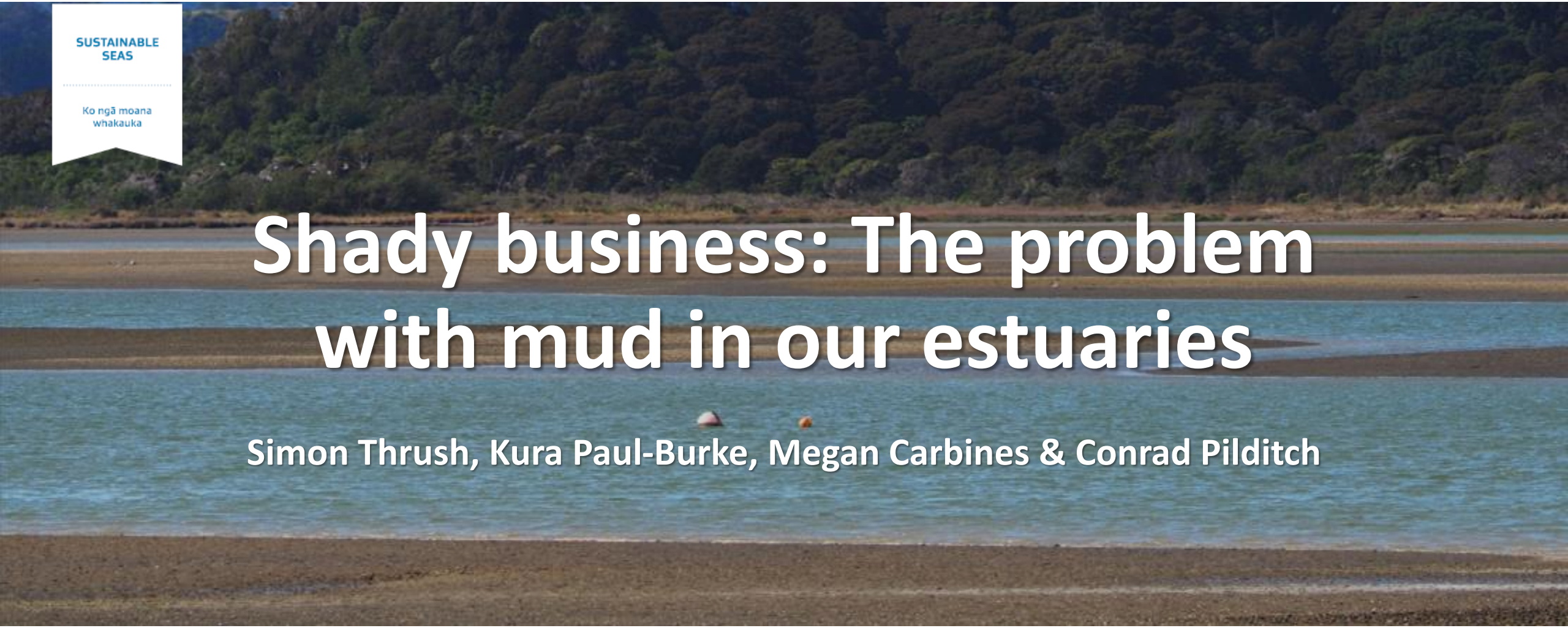
National SCIENCE Challenges

Webinar: 11am, Thursday 20 May 2021

SUSTAINABLE SEAS

Ko ngā moana whakauka



Shady business: The problem with mud in our estuaries

Simon Thrush, Kura Paul-Burke, Megan Carbines & Conrad Pilditch

THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

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Acknowledgements

- BC (Before the Challenge)

- Challenge projects & researchers:
  - Tipping Points (Phase I)
  - Ecological responses to cumulative effects (Phase II)

- Collaborating partners
  - Iwi
  - Councils – AC, WRC, BoPRC, MDC, ORC, ES
  - MfE, DoC, NZ Fisheries/MPI

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"To enhance utilisation of marine resources within environmental and biological limits"

What we aim to cover today

- **A tangata whenua perspective:** Assoc Prof Kura Paul-Burke (UoW)
- **Known knowns, known unknowns & potential unknown unknowns**: Prof Simon Thrush (UoA)
- **Current management perspectives:** Dr Megan Carbines (AC)
- **Pathways forward:** Prof Simon Thrush

Ngā tohu o te taiao

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Recognising, interpreting and responding to contemporary signs of the natural world

Mahi Tahi

Collaborative observation, action, reflection. Look to an intergenerational past, to inform the future

Kaitiakitanga

Action. Use mātauranga Māori and Western science to assist informed decision-making and management action for the long term

- Mātauranga ā iwi & Western science to better understand socio-cultural-ecological impacts
- Does not take much mud to drastically change things
- Role of sediments as a driver of change

- Co-developed with iwi at all levels and stages
- Intergenerational place-based mātauranga to assist design, site selection & field work implementation
- Assist real-life, meaningful understanding of ground changes in our harbour and the impacts on mahinga kai
- Dissemination of knowledge findings and outputs that are appropriate and accessible

Kaitiakitanga

- Kaitiakitanga must include positive, proactive, transformative action.
- Without action, the principles of kaitiakitanga are reduced to merely having a concern or interest
- but with no active responsibilities or decision-making capabilities.

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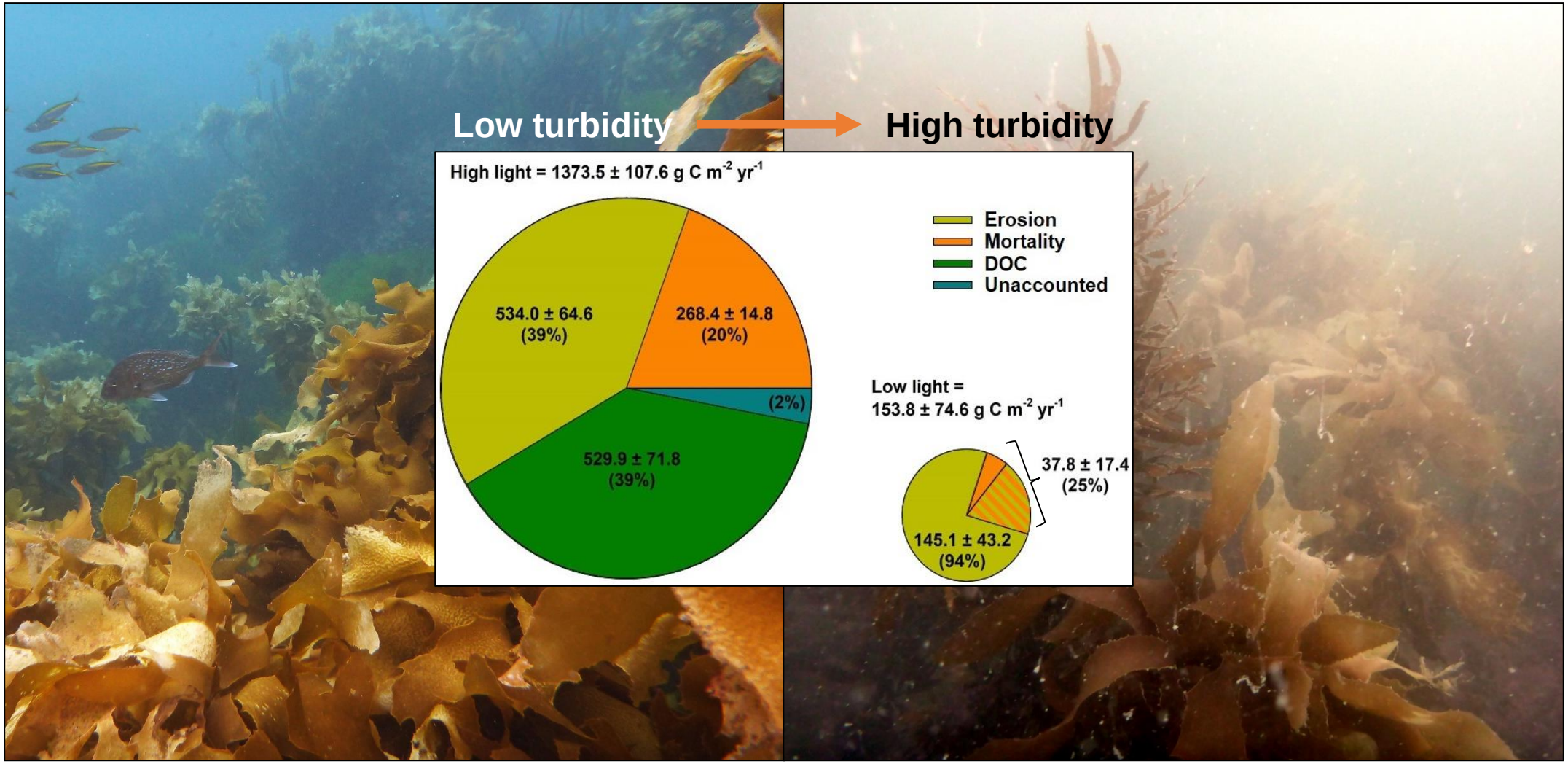
Guidelines for depositional events

- Sediment smothers plants and animals, change habitats, change ecosystem functions and services
- Depending on the location, elevated sedimentation can have long legacy effects

The SSC problem

- Especially critical for microphytobenthos and the suspension feeding animals (shellfish)
- Suspended sediment concentrations are variable and high concentrations for short periods of time are likely less serious that chronic turbidity over long periods.
- No simple measure of suspended sediment effects!
- Average values not very meaningful in terms of ecosystem and biodiversity effects

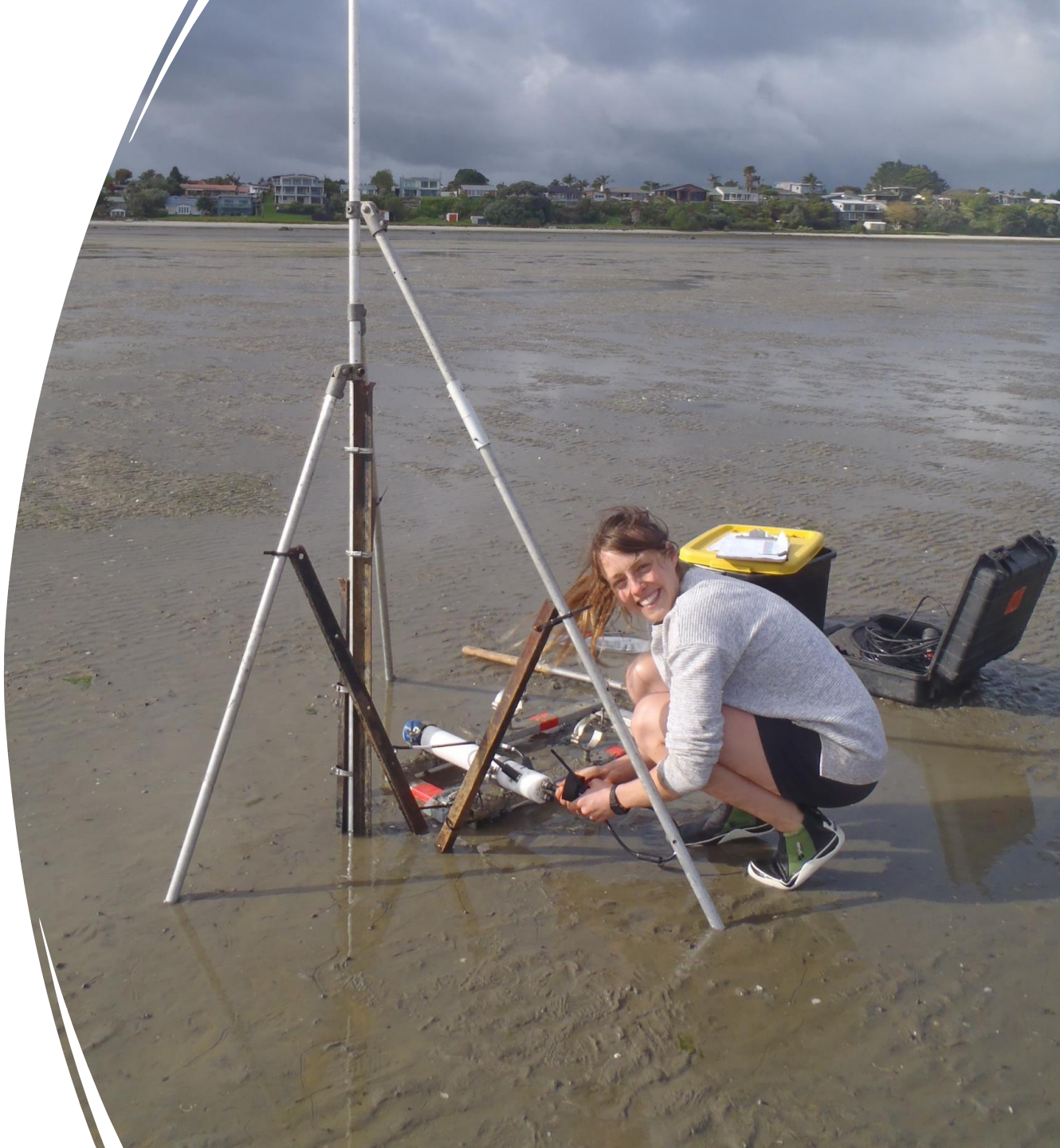
Coastal darkening substantially limits the contribution of kelp to coastal carbon cycles
C. Blain, C. Hansen, N. Shears. In review at Global Change Biology



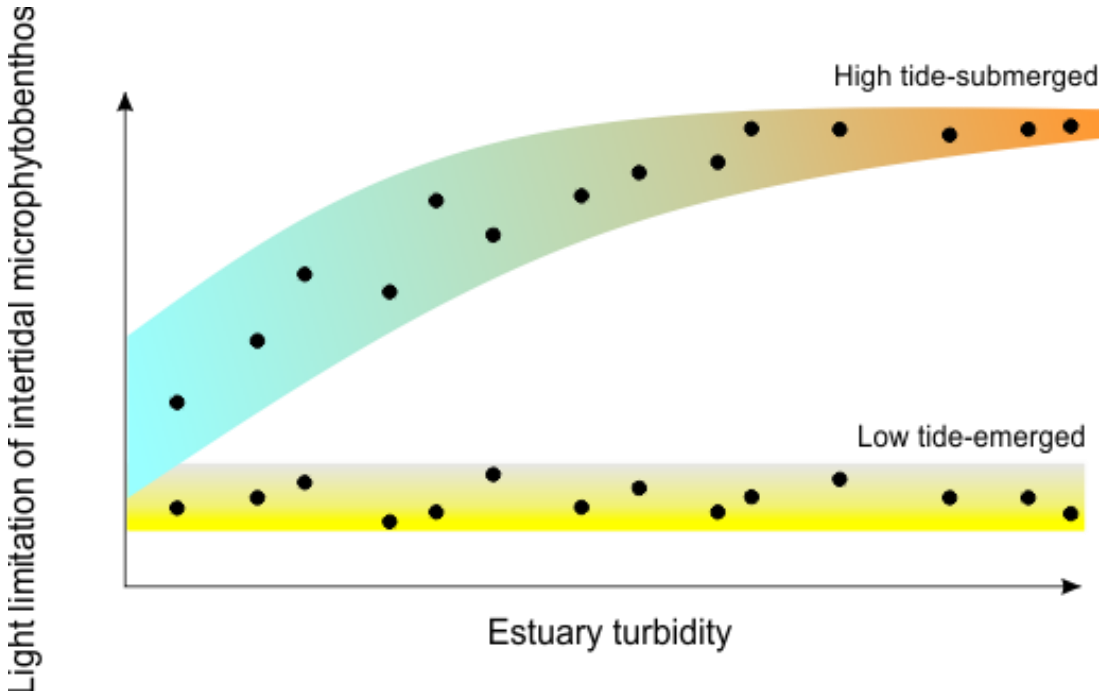
- Increased turbidity and reduced light limit the vertical distribution of kelp and leads to a shift in macroalgal communities
- Annually primary productivity estimates at high light sites were nearly 6 times greater than those at low light sites
- Increased turbidity ultimately reduces the potential role of kelp ecosystems as donors to coastal carbon cycles

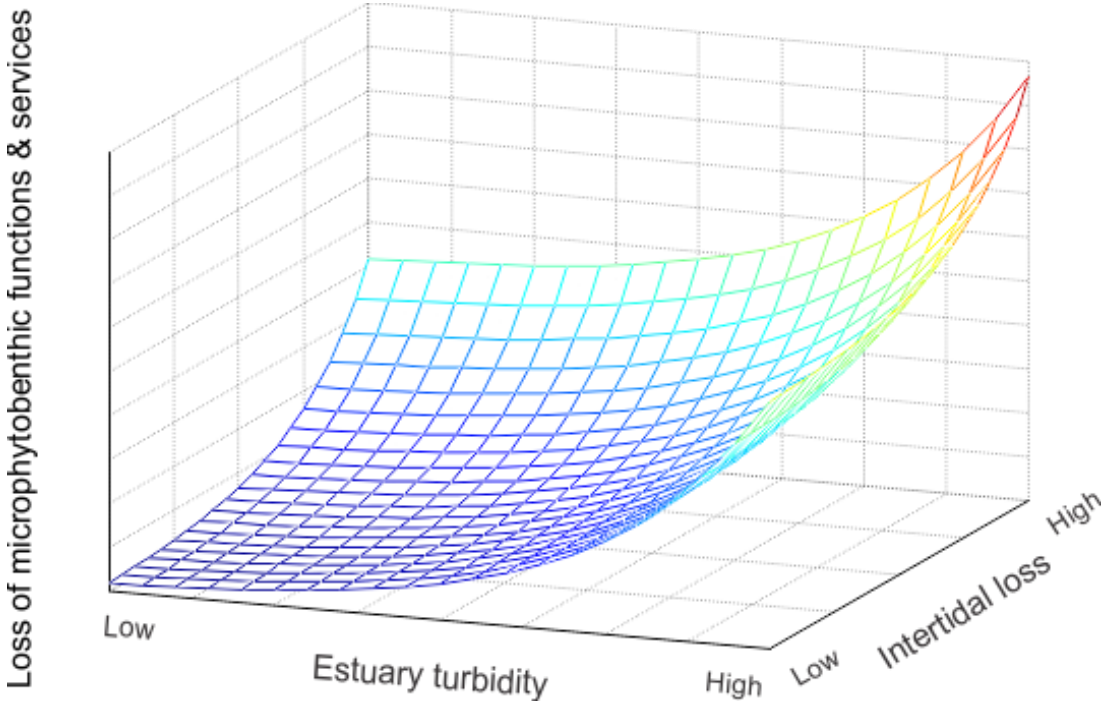
Cumulative effects are the impacts on the environment which result from the incremental impact of a stressor when added to other past, present and reasonably foreseeable future stressors.

- Especially prevalent in estuaries and coasts
- One of the most urgent and complex problems facing coastal and marine decision makers and scientists

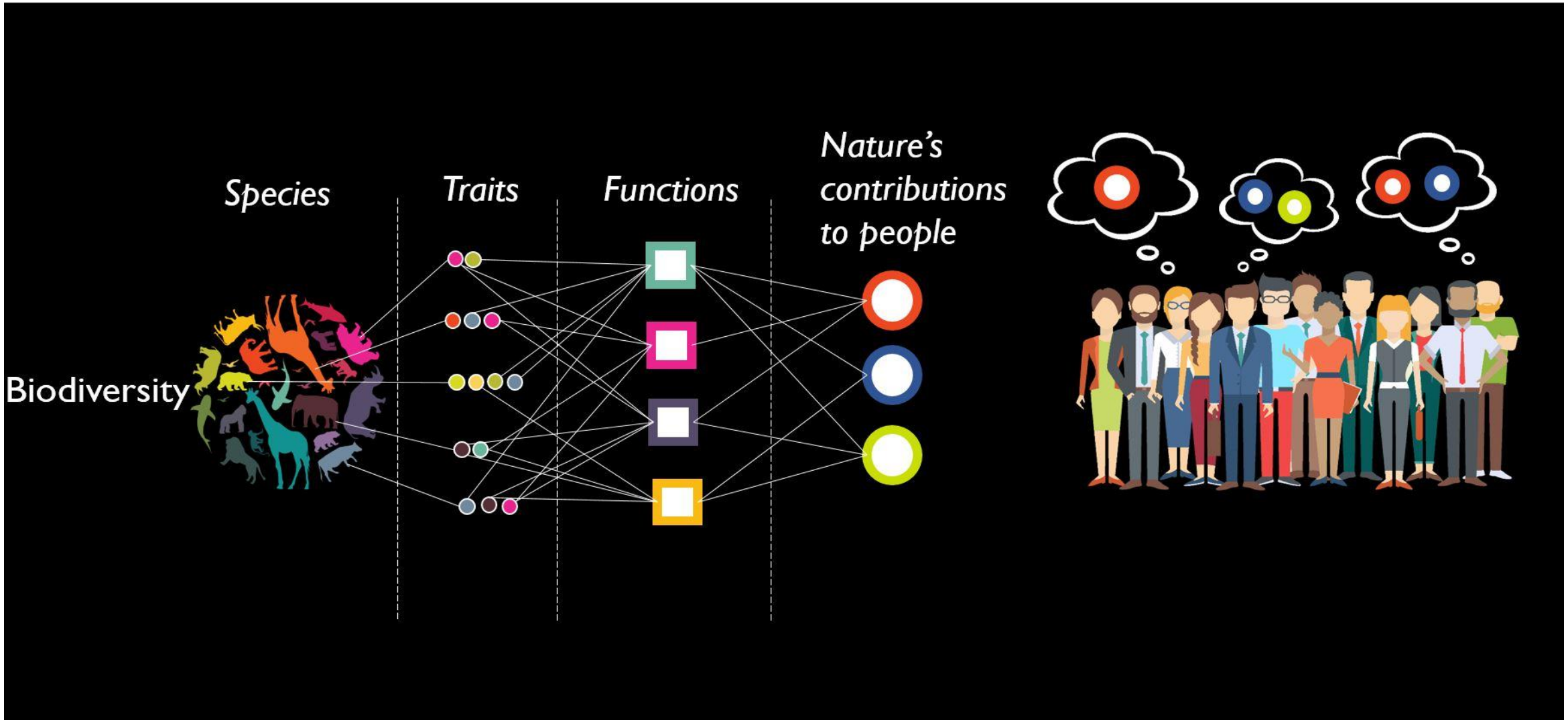


Cumulative effects assessments – estuary seafloor processes



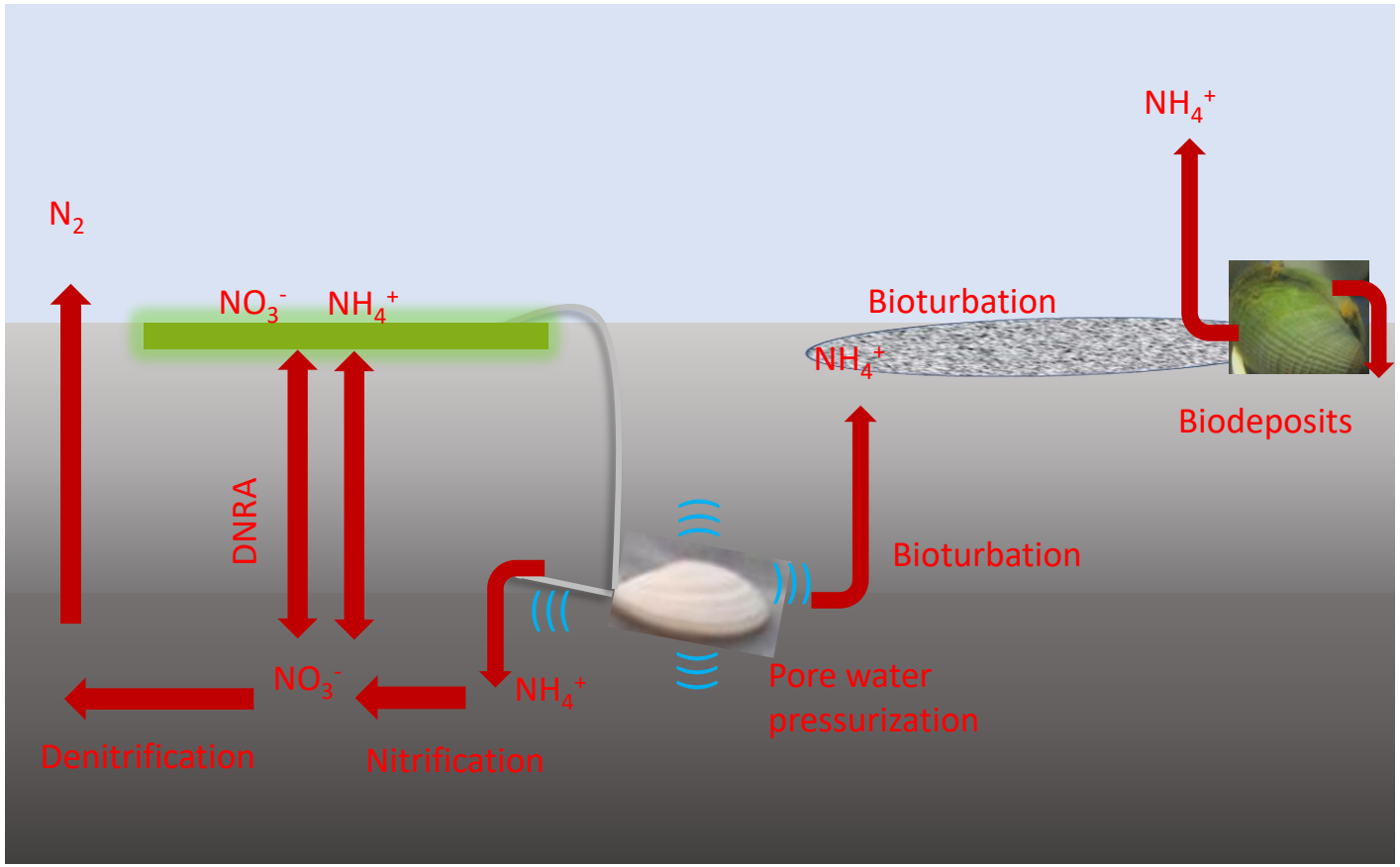


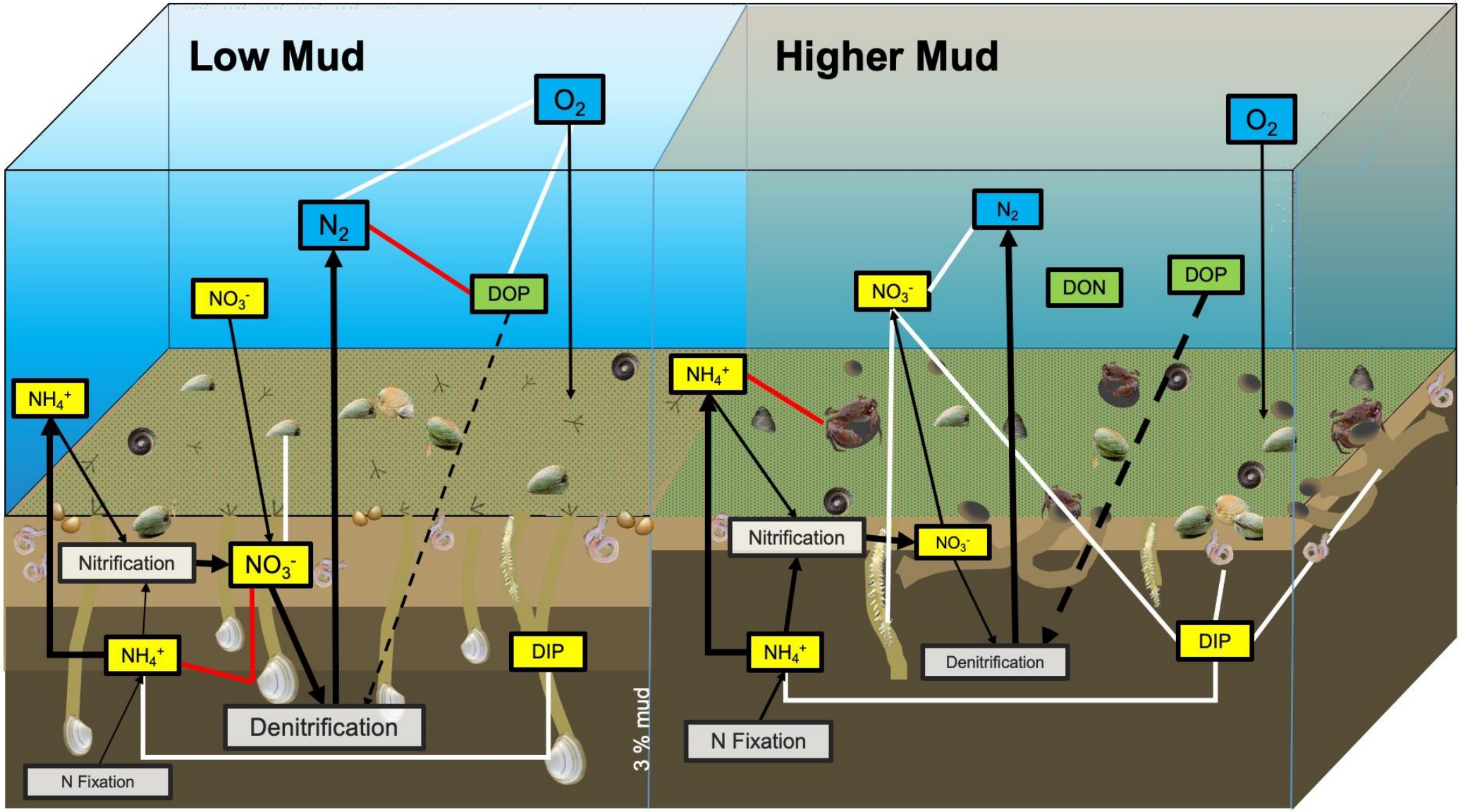
Its all about the systems – the role of networks…



Siwicka E and Thrush S F (2020). Advancing Approaches for Understanding the Nature-People Link. Ecological Complexity, 44 100877. https://doi.org/10.1016/j.ecocom.2020.100877

It helps to know how it works if we want to fix it





Critical ecosystem functions shift when sandflats have > 3% mud.

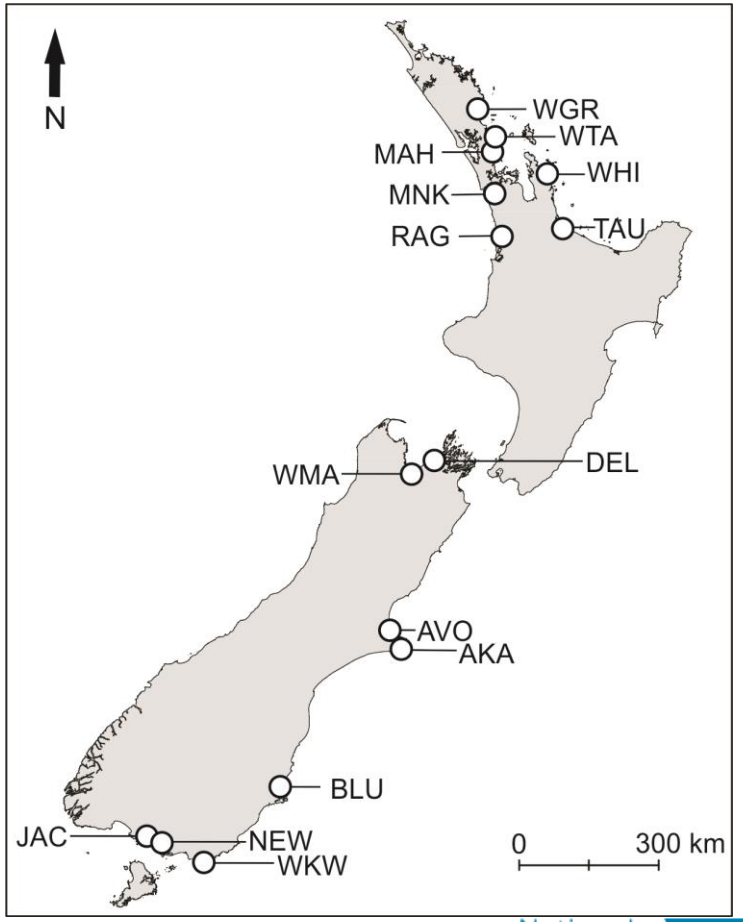
Amanda Vieillard PhD thesis, IMS

Tipping Points - highlight how the adaptive capacity of these important ecosystems is constrained by sediment and nutrient loading and the loss of shellfish

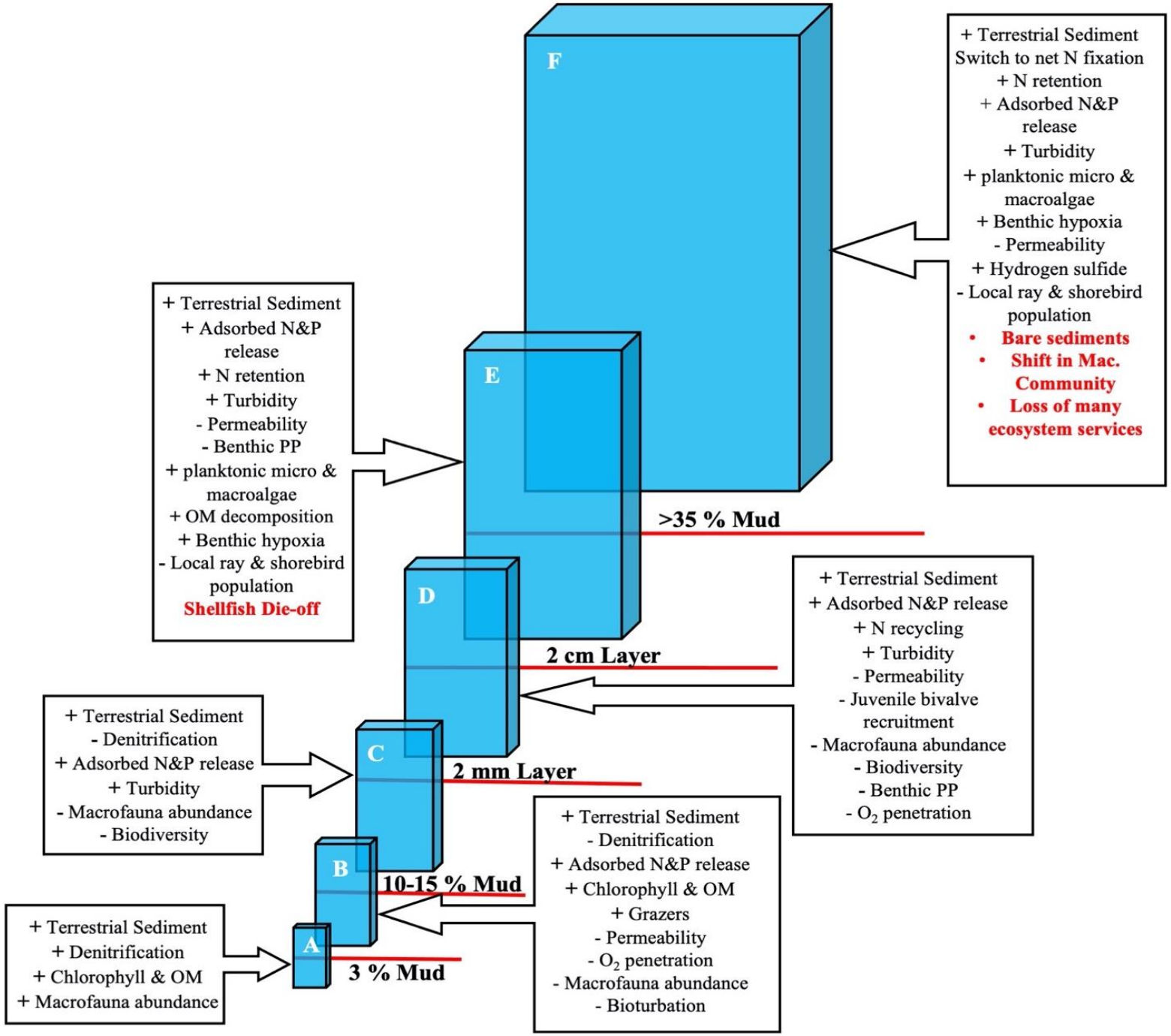
Functional shellfish populations impacted

Functional extinction reduces N processing

Increased risk of eutrophication makes habitat unsuitable for shellfish



The mud tipping point cascade



Amanda Vieillard 2020. Ecogeochemistry of oligotrophic, soft sediment estuarine systems, PhD Thesis, University of Auckland

So many questions

- How much is too much?
- How many is too many?
- ‘Rare’ events ‘less rare’?
- Lasting or cumulative effects?
- Interaction with existing sediment/other stressors/health of what’s there?
- Scale of effect and control?

Auckland developer claims he's not to blame for acres of dead cockles

22/05/2018 | Isobel Ewing

Complex

Long term sedimentation
Some short term events
Heat wave
Parasites and disease

Multiple stressors
Cumulative effects
Tipping Point?
Recovery?

Ecosystems, Values and People

It is not just science, sediment or limits – it's a complex conversation

What are we managing for?

Opportunities, challenges and needs

- PCE Vision: *If we manage our estuaries ki uta ki tai – from the mountains to the sea – our estuarine habitats will thrive for years to come.*
- "This National Policy Statement applies to all freshwater (including groundwater) and, to the extent they are affected by freshwater, to **receiving environments** (which may include **estuaries** and the wider coastal marine area)"
- The link between land management and what ends up in the estuary more explicit
- Still many questions to help planners and decision makers
    - Understanding the costs and benefits of alternatives
    - If we have incomplete information, what can we use?
    - Are there feedback loops and secondary effects?
    - How to account for historical impacts, multiple sources of sediment, and sediment movement?
    - Can we apply the same rules to similar estuaries?
- Risk and uncertainty are critical parts of the conversation and the calculation
- Estuaries aren't just something at the end of the pipeline and they aren't all the same

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RIMU Research and Evaluation Unit

Setting limits ? Avoiding risk

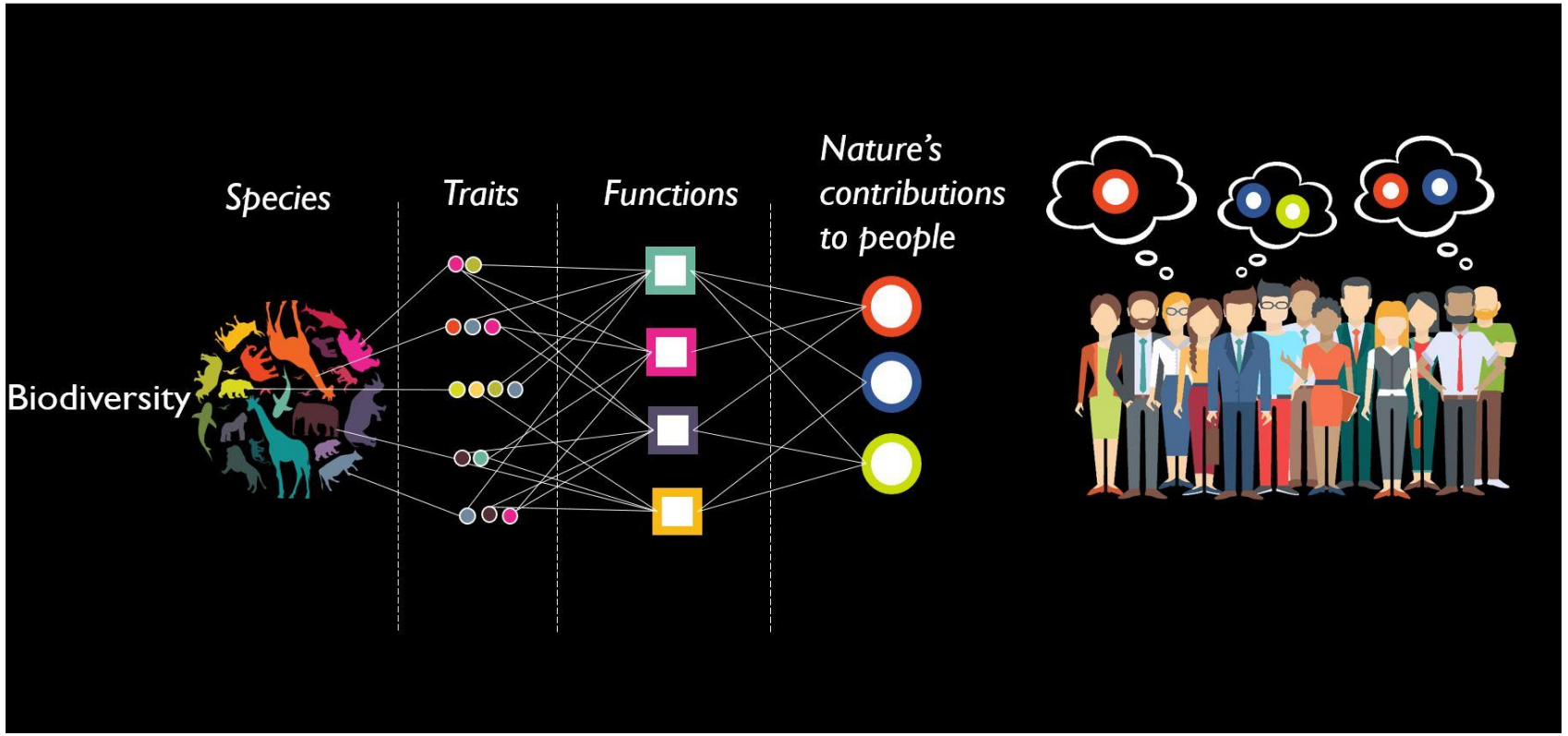
Principles → Practice?

- Move to managing cumulative effects through knowledge of ecosystem processes
- National guidelines are insensitive to cumulative effects
- One size fits all measures are unlike to protect against adverse 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.

- *Focus on estuaries and coasts*
- *'set limits' differently for different places and systems*
- *Employ a knowledge of how a system will react to change (based on things like existing condition, system type, species present and other stressors present)*
- *Employ a highly precautionary principal*
- *Avoid "Set and forget" policy*
- *Employ MSP and risk assessments that incorporate cumulative effects*
- *Manage to enhance resilience*
- *It's a zero sum game – do not waste it*

We need to implement EBM because…

Non-Integrative Bureaucratic Structures do not help



Key messages

- Mud as a stressor is a complex multi-faceted issue
- It does not take much mud to alter ecosystem functioning
- Significant knowledge gaps exist – interactions with other stressors, translating catchment loadings into impacts
- Need an estuaries approach to estuaries management. It’s not simple and how can we use what is known?
- Co-developed research with hapū/iwi assists kaitiakitanga for mahinga kai, decision-making and management actions for the long term
- A more integrated and marine ecosystems focused management is our only hope

Our top 5 reads

1. Paul-Burke, K et al (2018). Using Māori knowledge to assist understandings and management of shellfish populations in Ōhiwa harbour, Aotearoa New Zealand. *New Zealand Journal of Marine and Freshwater Research* doi.org/10.1080/00288330.2018.1506487
2. Thrush, SF et al (2004). Muddy waters: Elevating sediment input to coastal and estuarine habitats. *Frontiers in Ecology and the Environment* 2: 299-306 doi.org/10.1890/1540-9295(2004)002[0299:MWESIT]2.0.CO;2
3. Thrush SF et al (2021). Cumulative stressors reduce the self-regulating capacity of coastal ecosystems. *Ecological Applications* doi.org/10.1002/eap.2223
4. Mangan S et al (2020). Shady Business: The darkening of estuaries constrains benthic ecosystem function. *Marine Ecology Progress Series* 647: 33-48 doi.org/10.3354/meps13410
5. Thrush SF et al (2016). Addressing surprise and uncertain futures in marine science, marine governance, and society. *Ecology and Society* dx.doi.org/10.5751/ES-08574-210244

Bonus reading

Gladstone-Gallagher et al (2019). Old tools, new ways of using them: Harnessing expert opinions to plan for surprise in marine socio-ecological systems. *Frontiers in Marine Science* doi.org/10.3389/fmars.2019.00696

Resources for managers

[Monitoring for tipping points in the marine environment]

[Managing the impact of turbidity, nutrients and sea level rise on coasts and estuaries]


Q&A session
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