National SCIENCE Challenges

SUSTAINABLE SEAS

Ko ngā moana whakauka

Changes in nature and the nature of change

Implications for assessing risk and uncertainty in the real world,

Addressing risk and uncertainty, Sustainable Seas Conference, November, 2018, Wellington

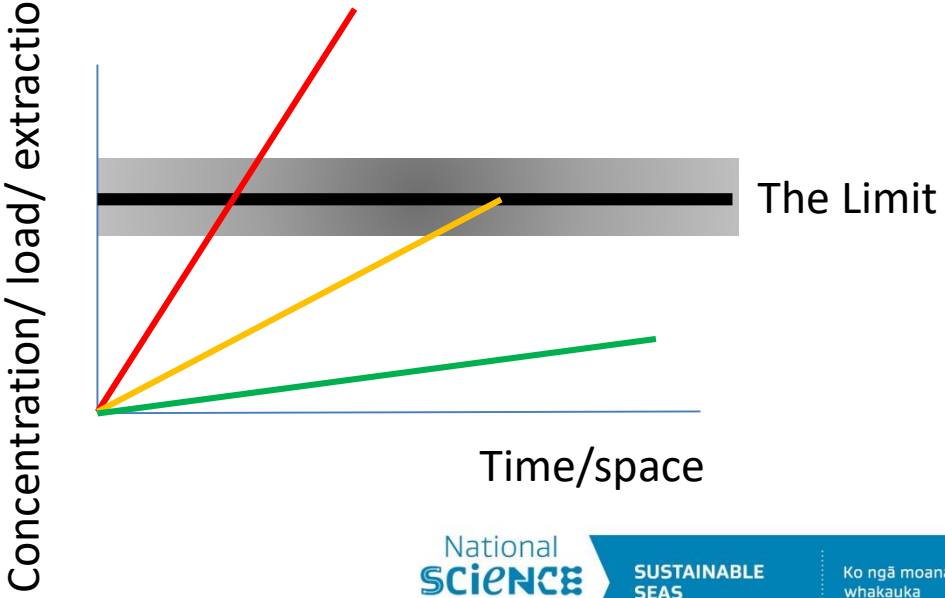
Simon Thrush & the Tipping Points Project, Institute of Marine Science, The University of Auckland

THE UNIVERSITY OF AUCKLAND NEW ZEALAND · THE UNIVERSITY OF WAIKATO · Victoria UNIVERSITY OF WELLINGTON · NIWA Taihoro Nukurangi · UNIVERSITY OF OTAGO · UC UNIVERSITY OF CANTERBURY · GNS SCIENCE · CAWTHRON The power of science®

Setting limits and avoiding risk

- Set and forget policy
- One stress at a time please
- Focus on stress or extraction loads not ecosystem responses

Stuff.co.nz

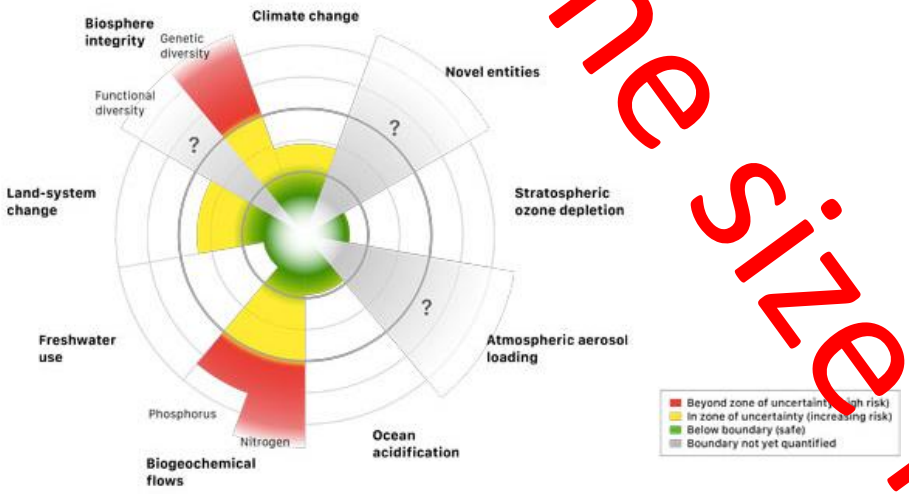


Stockholm Resilience Centre
Sustainability Science for Biosphere Stewardship

Stockholm University

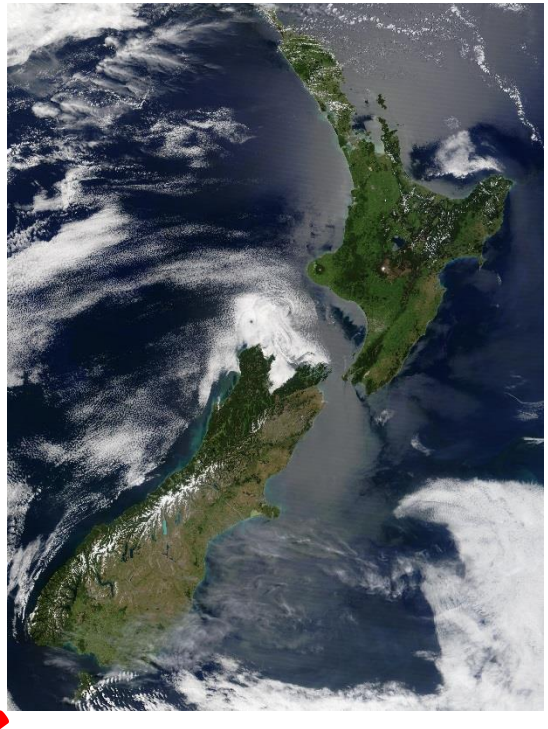
RESEARCH

Stockholm Resilience Centre / Research / Planetary boundaries / About the research / The nine planet

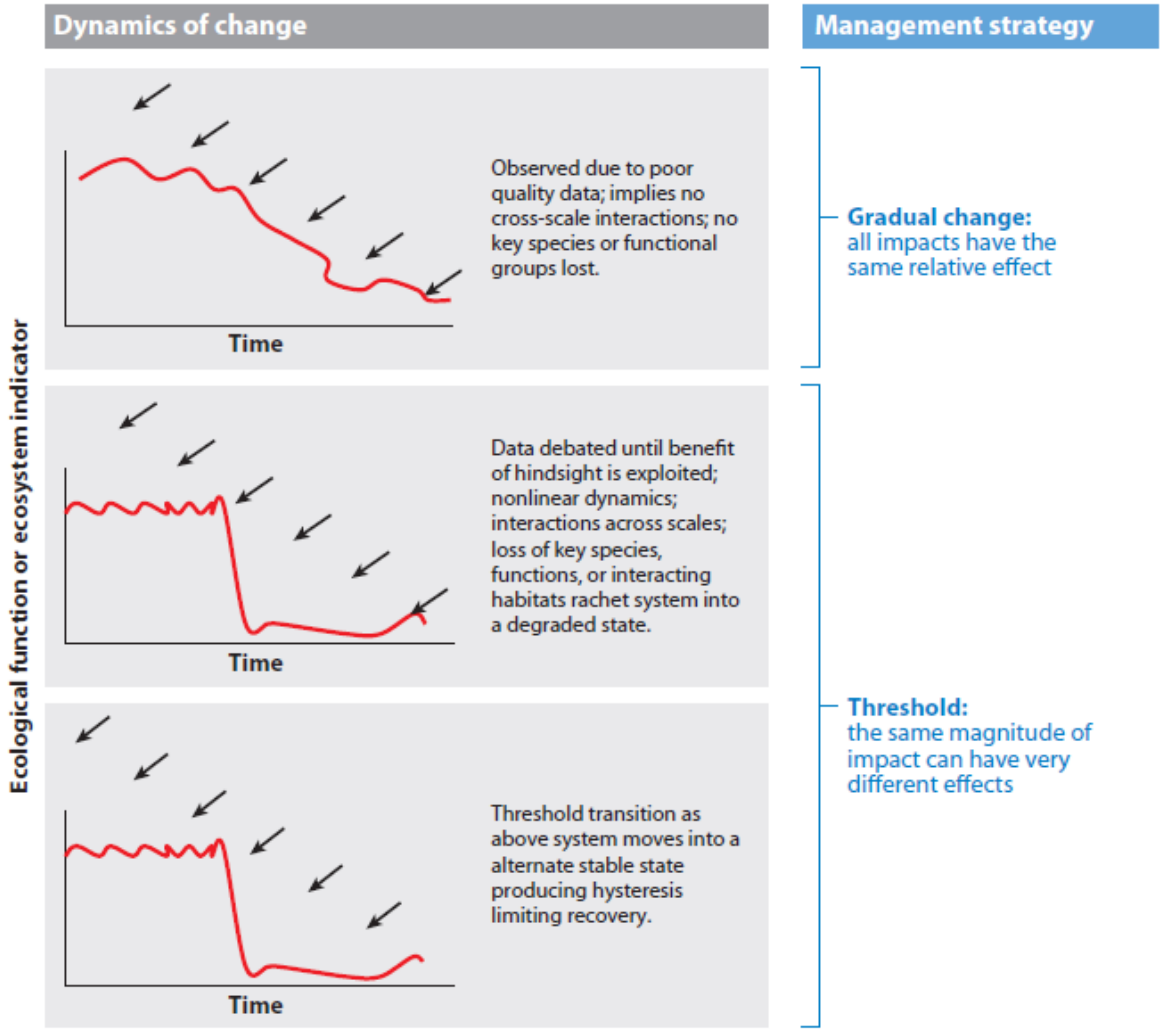


Estimates of how the different control variables for seven planetary boundaries have changed from 1950 to present.

One size fits all



But how do ecosystems actually change?



Thrush, S.F., Dayton, P.K. (2010) What can ecology contribute to ecosystem-based management? *Annual Review of Marine Science,* ***2, 419-441.***

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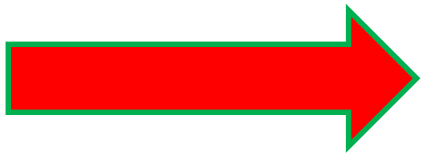
Hindsight  Foresight

Monitoring can detect

- A past TP
  - Change management from reactive to restoration
  - Use to determine precautionary thresholds for other locations
- An approaching TP (EWS)
  - Take action

How do NZ programmes stack up?

Typically

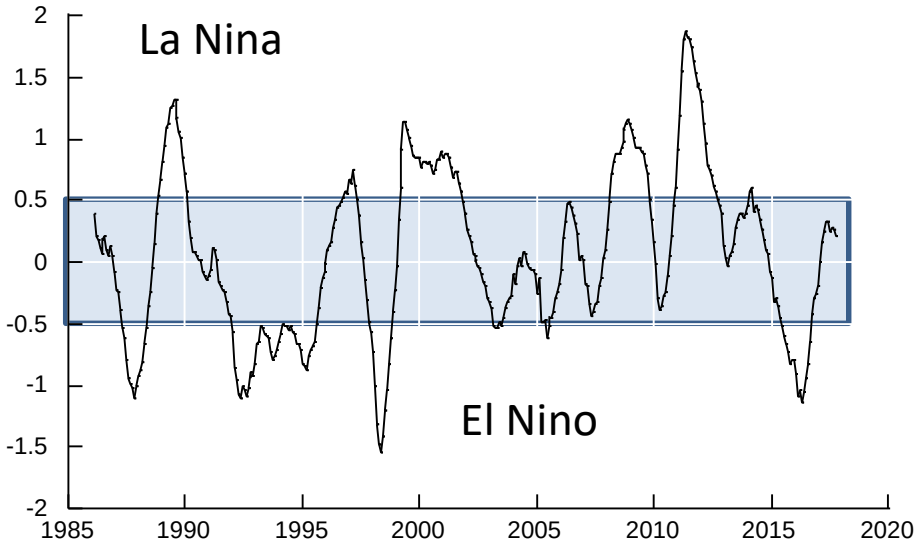
- Short
- Low frequency
- Spatially and temporally nested

Conclusion = we have not been able to gather good long term data

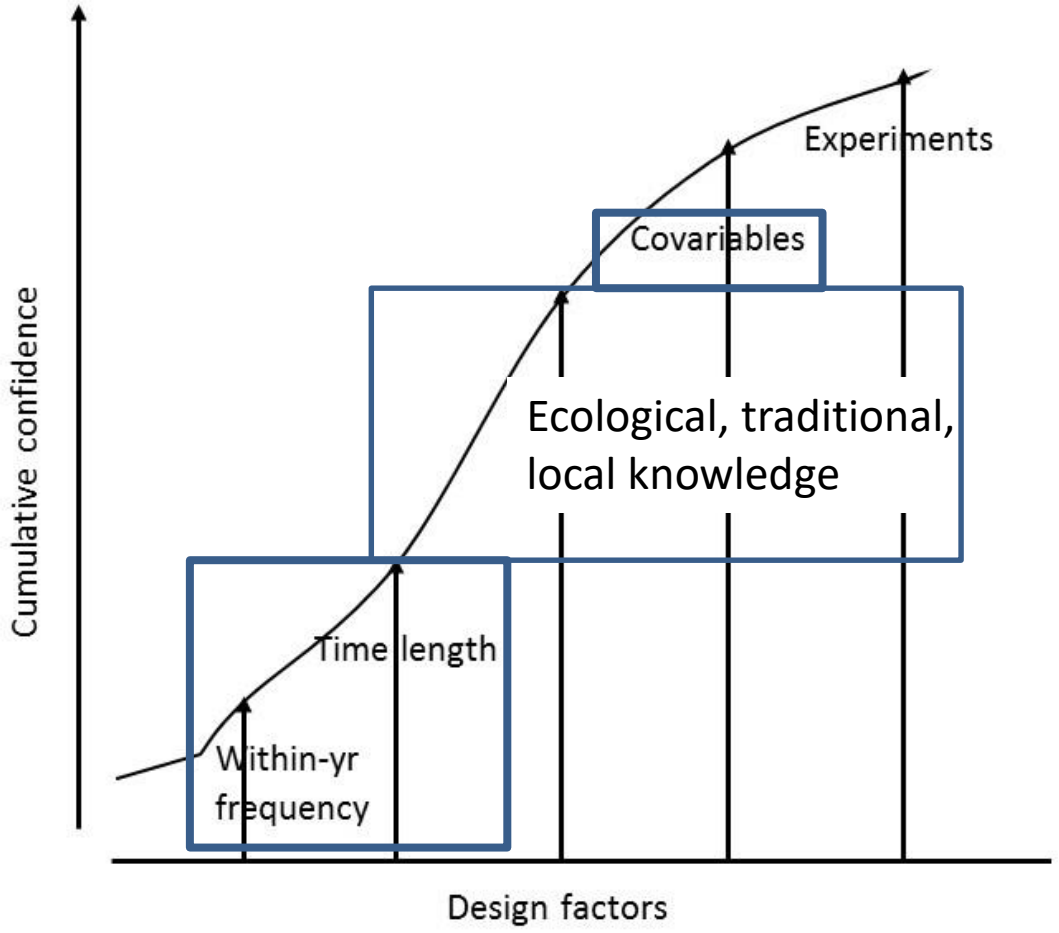
Type	Extent	Frequency (lag)
Estuarine macrofauna	9 – 30y	2mo – 5y
Intertidal and subtidal rocky reef epibenthos	<5 – 25y	3mo, or annual, or irregular
Fish from trawls	38y	Annual to 3y

Climate variability

- 67 - 78% species lower detection of TP in El Nino years and higher variability



Increasing certainty - Making more with less



- Use most appropriate scales, data and tests
- Extract information from noise
- Use a variety of techniques to increase certainty

Multiple stressors & Cumulative impacts

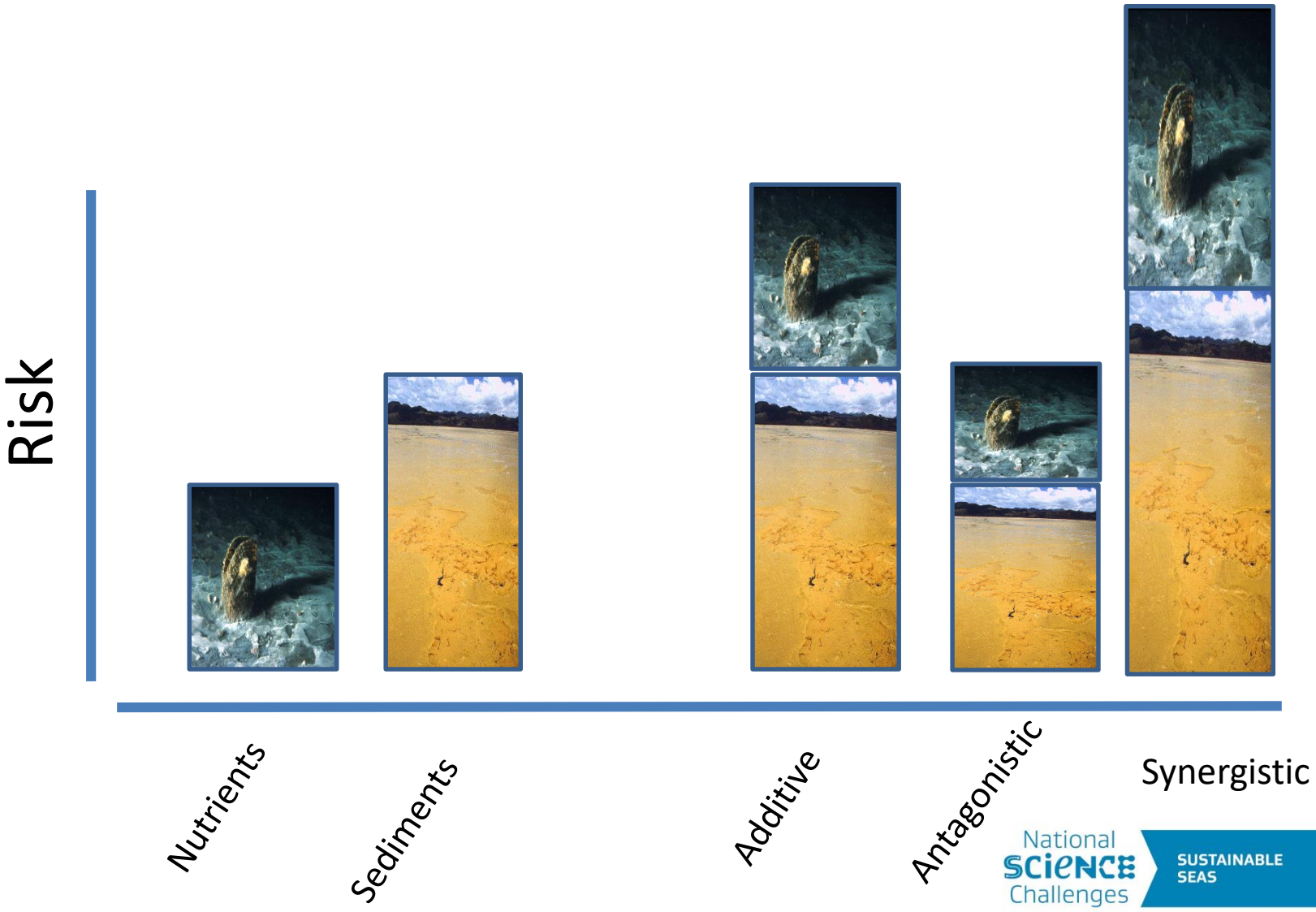
Disturbance regimes
- Spatial extent
- Frequency
- Intensity

Single agent of change (e.g., fishing)
- Changes in trophic relations
- Changes in ecosystem function
- Biodiversity loss
- Habitat disturbance
- Pollution
- Noise

ericweathersreport.com

Multiple agents of change
- Eutrophication * fishing
- Eutrophication*sedimentation
- Sedimentation* Sea level rise
- Increased SST * ocean acidification
- Pollution * habitat loss

Risks and cumulative effects



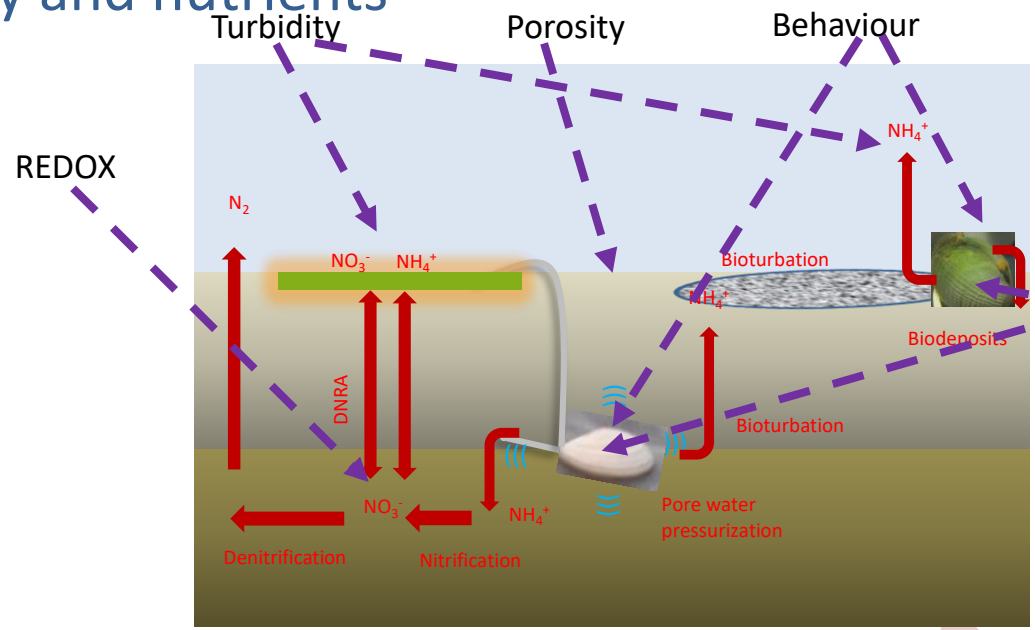
TP experiment investigates the big consequences of small changes in turbidity and nutrients

Mechanisms

No simple cause-effect relationship

It's a network of many species and environmental variables

Consequence



Functional shellfish populations impacted

Functional extinction reduces N processing

Increased risk of eutrophication makes habitat unsuitable for shellfish

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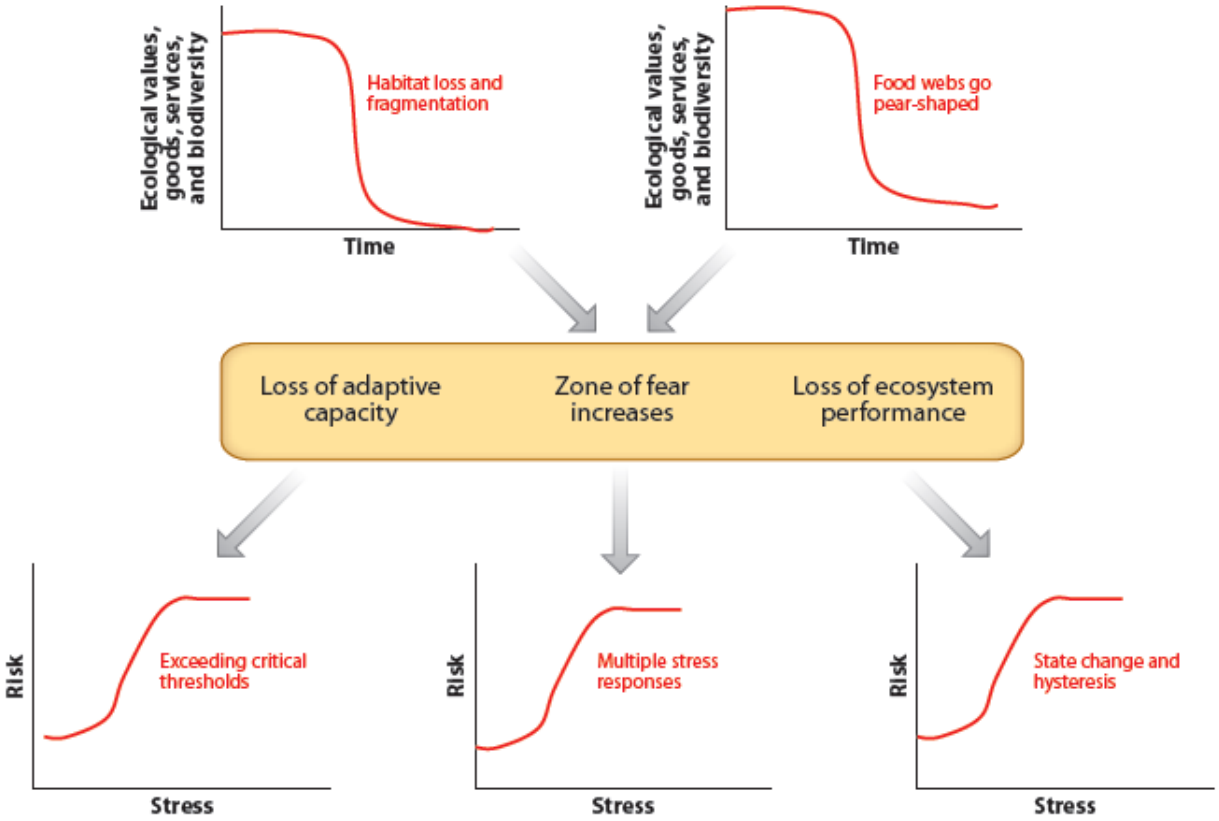
Rocky reefs

Squeezed out by two stressors

Cumulative and interactive effects radically shift risk profiles



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Ecosystem-based management…

Because we are all in it together

Short-term, certain, sectorial use

Long-term, less certain, multiple-use

- Resilience
- Complex adaptive systems
- Ecosystem response to change
- Sustainability
- Ecosystem Services
- Social-Ecological Systems

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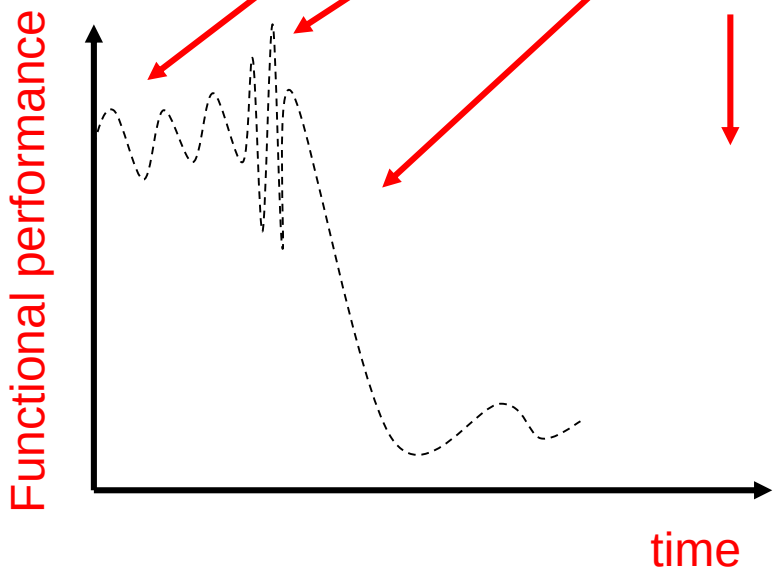
Time to act?

As well as defining thresholds in ecological systems we need to think about the socio-ecological systems and consider bureaucratic inertia, institutional stupidity……



openparachute.wordpress.com

What do we need to do?

- Better frameworks to quantify cumulative effects
  - Incorporate Connectivity, not but just populations – ecosystem functions and services
  - Link ecosystem responses to stressors and cumulative impacts

- Manage for Surprise
  - Operationalise Resilience
  - Enhance biodiversity - particularly functional diversity, habitat heterogeneity and redundancy.
  - Precautionary approaches when uncertain of consequences