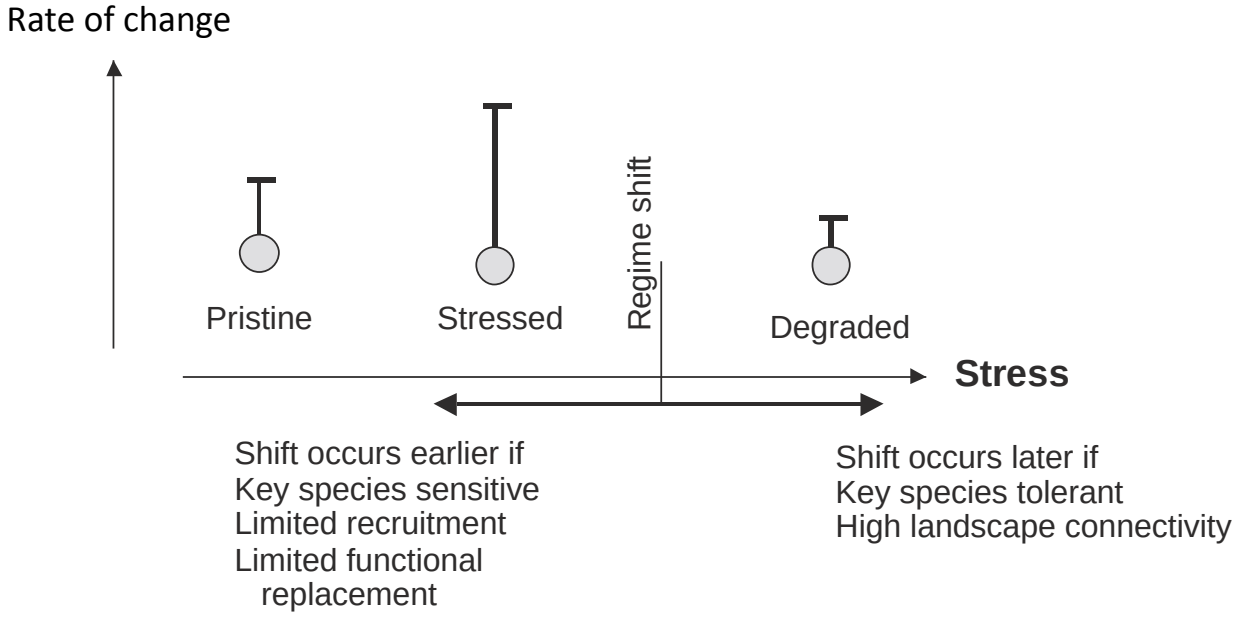
Environmental conditions

- Effect of suspended sediment on biodiversity

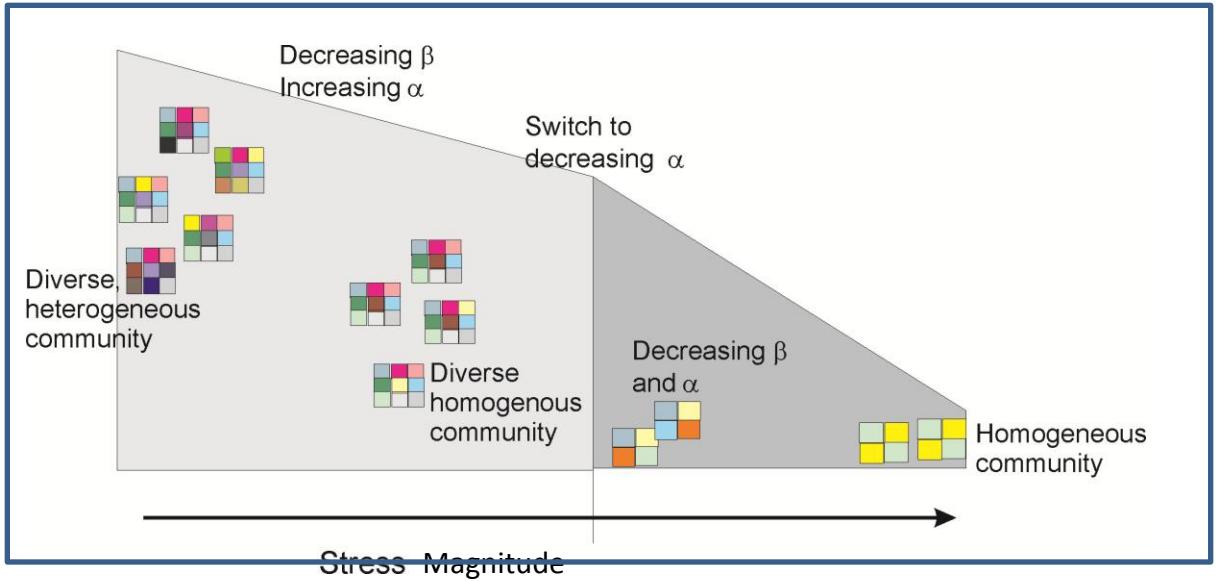


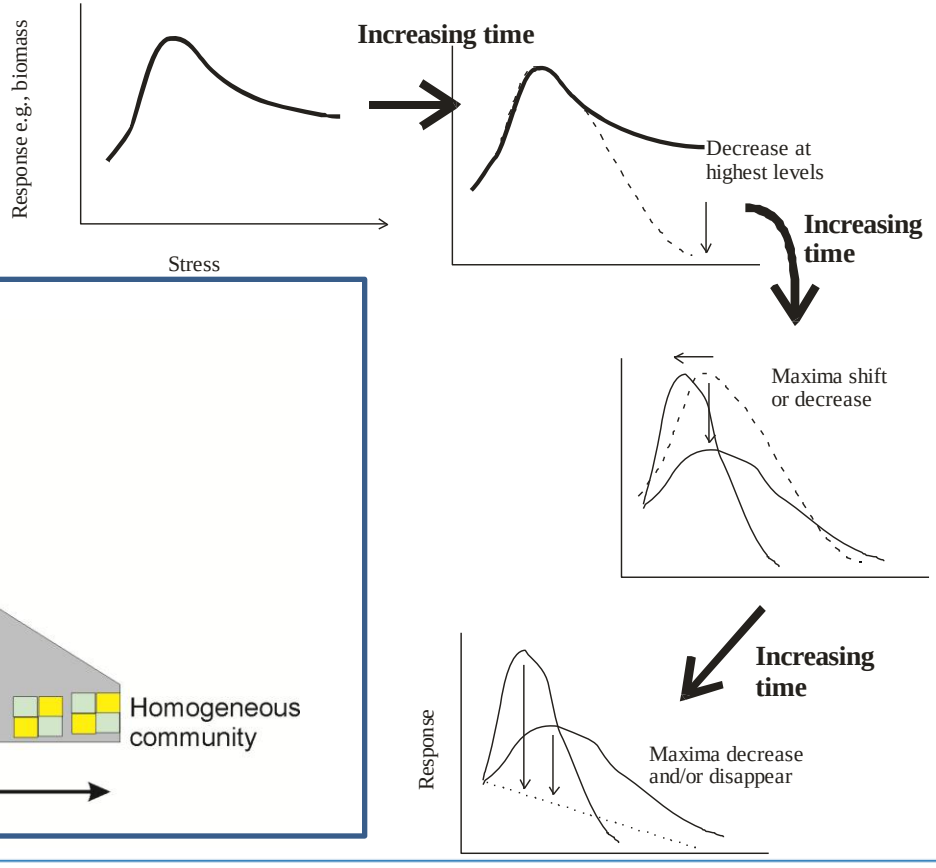
Species and ecosystem interactions

- Key species drive results



Magnitude, duration and extent?





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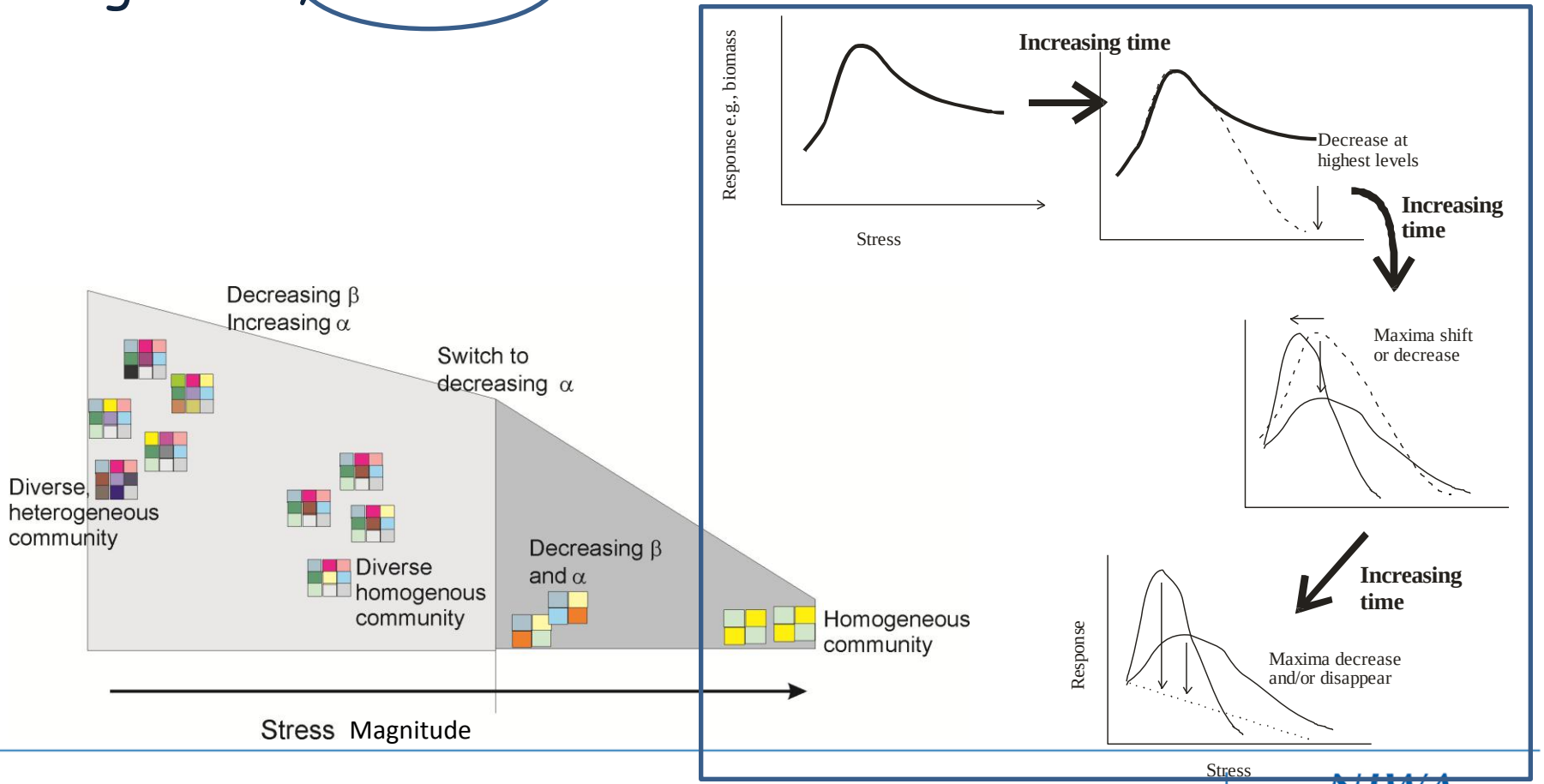
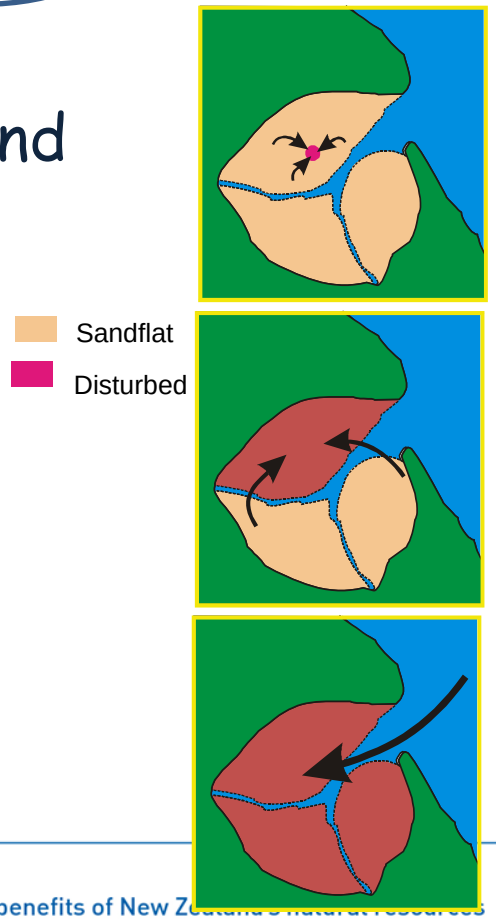


Magnitude, duration and extent?

- Very similar to magnitude and duration
- Particularly important for restoration or recovery management



Dominant Colonist sources

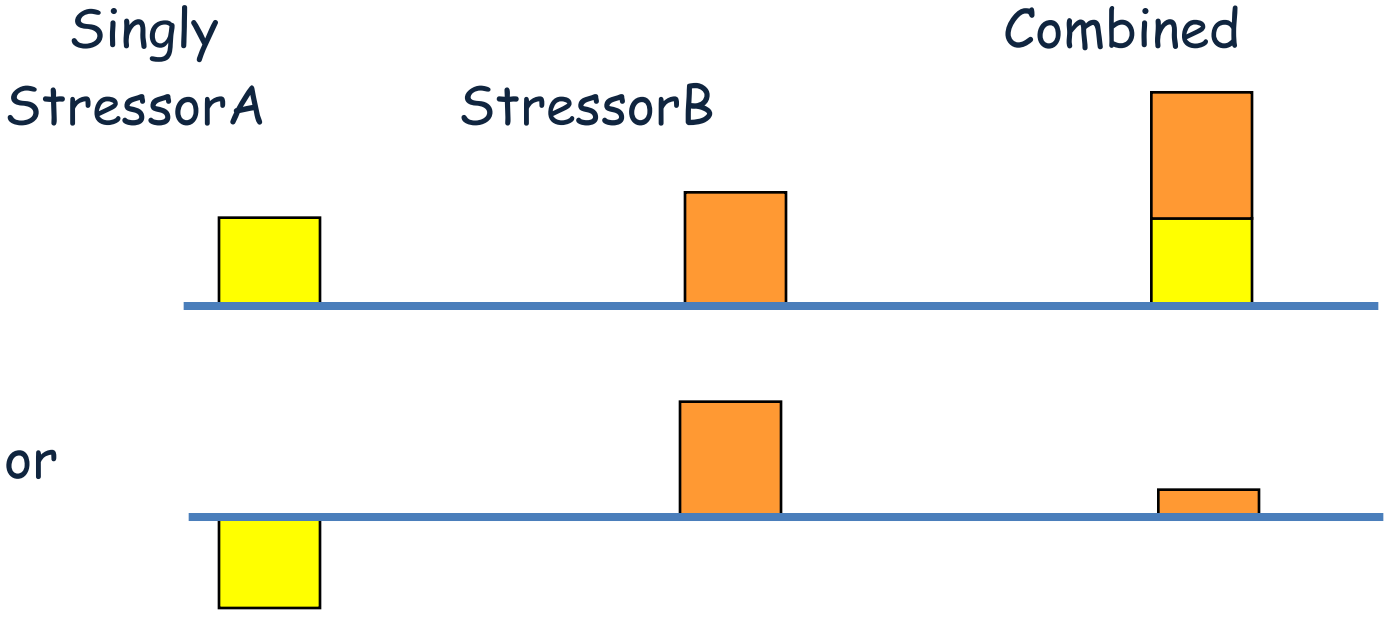
Surrounding sediments (e.g., with bedload)

Nearby habitats (e.g., Planktonic larvae and drifters - locally sourced)

Outside the system (i.e., Planktonic larvae and drifters - distant source)

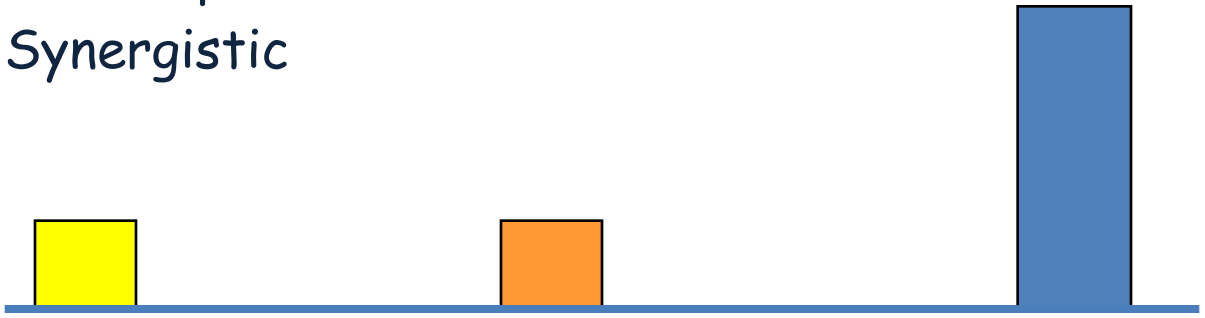
Other stressors- key is how they interact?

1. Additively



Other stressors- key is how they interact?

2. Mulitplicative Synergistic

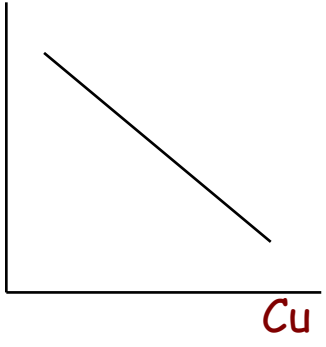


Or Antagonistic

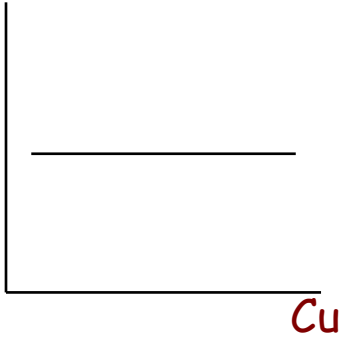
Other stressors- key is how they interact?

3. Threshold effects- effect of one stressor is entirely dependent on the level of another stressor

e.g., < 30% mud content



>30% mud content

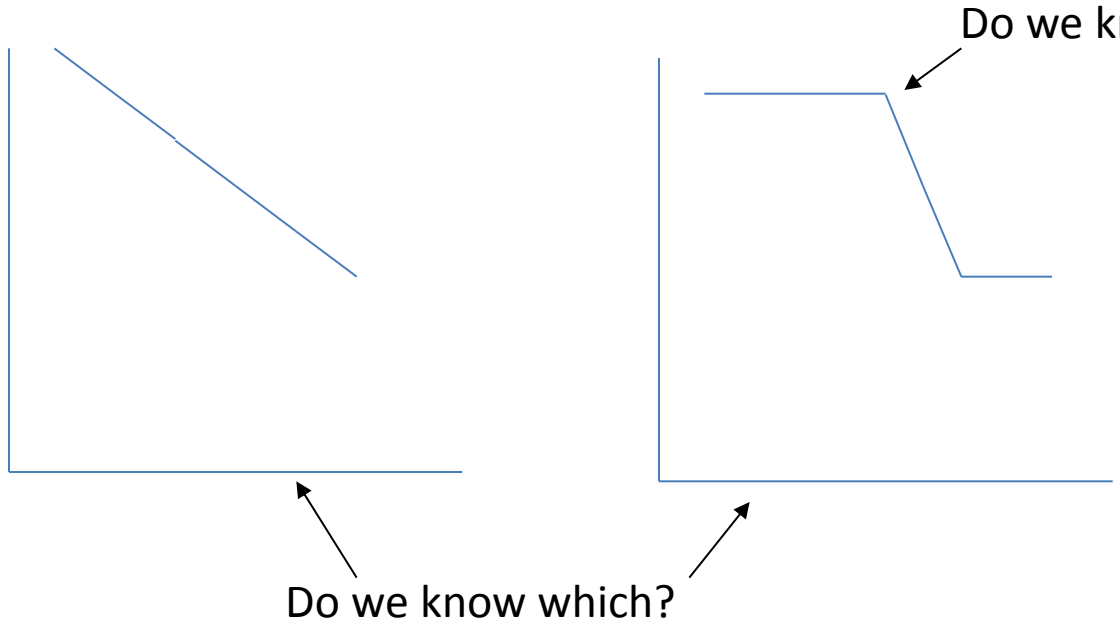


Other stressors- key is how they interact?

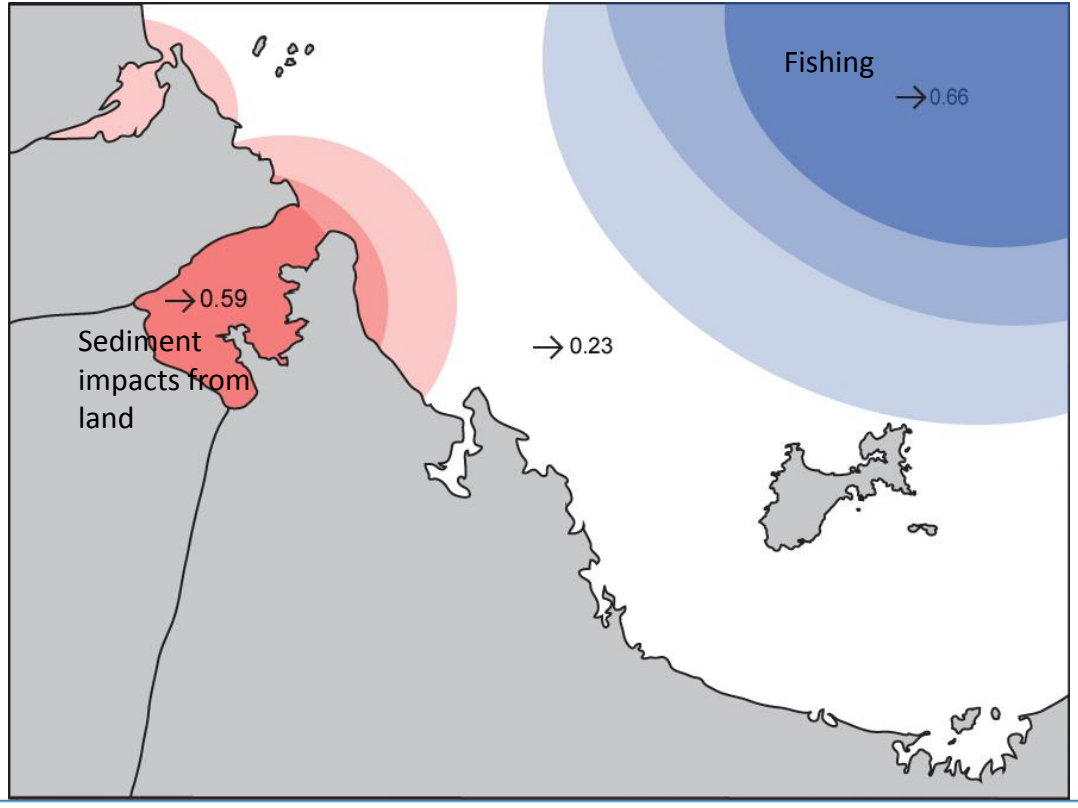
Limit setting will only be an effective management tool for estuaries if interactions between stressors is explicitly considered

Ecosystem Based Management (EBM)

Management strategies- key question- linear or threshold?



Management tools- assessing the risk of threshold effects on biodiversity



Management strategies for biodiversity

- Need to be spatial
- Need to know what is where in biological terms not environmental conditions
- Preserve habitat diversity
- Multiple strategies increase resilience against surprises
- Need to understand what is more cost-effective
  - Maintaining healthy places, reducing more stress in poor health places, or restoring bad health places?