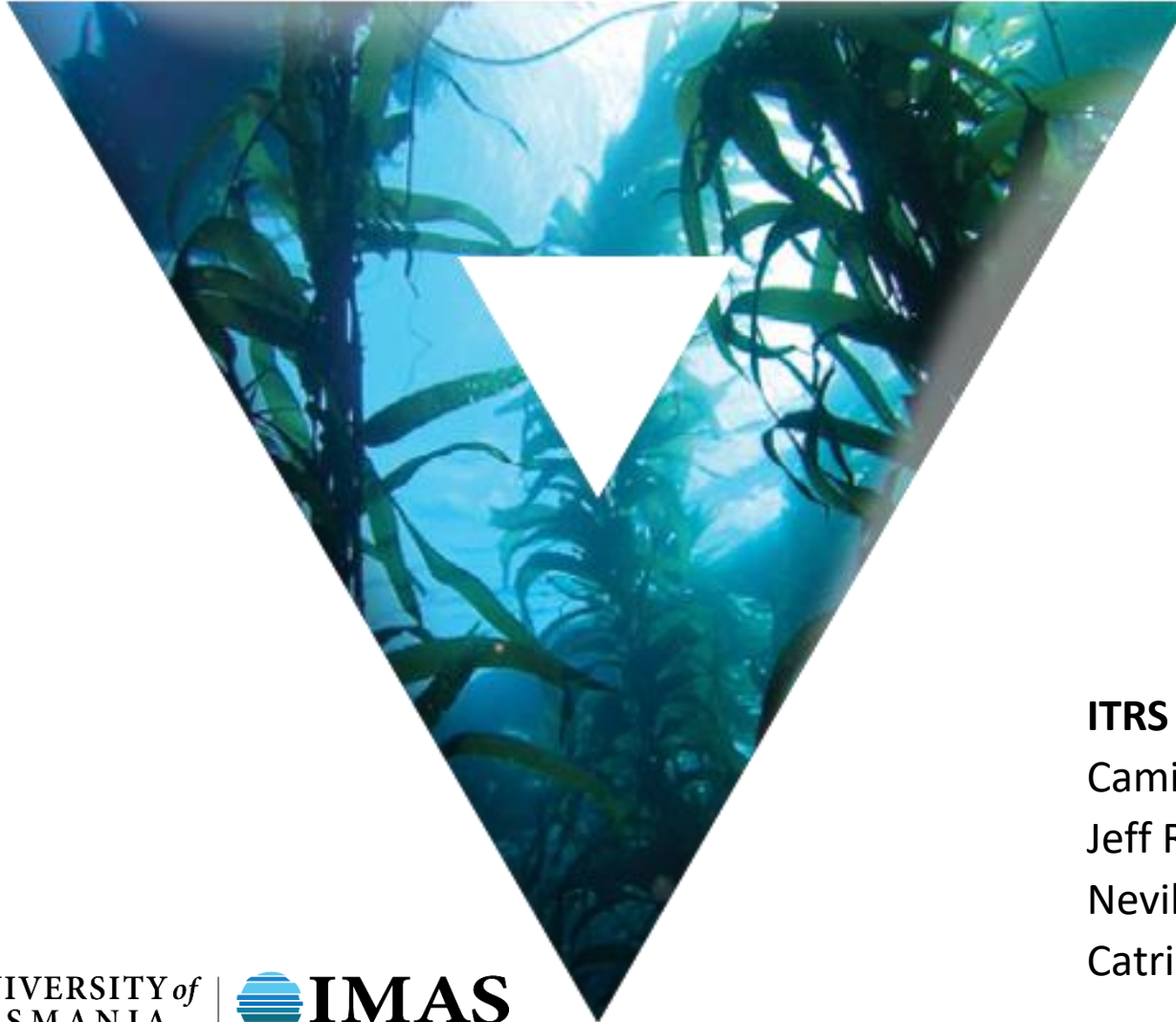


Functional response of temperate reef communities as a tool for monitoring nutrient enrichment



ITRS 2023

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Nutrient enrichment & temperate reefs

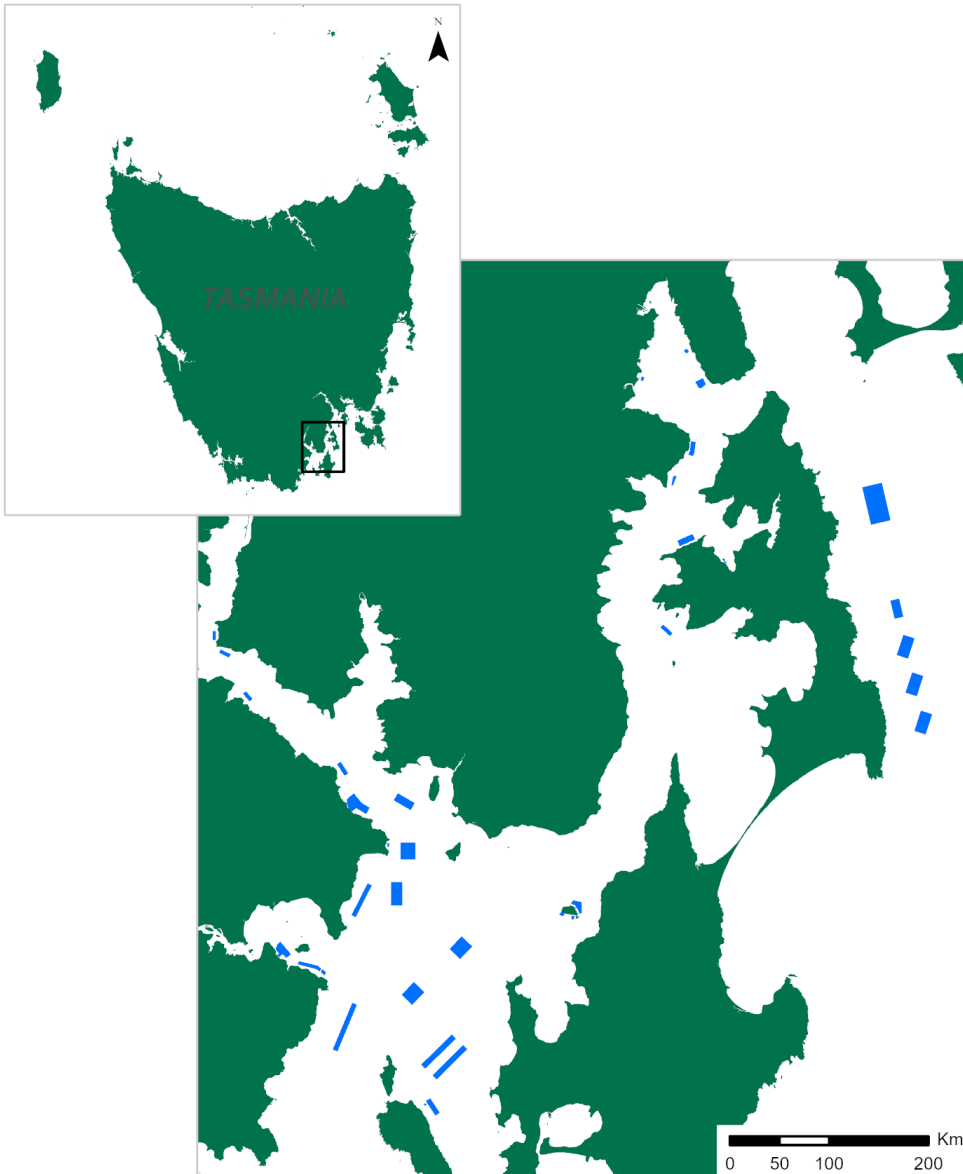
Coastal industry and urbanisation is intensifying

- Nutrient enrichment a key direct threat
 - Ecosystem collapse
- Multi-use, multi-input systems (urbanisation, catchment activities, aquaculture)
- Whole-of-system management issue

In SE Tasmania the focus is largely on the salmon aquaculture industry



Salmon aquaculture in Tasmania



- Has expanded over the past decade
- Expansion of the industry = potential interaction with reef ecosystems
- Increased potential for broadscale interactions
- Understanding interaction is important for management

Nutrient enrichment & temperate reefs



Coastal industry and urbanisation is intensifying

- Multi-use, multi-input systems (urbanisation, catchment activities, aquaculture)
- Nutrient enrichment a key direct threat
 - Ecosystem collapse
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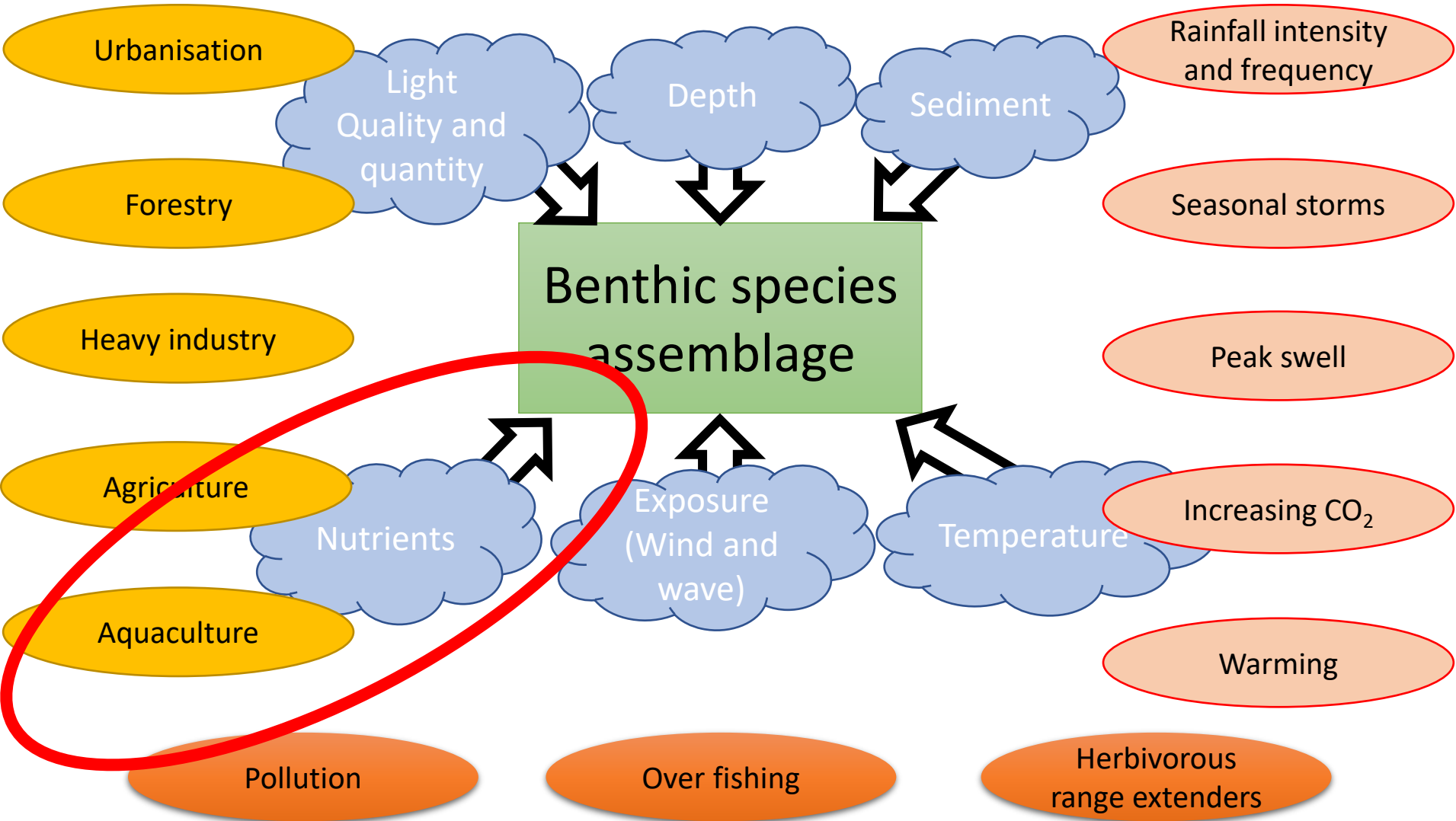
In SE Tasmania the focus is largely on the salmon aquaculture industry

Key Challenge:

Develop of monitoring program that can detect a loss of resilience to nutrient enrichment before ecosystem collapse

Estuary catchment activity

Anthropogenic climate change



With thanks to Jane Ruckert

A targeted method for assessing nutrient enrichment

- Focus on functionality, not biodiversity
- Universal indicators of nutrient enrichment on rocky reefs

Canopy Condition

- Canopy cover
- Sub-canopy cover (brown/green/red)

Substrate condition

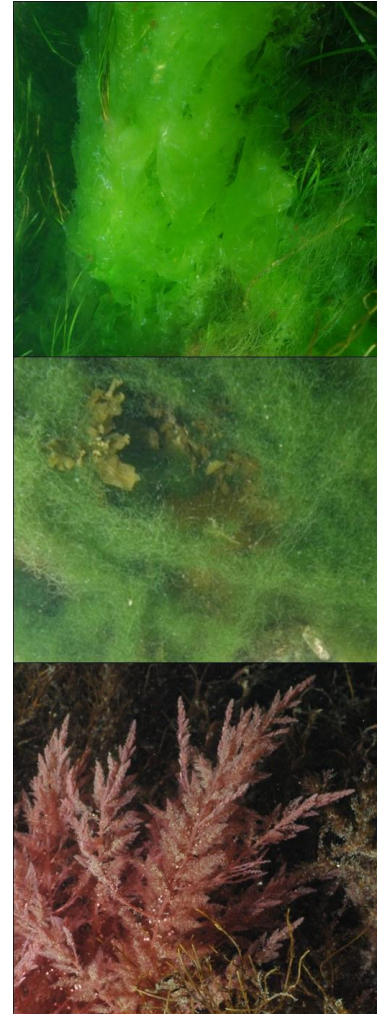
- Turfing algae
- Encrusting algae + type
- Sponge cover

Enrichment parameters

- Epiphytic algae
- Filamentous algae
- Nuisance green (*Ulva/Chaetomorpha*)
- Nuisance red (*Asparagopsis*)

Trophic interactions

- Major mobile invertebrates
- Encrusting fauna on algae



Trialling novel monitoring techniques

Test site: D'Entrecasteaux Channel, SE Tasmania

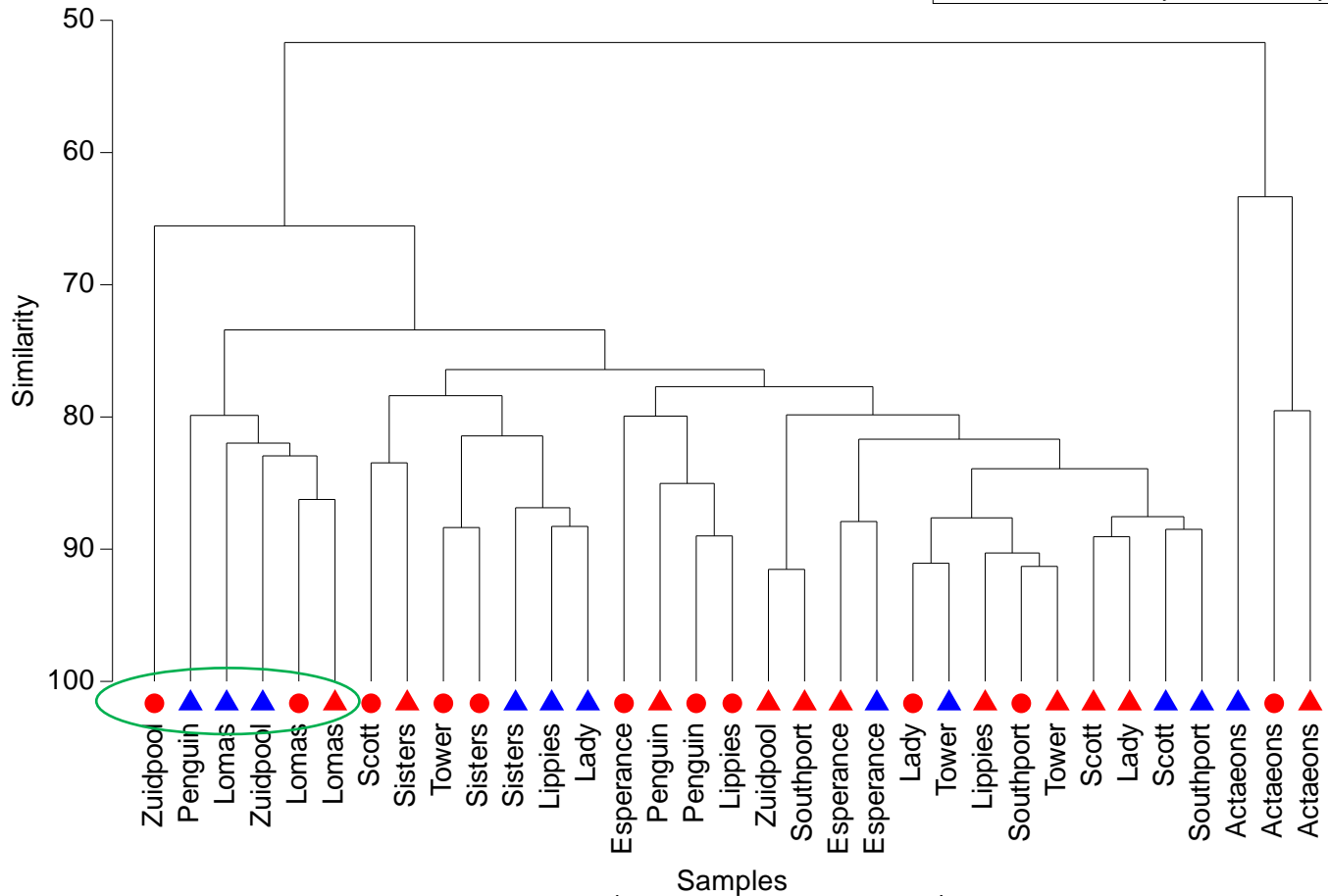
- Broadscale enrichment gradient
 - Direct, diffuse, control
- 11 sites, 12x1 m² quadrats per site
- 2 x divers assessed quadrats 1-4
- Twice-yearly sampling

Multivariate approach

- Change to one metric alone does not indicate enrichment
- Elevation across multiple sampling occasions indicate sustained stress



Resemblance: S17 Bray-Curtis similarity



Broadscale enrichment gradient detected

- PERMANOVA significant between zones (P(permutation) = 0.03)

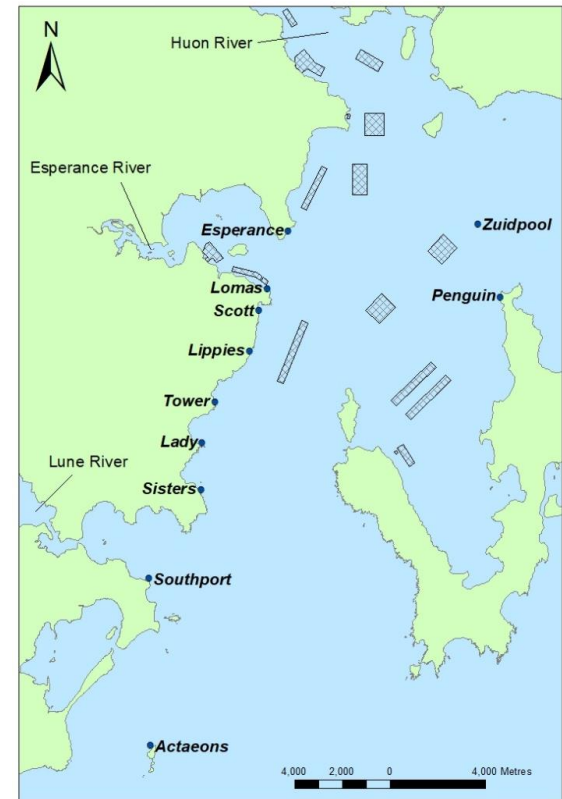
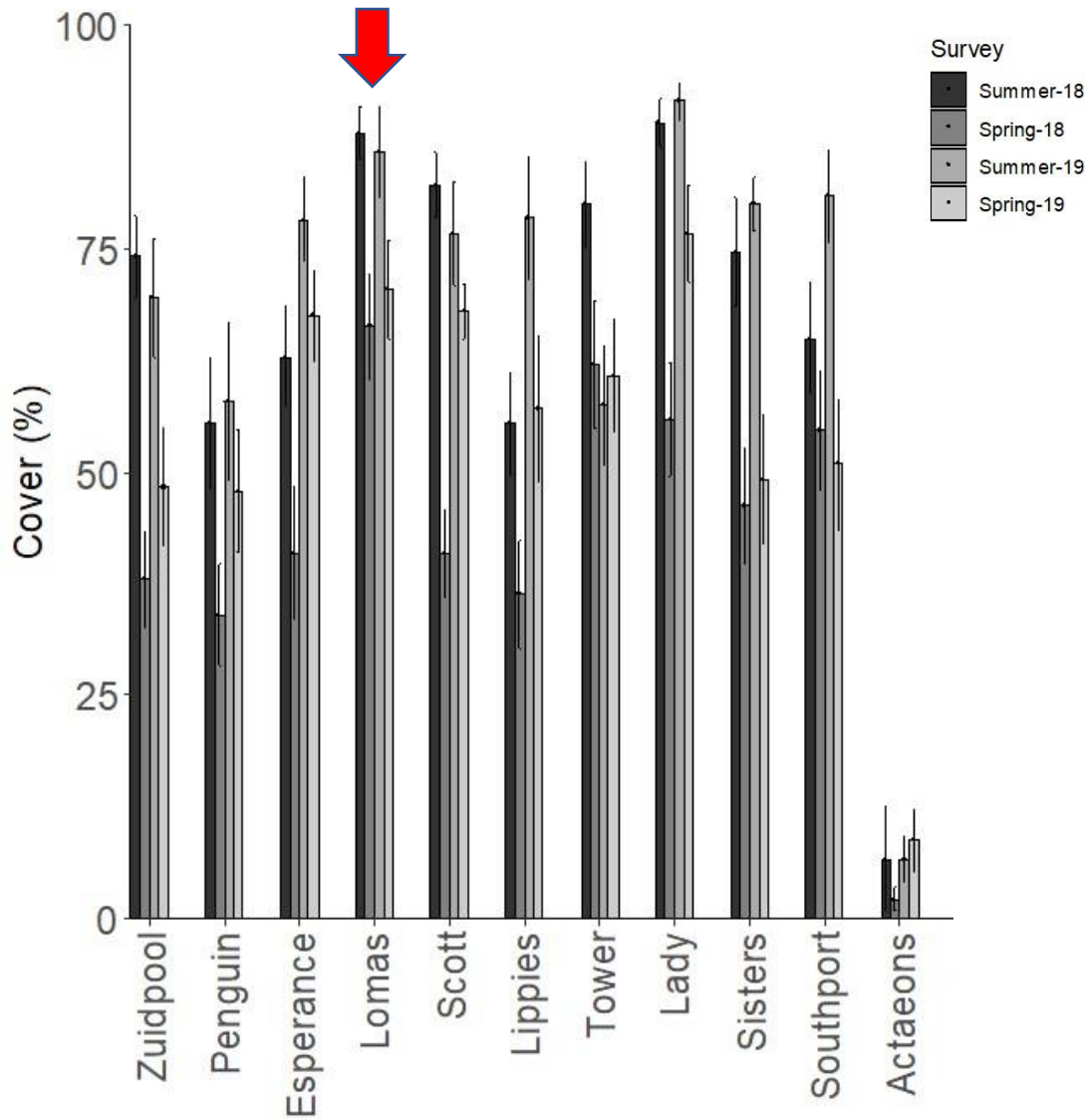
Summer 2019 was functionally distinct

- Higher canopy & epiphytic algae
- Regional phenomenon

Enrichment parameters

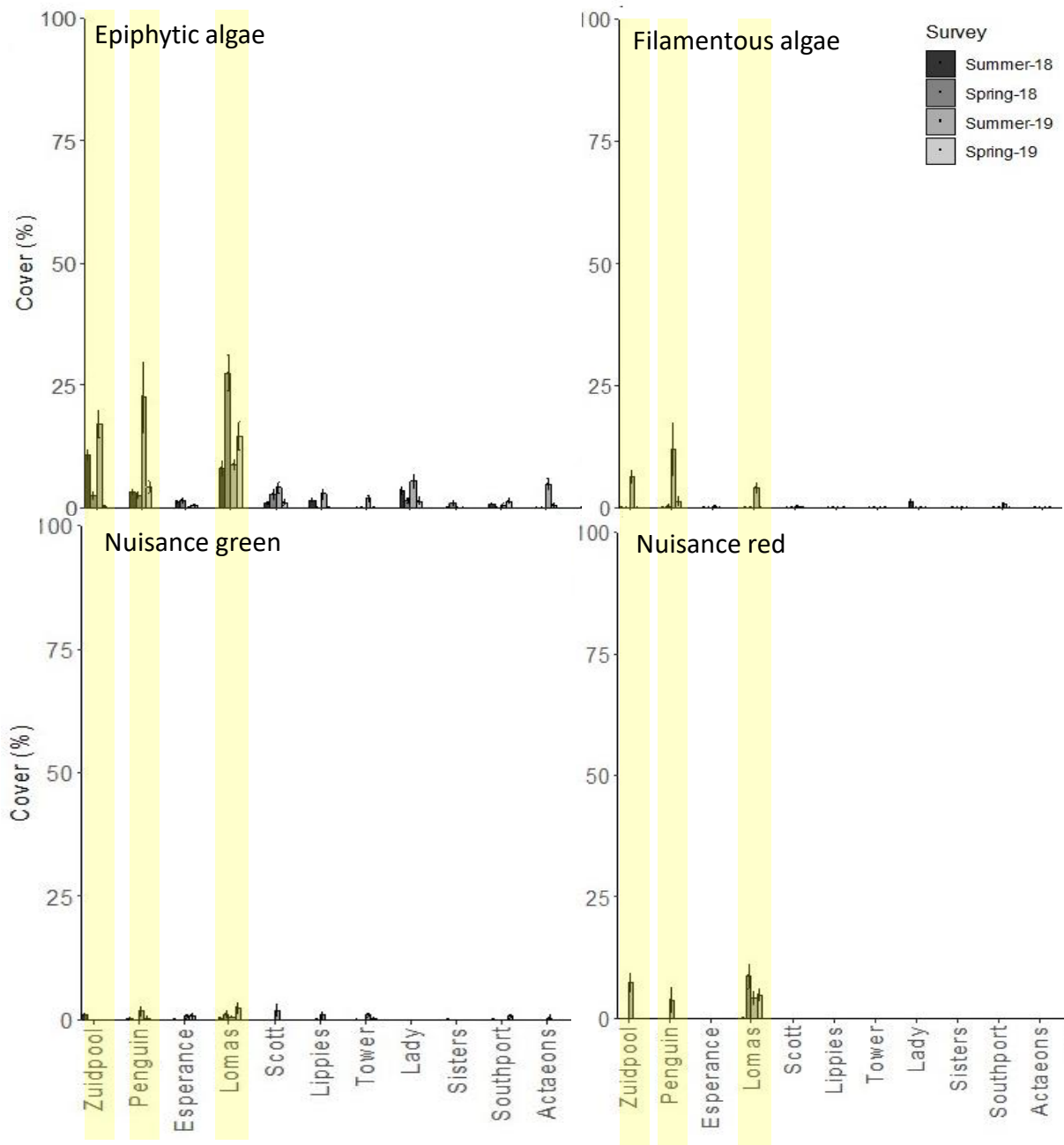
- Enrichment vectors correlated with Lomas for all three surveys
- Zuidpool & Penguin correlated with enrichment parameters for Summer 2019
- What does that mean?

Canopy cover (%)



Is our canopy intact at our x3 “of interest” sites?

Lomas recorded some of the highest canopy values across the region

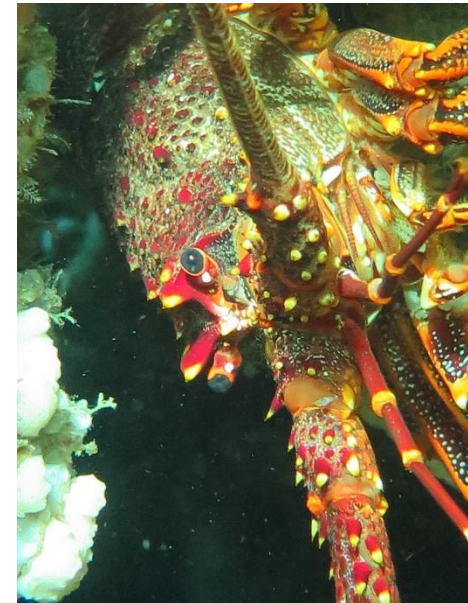


At what levels did we observe our enrichment indicators?

- Enrichment indicators were generally higher at Lomas, Zuidpool and Penguin compared to all other sites (broadscale gradient)
- There is sustained low level presence of epiphytic algae and nuisance reds at Lomas
- Monitor change over time

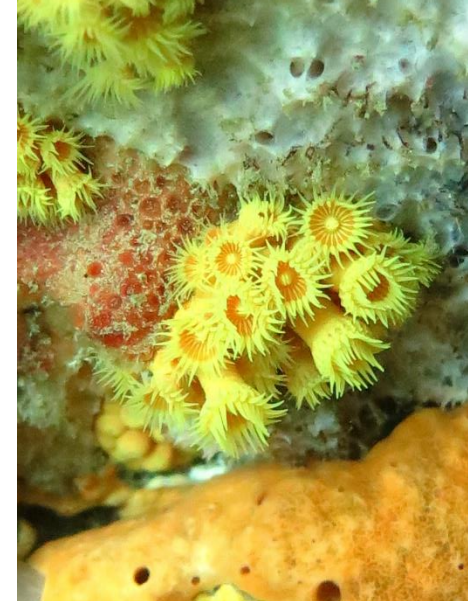
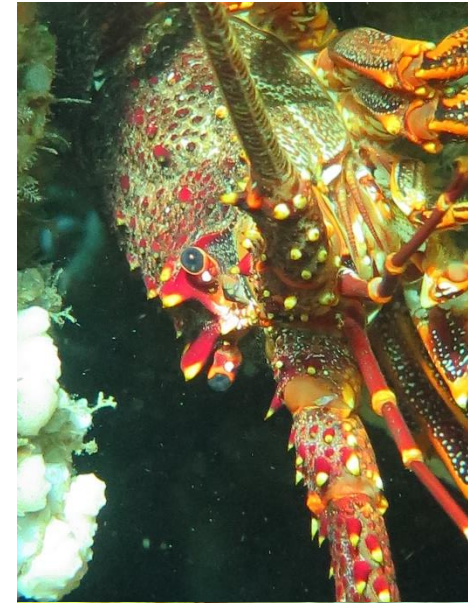
Synthesis

- Method can detect a broadscale enrichment gradient
- Also performs across acute enrichment gradients
- Simple enough to be transferable
- Adoption into aquaculture monitoring programs in SE Tasmania
 - Performance over longer timeframes currently being assessed

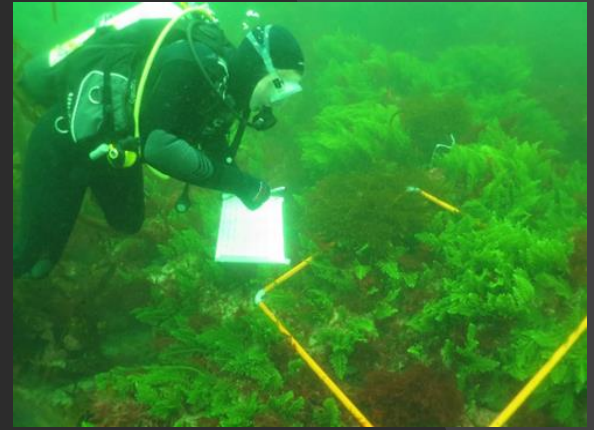


Synthesis

- Interaction between nutrient enrichment and wave exposure problematic
 - Difficult to establish proper control locations
 - Baseline data essential (biodiversity & functional)
- Low exposure environments = high susceptibility to nutrient enrichment
- Threshold and trigger values in complex systems?
- Method shows promise for ongoing monitoring



Questions?



Contact: Camille.White@utas.edu.au

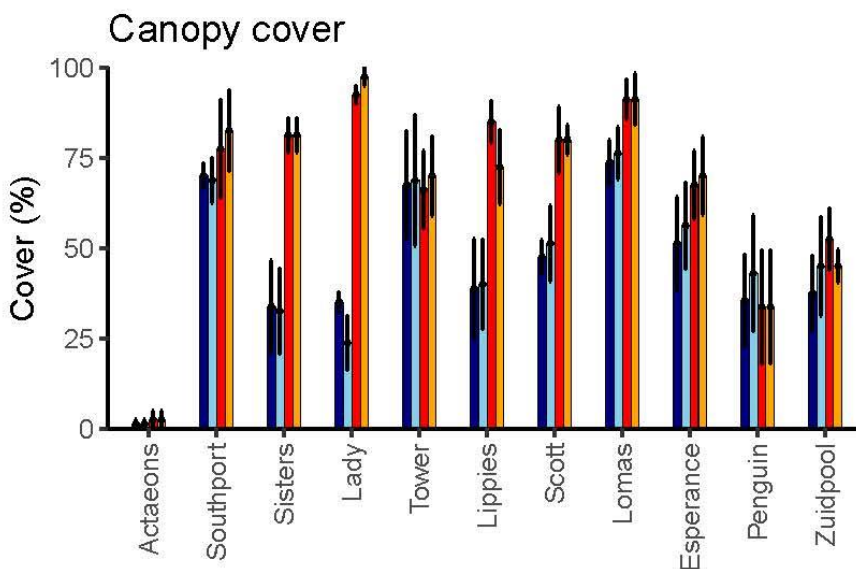
Method performance

Canopy detectable effect size (% change):

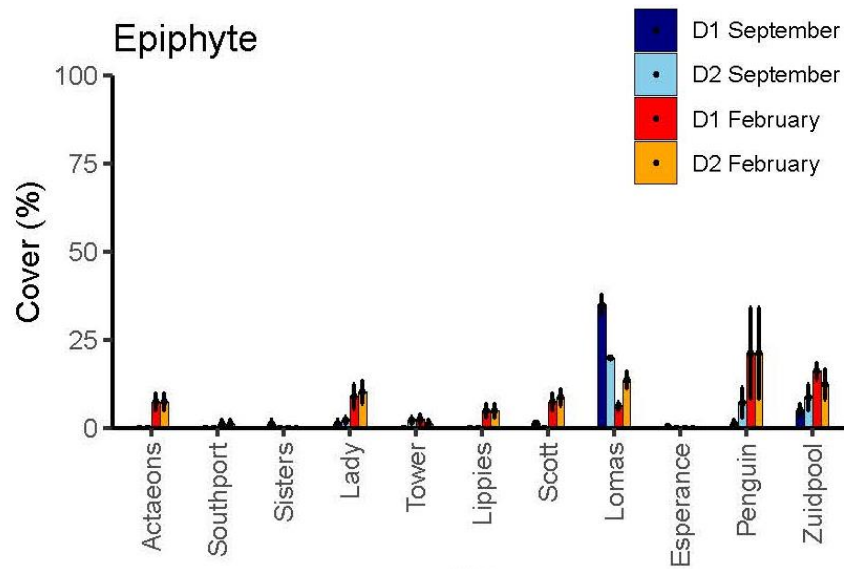
	Actaeons	Southport	Sisters	Lady	Tower	Lippies	Scott	Lomas	Esperance	Penguin	Zuidpool
Spring	192	37	44	35	36	52	38	27	56	51	44
Summer	115	20	12	7	36	27	23	19	18	47	30

Epiphytic algae detectable effect size (% change):

	Actaeons	Southport	Sisters	Lady	Tower	Lippies	Scott	Lomas	Esperance	Penguin	Zuidpool
Spring	-	-	208	128	-	-	139	40	128	93	118
Summer	81	307	-	92	123	120	89	38	-	99	51



Discrepancy: Mean = 3.8%, SD = 3.7



Discrepancy: Mean = 2.1%, SD = 3.5