National SCIENCE Challenges

SUSTAINABLE SEAS

Ko ngā moana whakauka

Webinar starts: 1:05pm, Thursday 27 August

Sea-floor species health and survival to underwater 'sediment clouds'

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On behalf of the Project Team

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1, NIWA; 2, Victoria University

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Presentation outline

Project background

- Aims

Our work

- Experimental system development
- Results

Project conclusions and future application

Q & A

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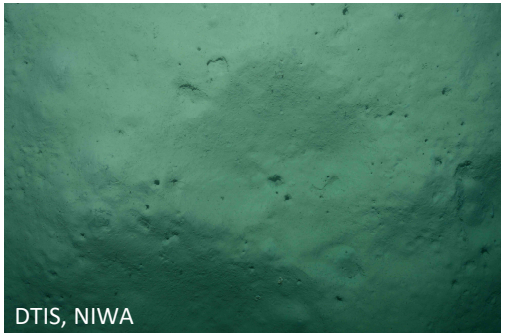
Background

- A large proportion of the seafloor in New Zealand waters is soft sediment
- Sediments can be disturbed by storms and/or by human activities
  - e.g. seabed dredging, mining, fishing, land-based activities
- Create clouds or plumes of suspended sediments
  - potentially extend over a wide area
- Limited data and understanding of biological responses to exposure to elevated suspended sediments (cf. direct seabed disturbances)
  - especially deeper shelf and continental slope fauna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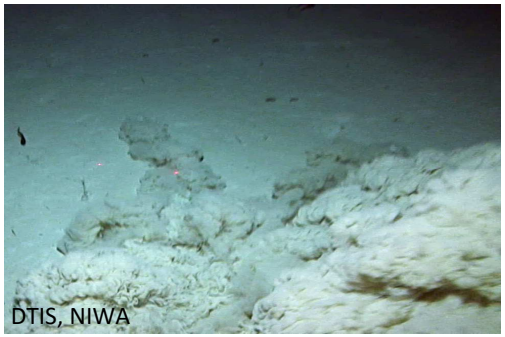
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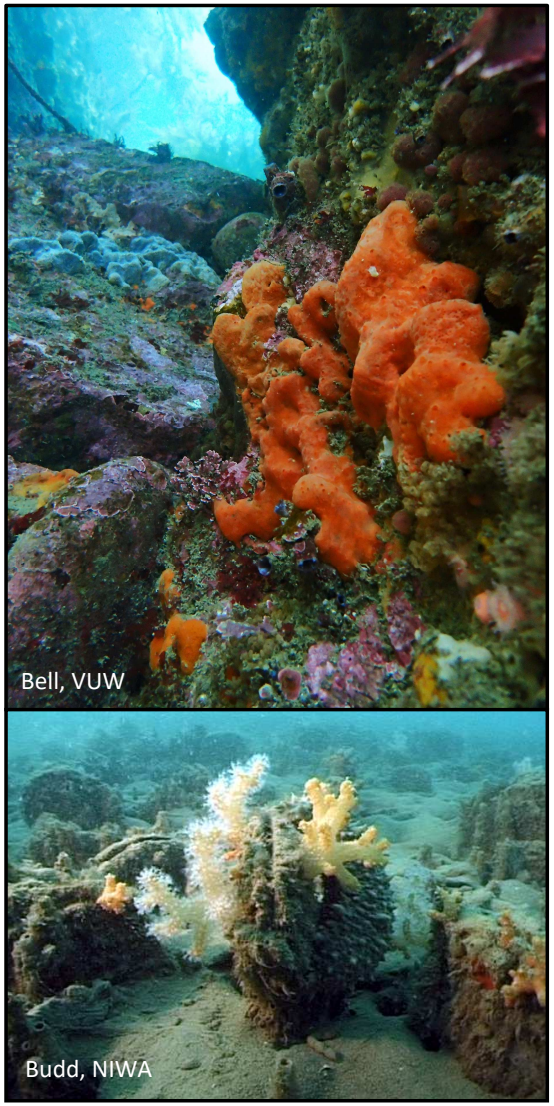
Biological responses

- Suspended sediment can affect the abundance, diversity and structure of benthic communities
- May influence factors such as survival, larval recruitment, feeding rates and efficiency, growth
- Species, and life history stages, vary in their vulnerabilities
- Some have specific strategies to reduce sediment intake
  - cessation or reduction of respiration or pumping
  - mucous production to remove sediment
  - particle expulsion



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Background (the Sustainable Seas "fit")

- The "*Sediment tolerance and mortality thresholds of benthic habitats*" project began in 2016
- Funded through the Challenge's Innovation Fund and part of the Dynamic Seas Programme from Phase I
- Aligned to the Sustainable Seas Challenge objective:

  "to enhance the value of NZs marine resources while providing a healthy marine environment"
- Improved knowledge of impacts, support for ecological risk assessments and ecosystem based models
- Extend Sustainable Seas research to deeper shelf waters

Innovation Fund

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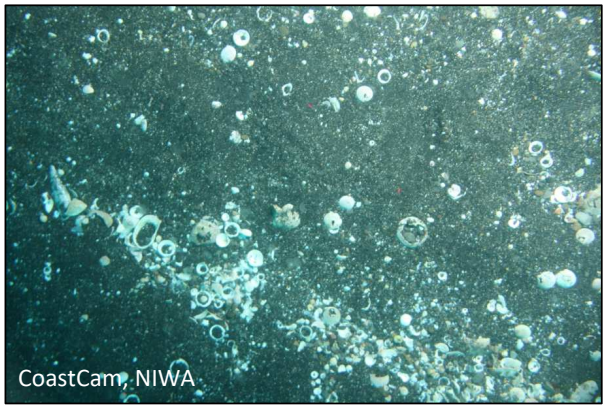
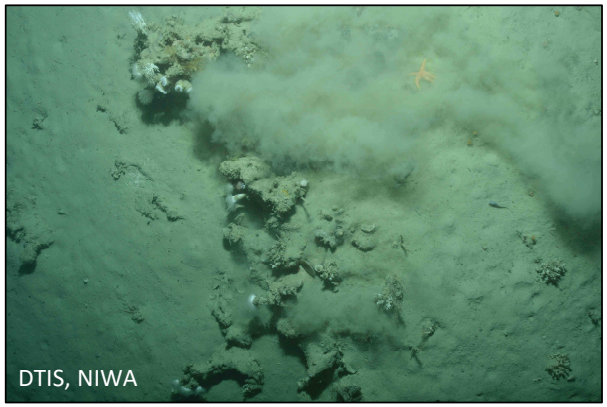
Aims

- to help establish threshold levels of suspended sediments where impacts might become “ecologically significant”

- provide information to mitigate or manage impacts of suspended sediments





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Study focus

Where?

- South Taranaki Bight and Wellington
- Consistent with West Coast Stage 1 Challenge study area
- Relevance to interest at the time in offshore impacts and sediment clouds (e.g. ironsands mining)

What?

- Common species
- Dog cockle (*Tucetona laticostata*)
- Sponge (*Crella incrustans*)

How?

- Laboratory experiments
- Suspended sediment system

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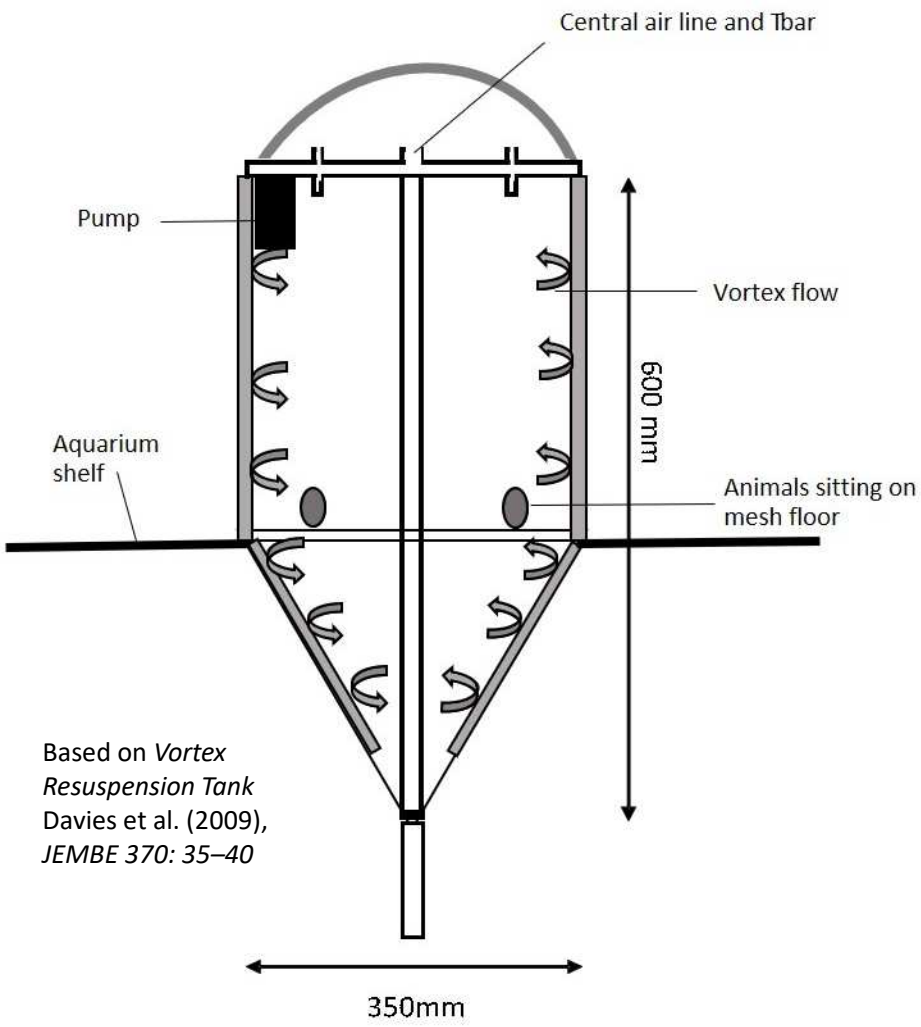
Chamber system development

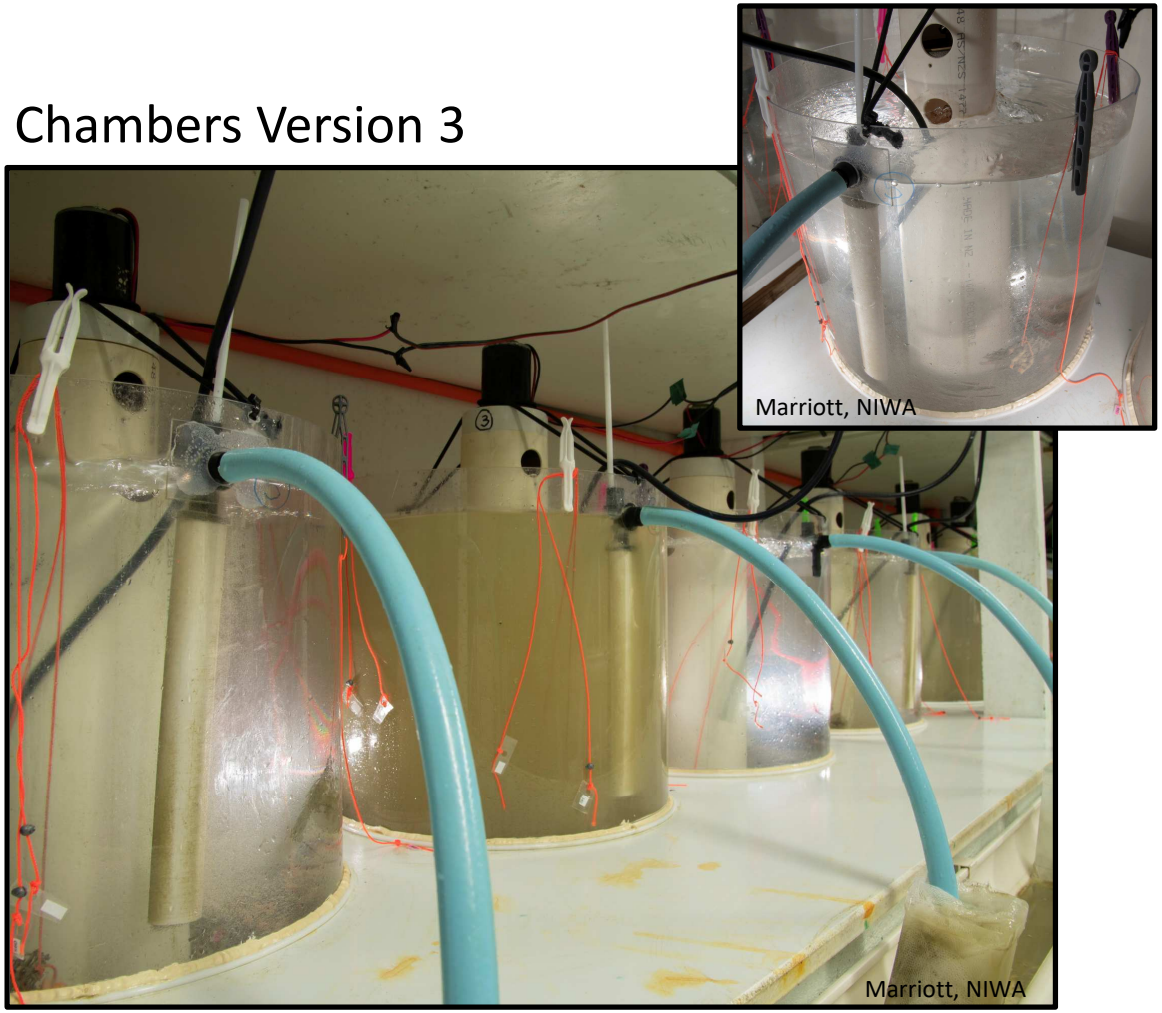


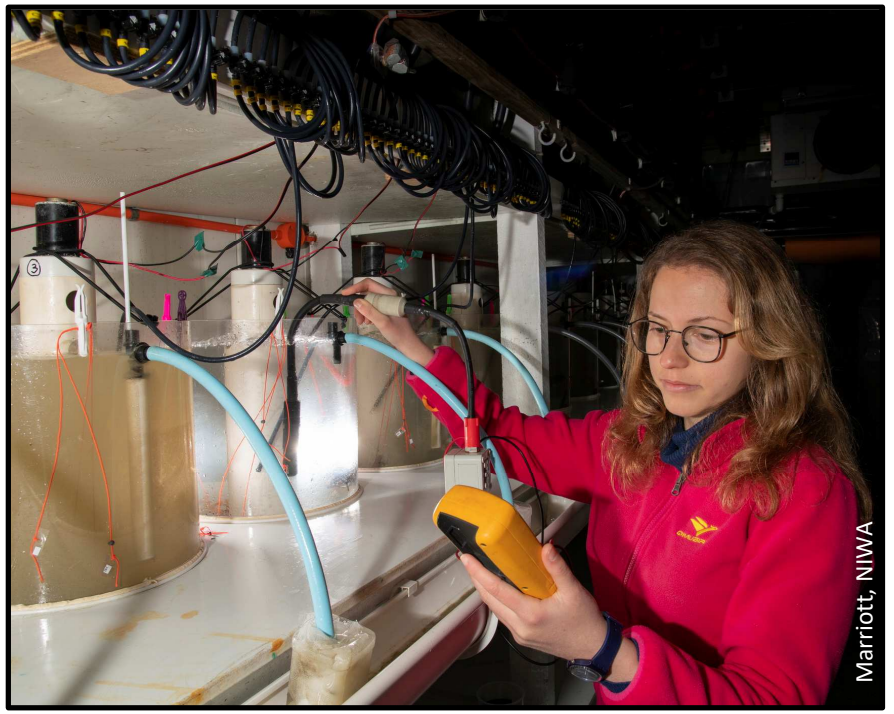
Based on *Vortex Resuspension Tank* Davies et al. (2009), *JEMBE 370: 35–40*

Suspend sediments, control loading
16 chambers, ~37 litres, flow through

Chamber system development

Chambers Version 3





Manual checks (optical turbidity meter)

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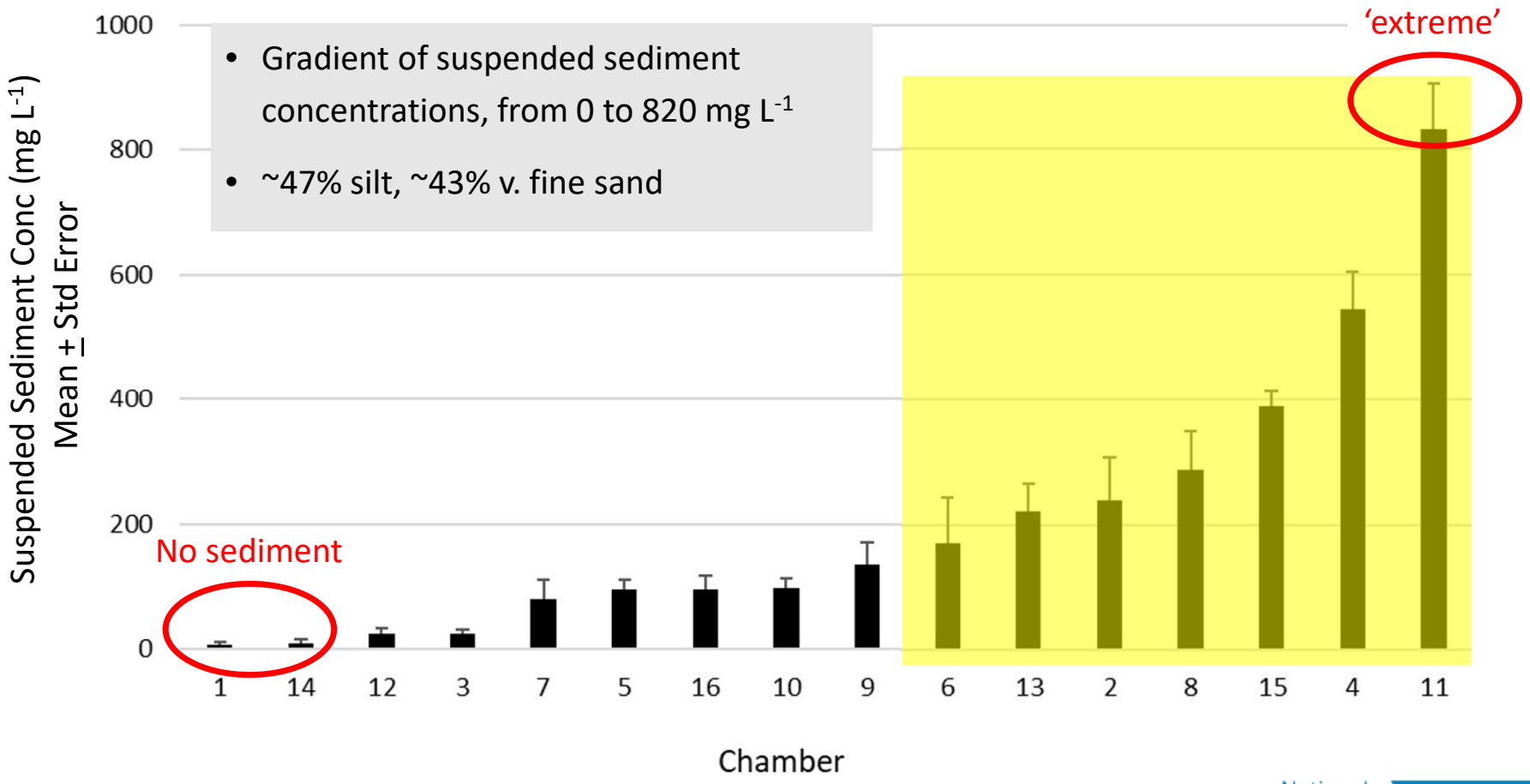
Experimental design



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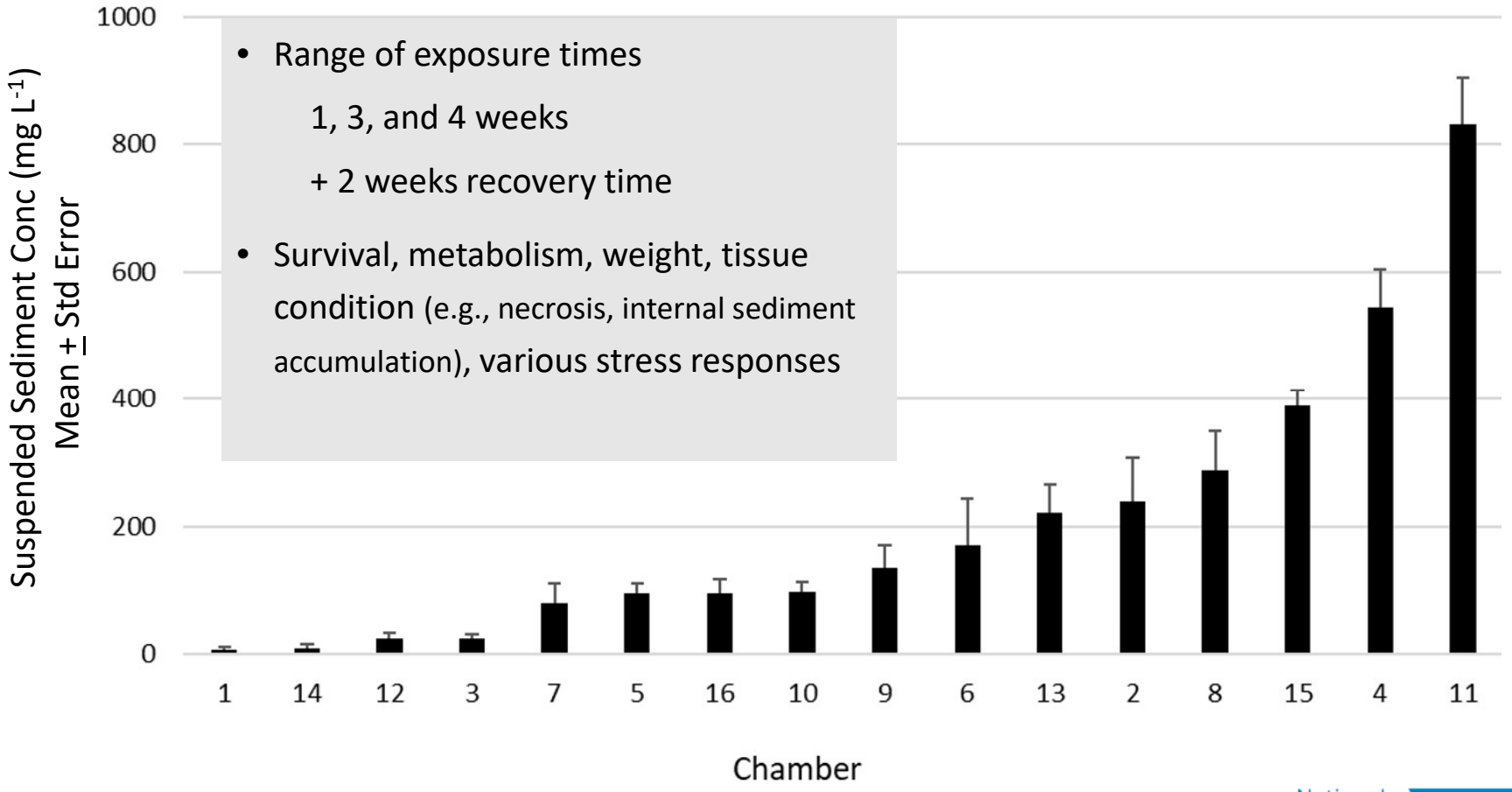
Experimental design

- Range of exposure times
  - 1, 3, and 4 weeks
  - + 2 weeks recovery time
- Survival, metabolism, weight, tissue condition (e.g., necrosis, internal sediment accumulation), various stress responses



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Collection

Tucetona laticostata (dog cockle)


CoastCam, NIWA

RV Kaharoa


Beaumont, NIWA

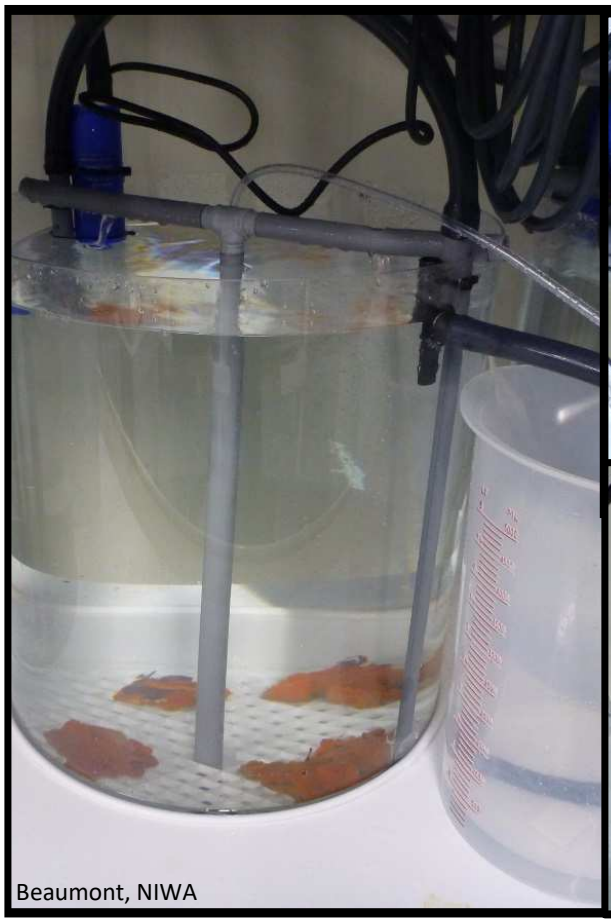
Victoria University of Wellington, divers

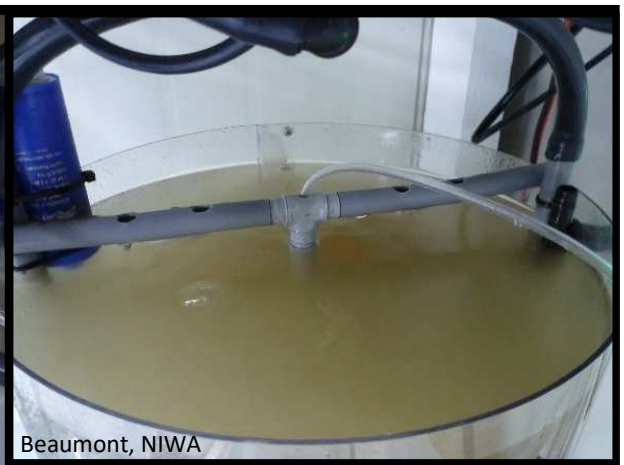
Crella incrustans (sponge)

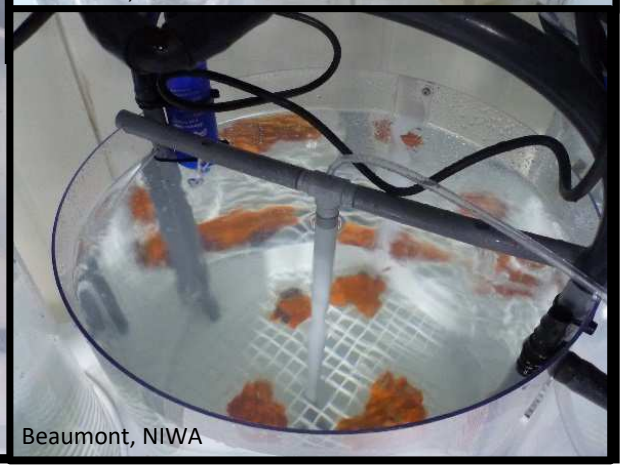

Bell, VUW

Cockles

Sponges







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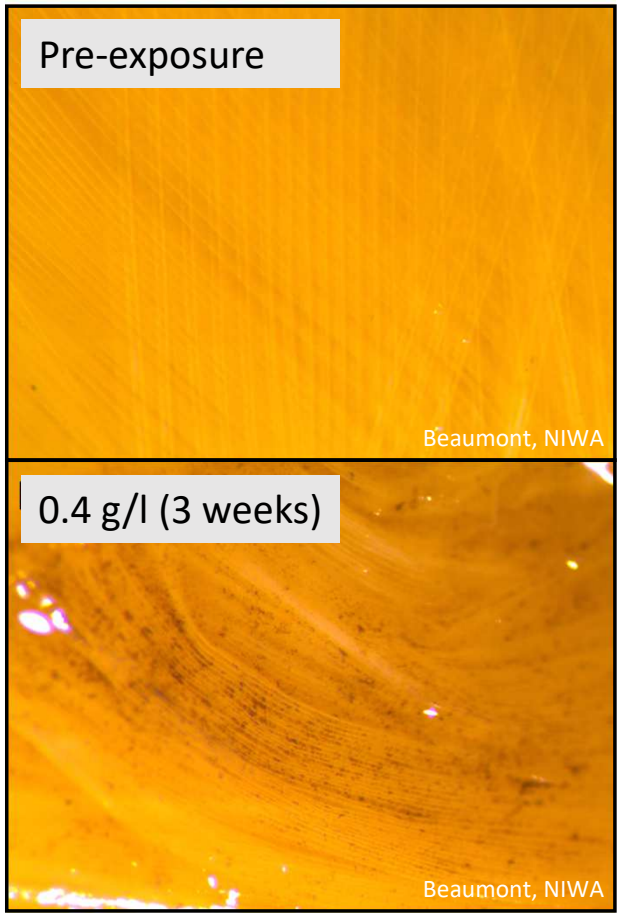
Tucetona laticostata

Cockle gills



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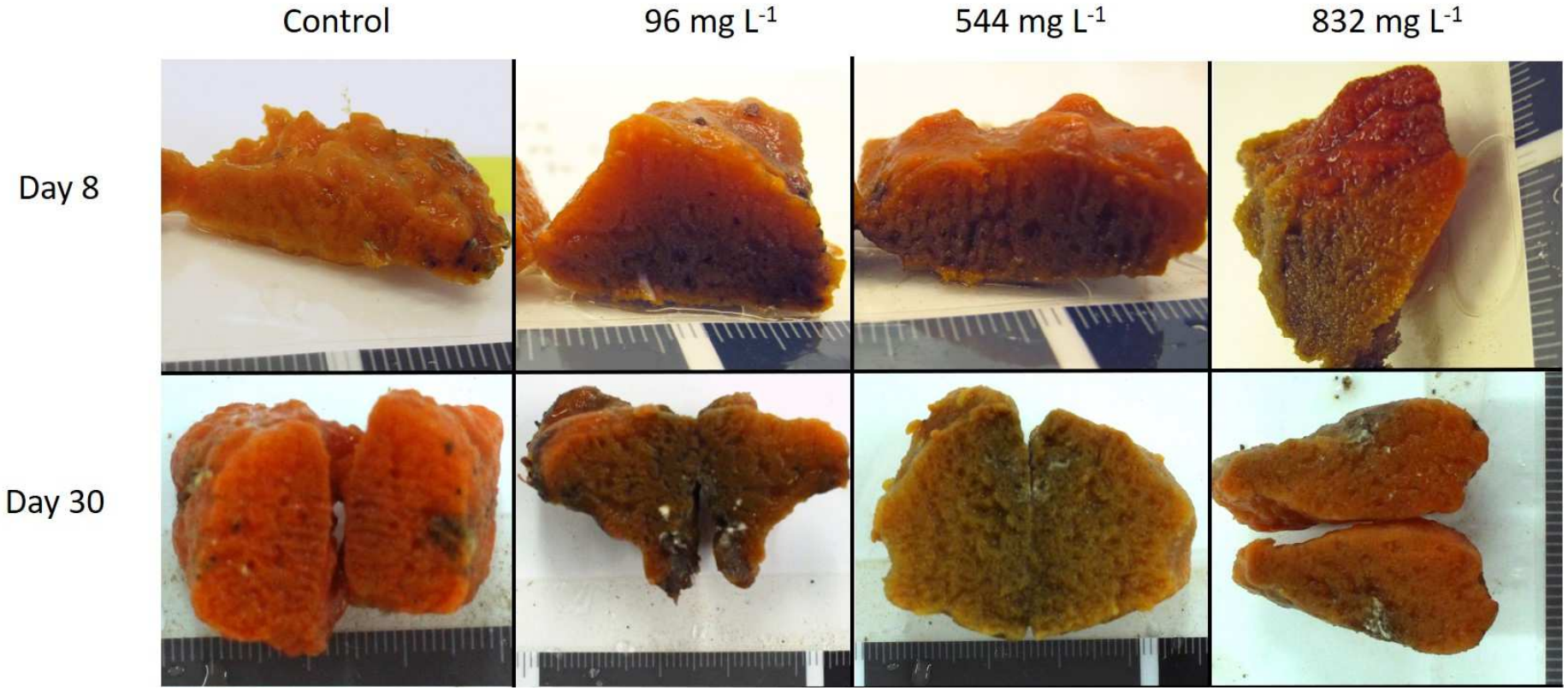
Crella incrustans

High survival

Sediments accumulated internally



Respiration rates not significantly affected

Crella incrustans

- Morphological changes
- Greater number of ‘apical fistules’ at higher suspended sediment concentrations (SSC)
- *Crella* tolerance to temporary (thin) sediment deposition?

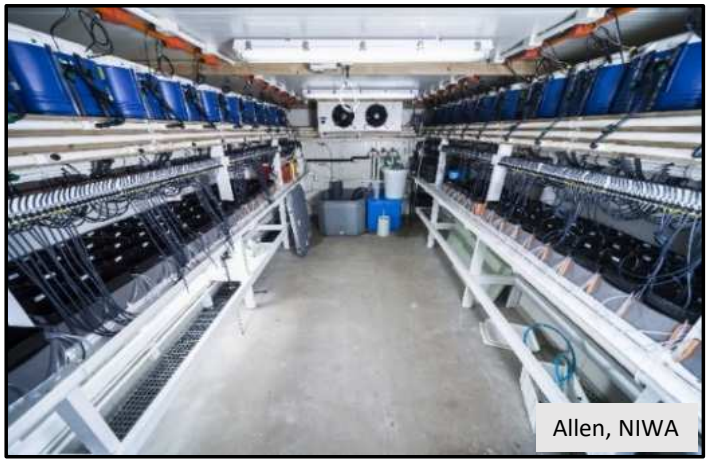
Conclusions

- Lack of strong negative effects on either *Tucetona* or *Crella*
- Both species had mechanisms to clear the sediments
- May be predisposed to 'coping', at least over the time frames and conditions investigated
- BUT, more sensitive measures, mechanisms of sediment processing, different life stages, will all enhance understanding of species responses

Conclusions and follow-up research

- Multiple insights into the resilience of two species
- Established effective laboratory system for maintaining sediment in suspension - not an easy task
- Developed approaches and methodology to undertake experimental work, to complement *in situ* observations and disturbance research


Bell, VUW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Beaumont, NIWA

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Conclusions and follow-up research

Results and methodologies have informed other sedimentation research projects

- Juvenile scallops (NIWA)

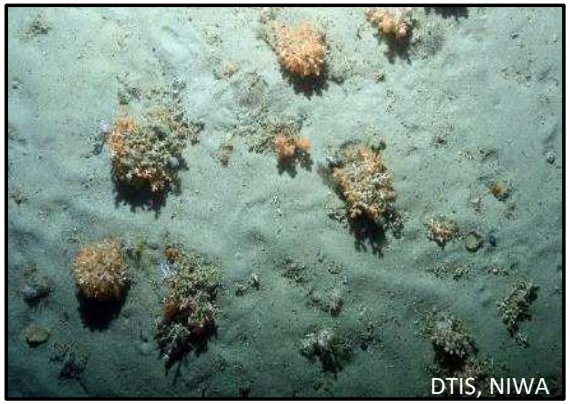
  Tolerance of juvenile scallops to suspended sediments, to inform ecosystem modelling (2020)

- Deep sea corals and sponges (NIWA, VUW)

  ROBES (Resilience Of deep-sea Benthos to the Effects of Sedimentation) (2016-2021)

  Chatham Rise corals (*Goniocorella dumosa*) and sponges (*Ecionemia novaezelandiae*) (2019)

  Follow up deep-sea coral experiments, expanding response variable scope to include genetic microbiome and histology studies (2020)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Acknowledgements

- Ko ngā moana whakauka / Sustainable Seas National Science Challenge for funding.
- *RV Kaharoa* crew and NIWA staff for dog cockle collection.
- Victoria University of Wellington's dive team for sponge collection.
- NIWA and VUW staff and students for their help with aspects of the experimental work.
- Images and photos provided by a number of NIWA and VUW staff and students

Results related to *Crella incrustans* have been published:

Cummings et al. (2020): Responses of a common New Zealand coastal sponge to elevated suspended sediments: indications of resilience. *Marine Environmental Research 155* doi.org/10.1016/j.marenvres.2020.104886

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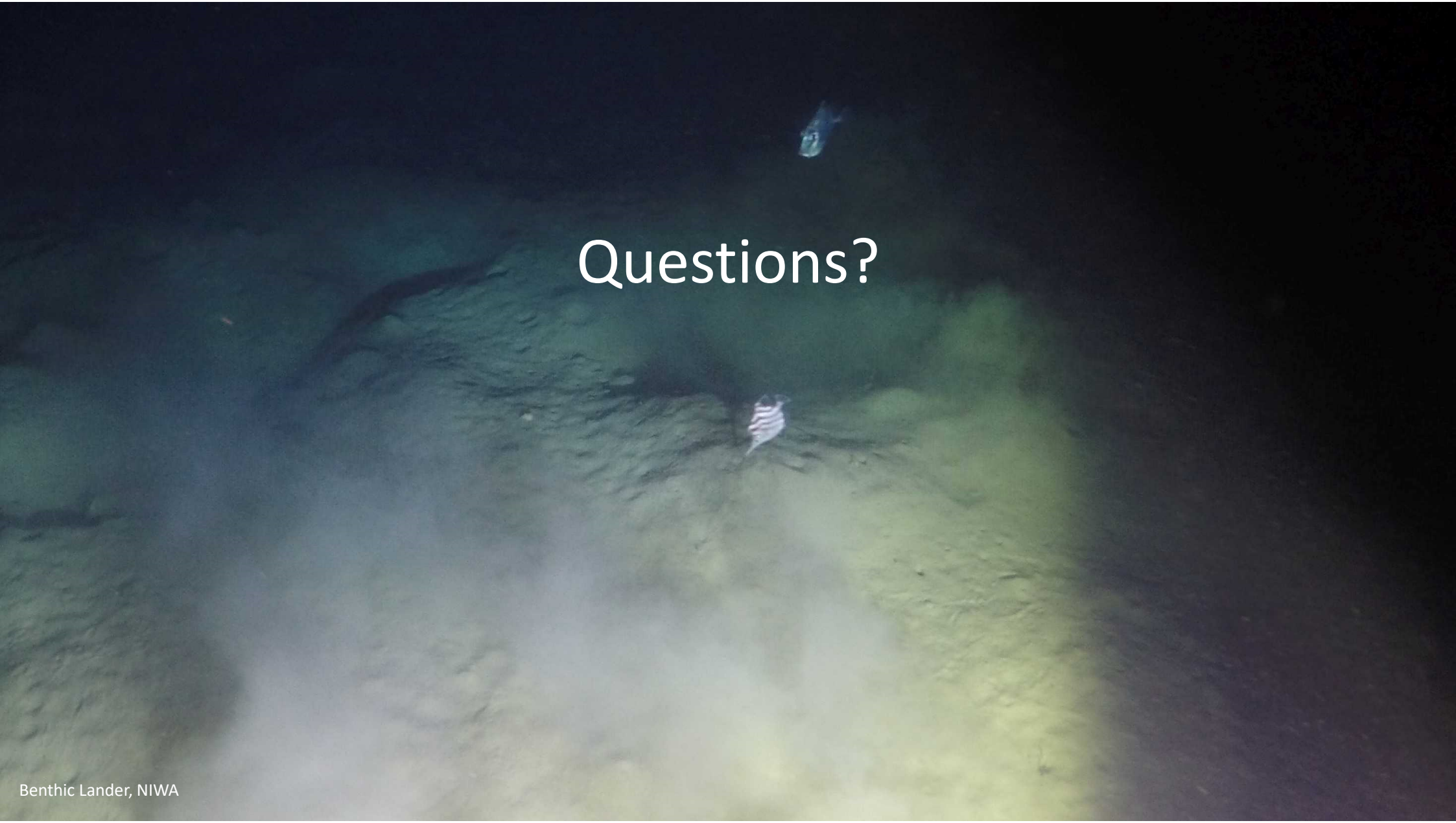
Questions?
Benthic Lander, NIWA