Effects of shading on health indicators of two branching corals, *Acropora formosa* and *Acropora hyacinthus*, in Central Queensland, Australia

Using nature for management of dredge projects

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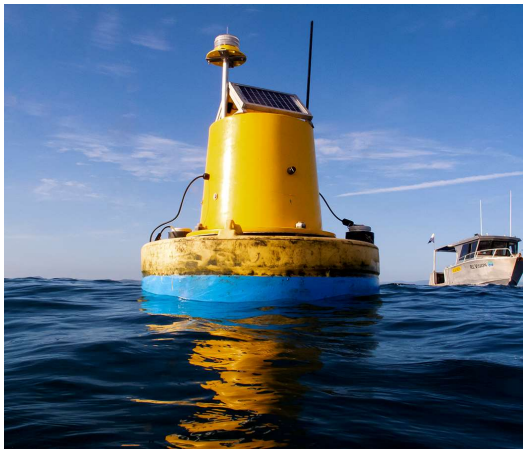
Introduction

- Port of Gladstone - Port Curtis, Central Queensland – Managed by GPC
- Port Curtis/Gladstone Harbour – Multi commodity port including coal, LNG and alumina – Deep harbour.
- 5Th largest port in Australia
- Surrounds two large island with many rivers and creeks.
- Mangrove forests, seagrass beds, soft sediments, rocky and coral reefs (shorebirds, turtles, crustaceans, fish, dugongs and cetaceans).
- Western Basin Expansion 2011-2013 – up to 32 million m^3 of dredge material



Water quality
- Turbidity

Seagrass studies
- Chartrand *et al.*
- No coral info

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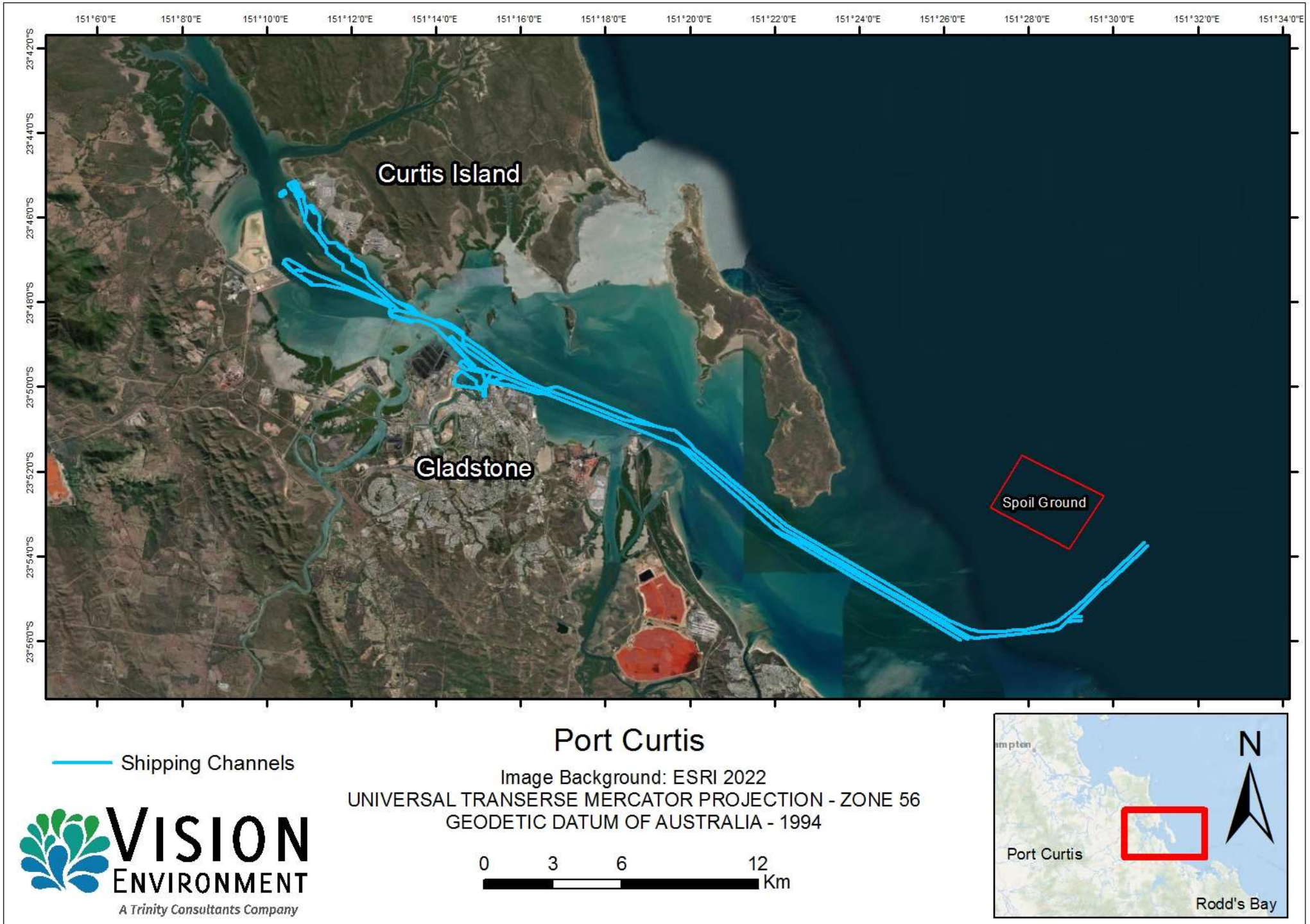

Port Curtis

Shipping Channels

Image Background: ESRI 2022
UNIVERSAL TRANSERSE MERCATOR PROJECTION - ZONE 56
GEODETIC DATUM OF AUSTRALIA - 1994

0 3 6 12 Km

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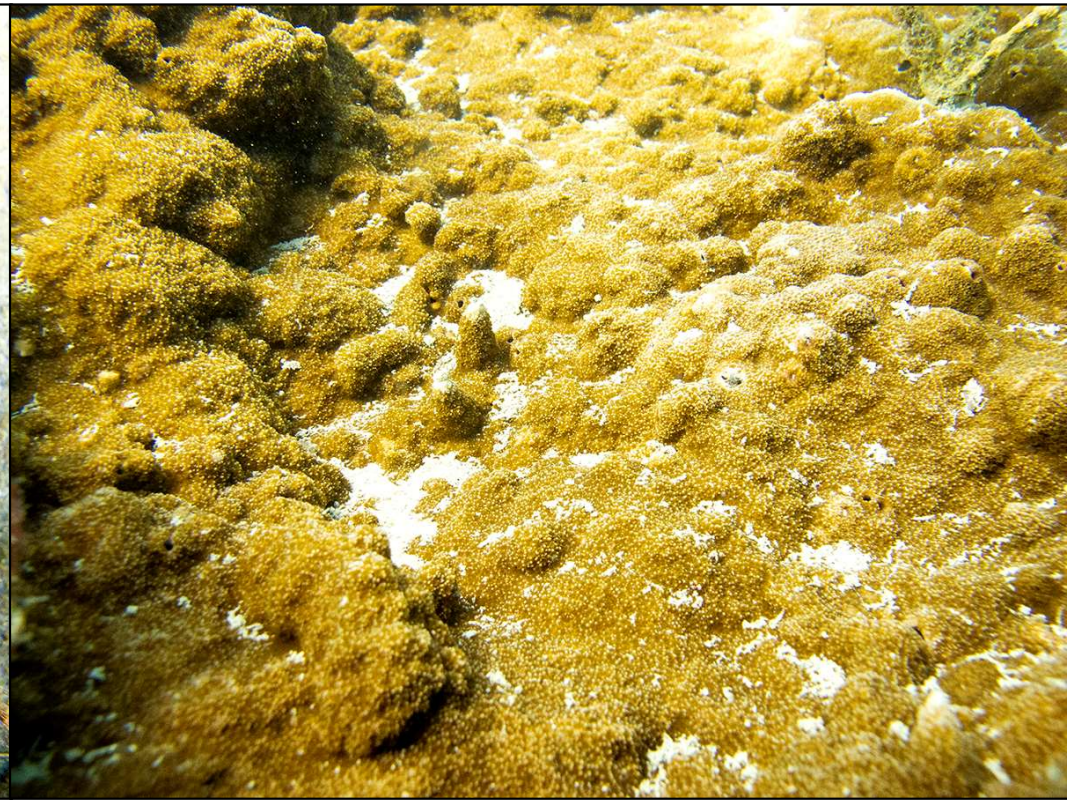
Potential factors affecting seagrass and corals

- Annual maintenance dredging
- Capital dredging
  - Clinton Vessel Interaction Project (CVIP)
  - Western Basin Dredge and Disposal Project (WBDDP)
- Turbidity – shading
- Sedimentation - smothering
- Contamination – direct toxicity



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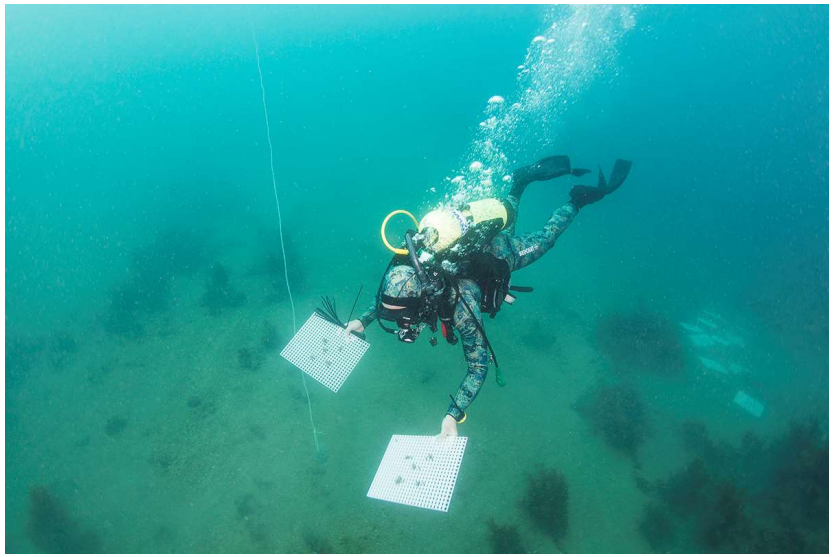
Port Curtis, Gladstone Harbour

Experimental design

- Two sites (6m & 8m depths)
- Two coral species
- Two shading treatments
- Acclimation period
- 3 different endpoints



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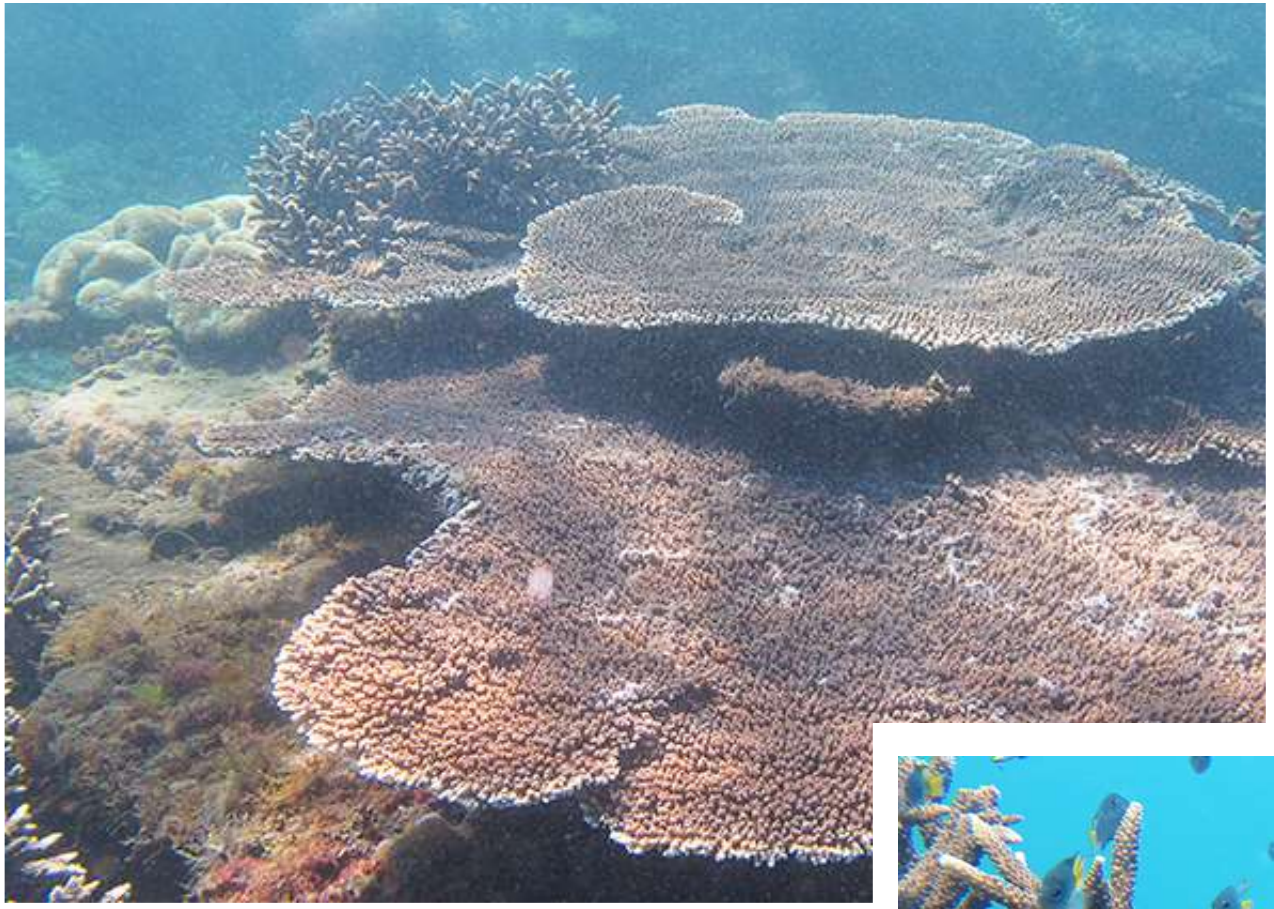
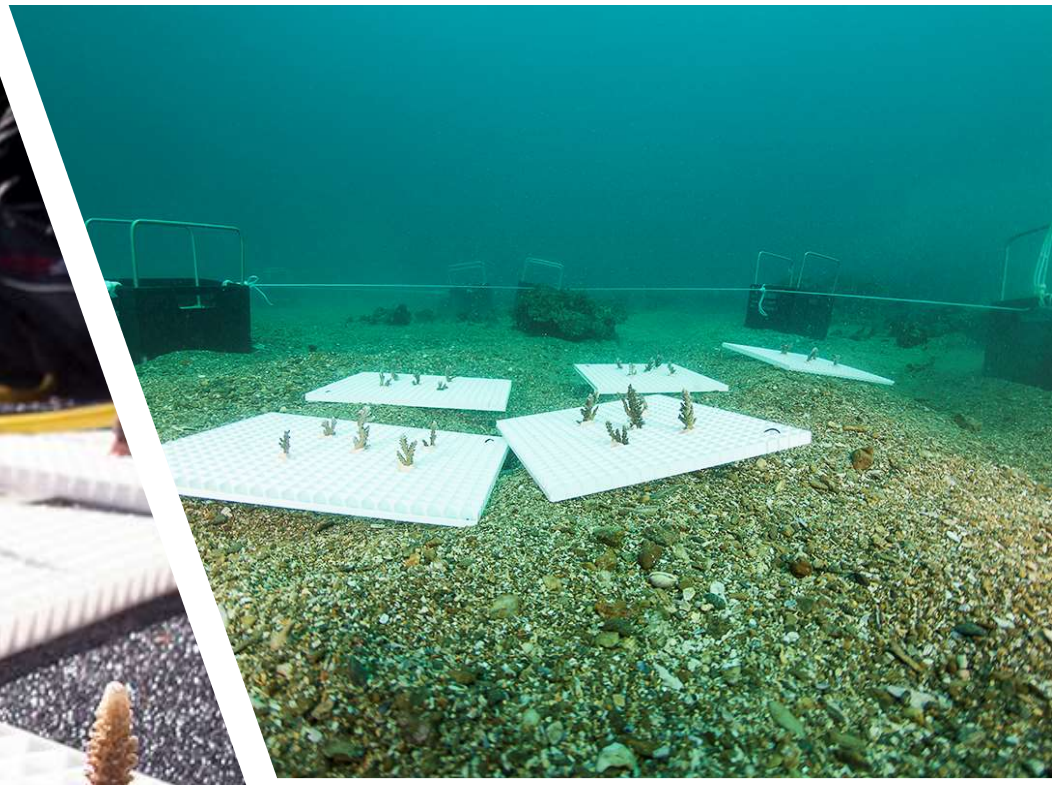
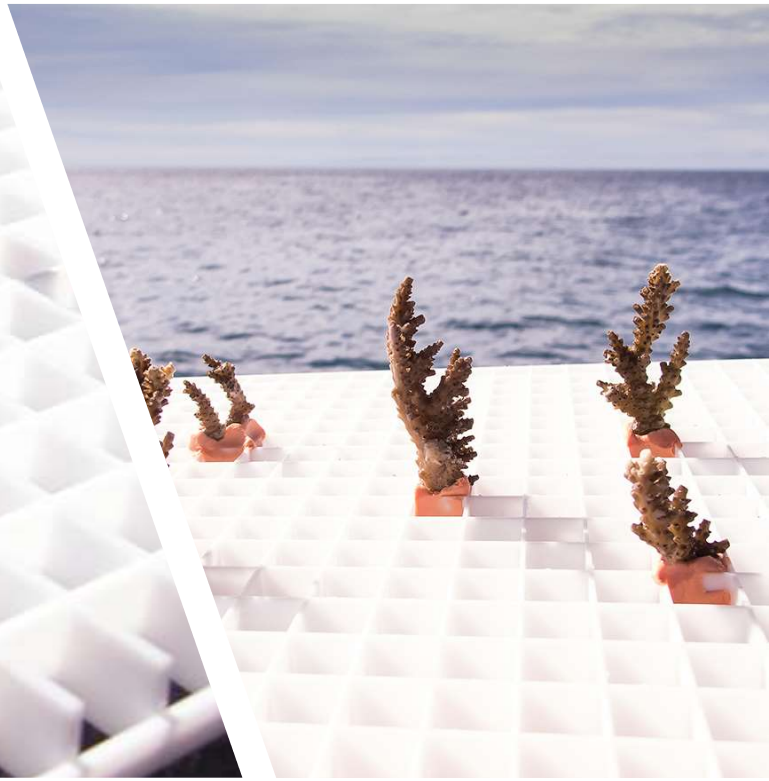


Acropora hyacinthus–
Plate coral

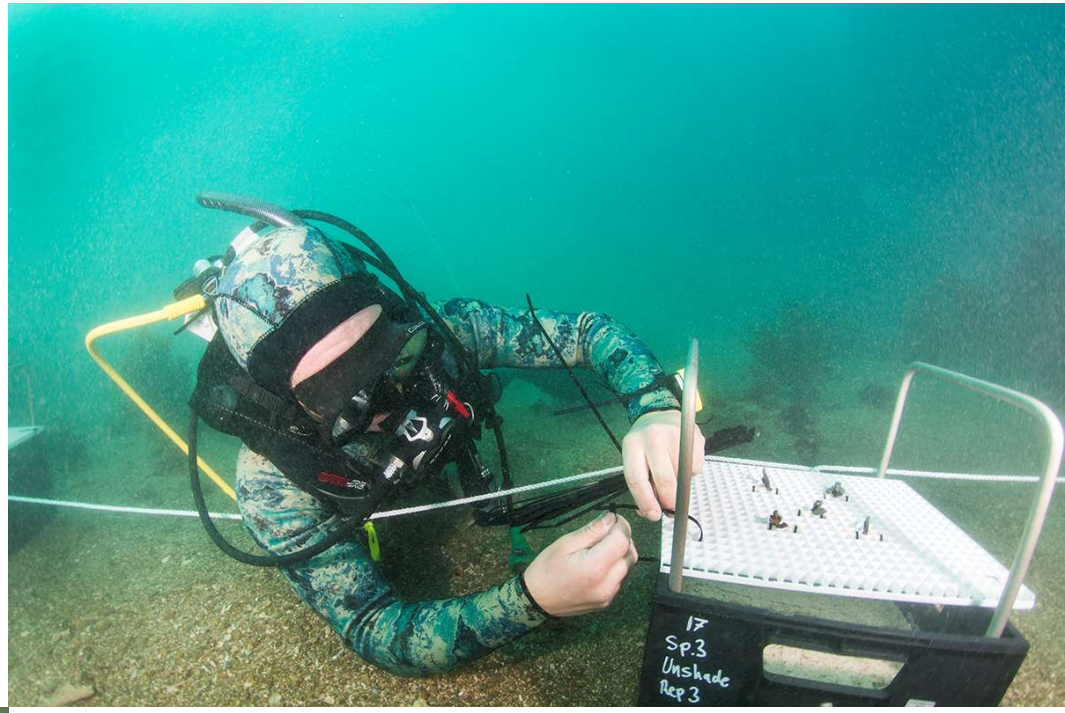
Acropora formosa –
Branching coral

GBRMPA Permit: G13/556811





- Acclimation period up to one month
- Experimental period of 60 days



Treatments

- Control (No shading)
- Shading (80-95% light reduction)
- Continuous light measurements

Measurements every 7-14 days

- Apical growth
- Pigment colour
- Herbivory

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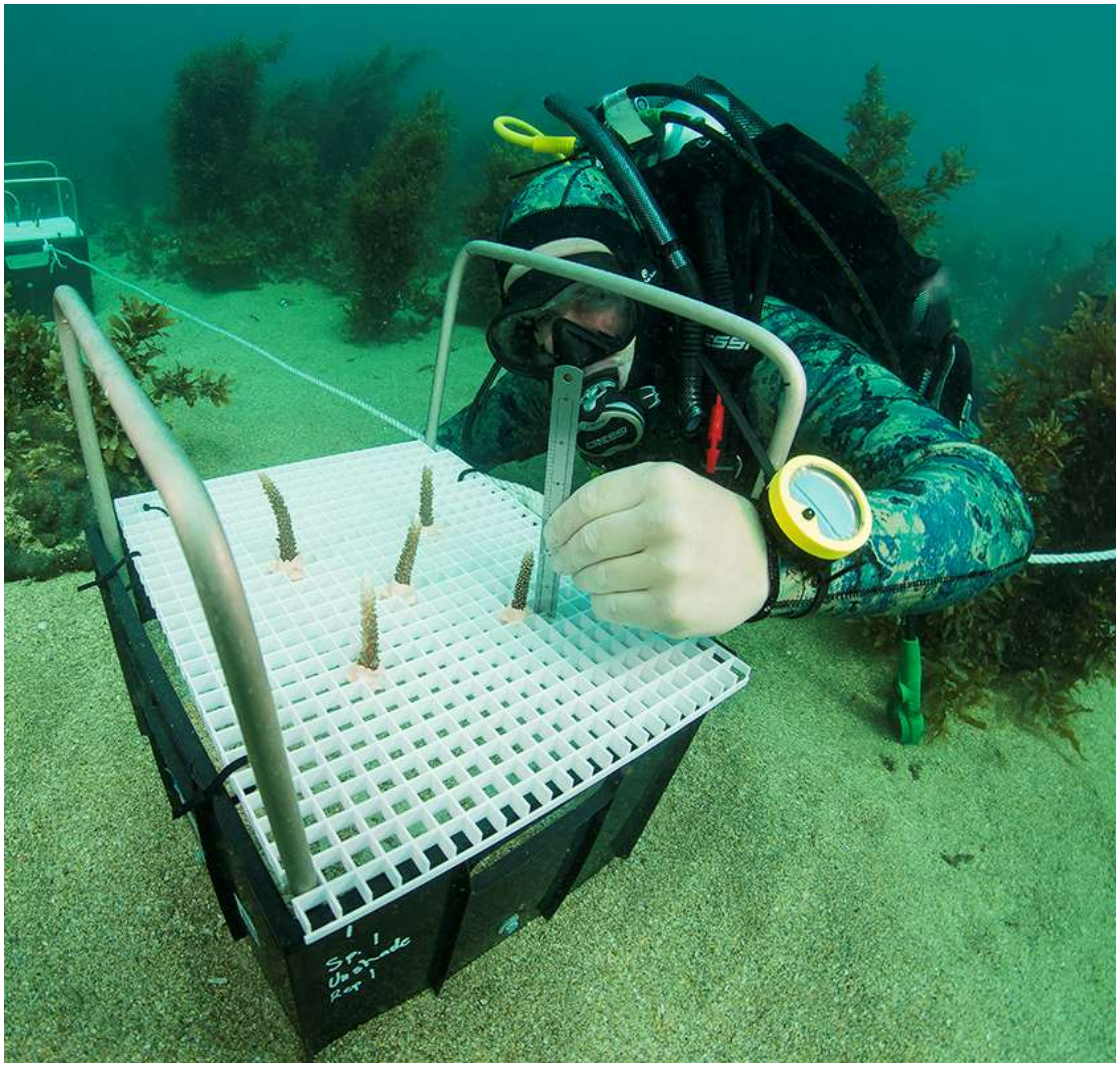
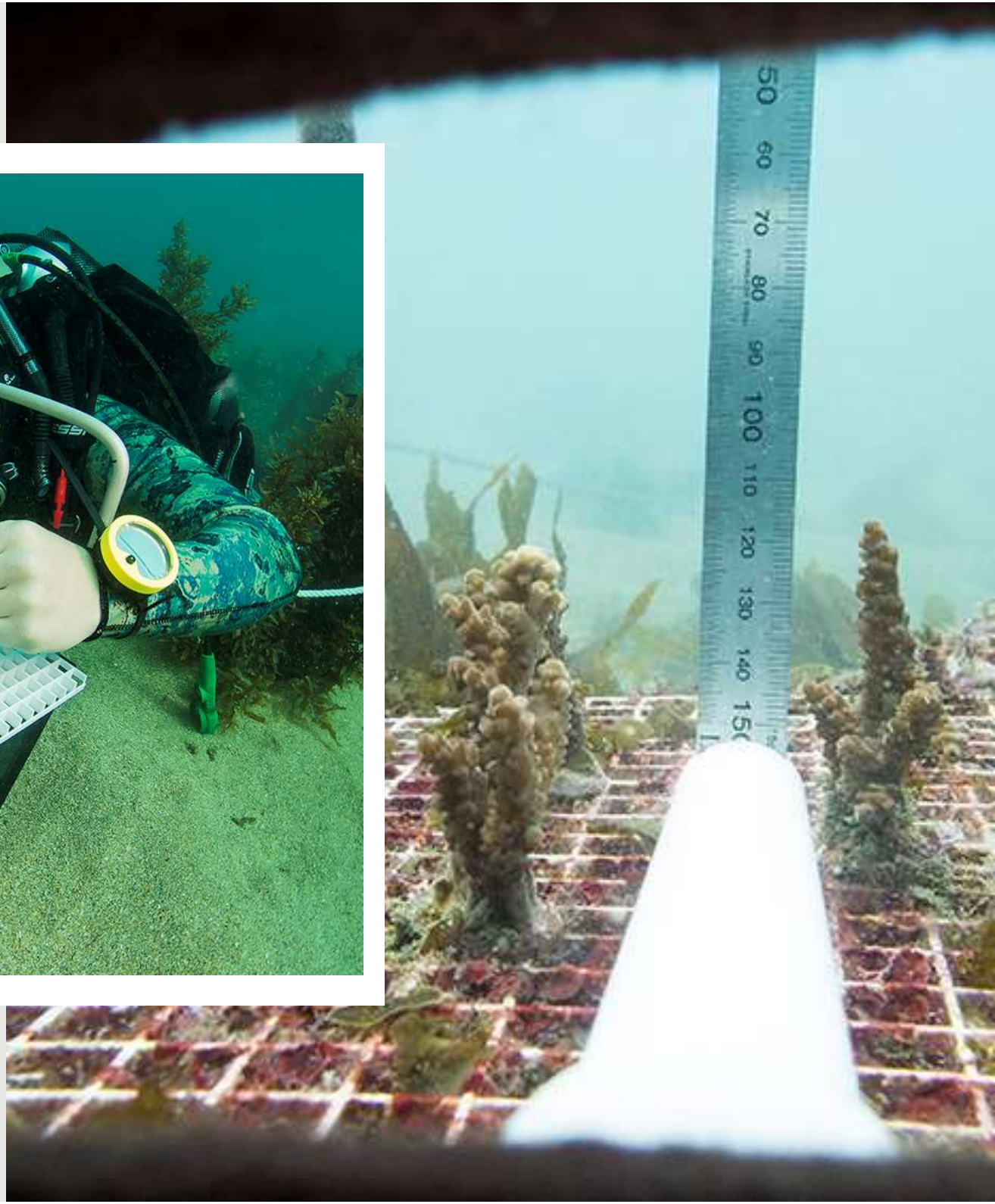
2
Sp.1
Shade
GBRMPA

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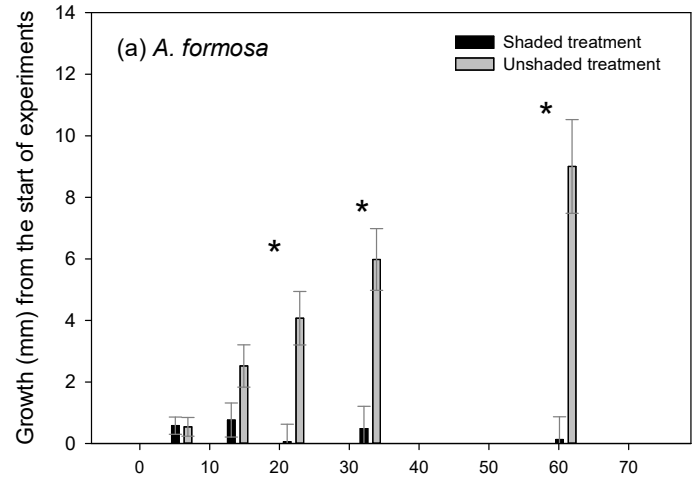

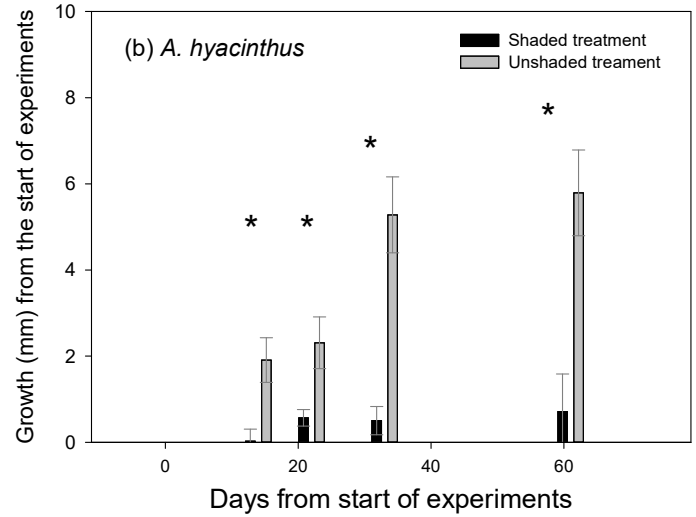

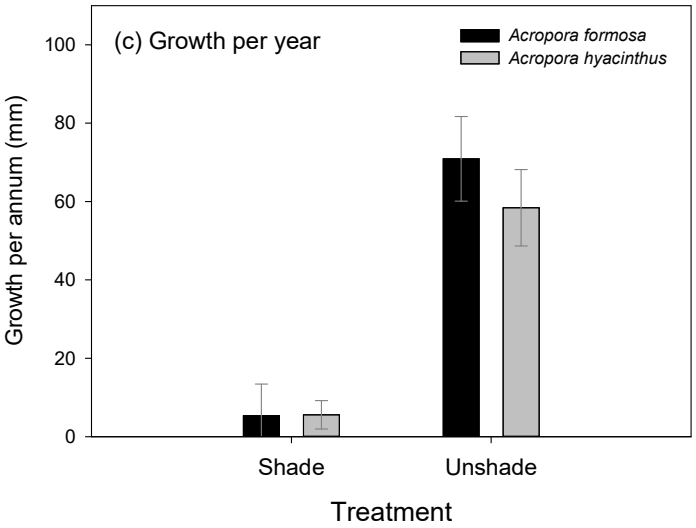

Total daily PAR

- Shaded - 0.6 mols/m^2/day
- Unshaded - 6.1 mols/m^2/day

Growth results

- *A formosa*
  - Unshaded - 9.7 mm /30 days
  - Shaded - 0.9 mm /30 days
- *A. hyacinthus*
  - *Unshaded* - 5.3 mm /30 days
  - *Shaded* - 0.5 mm /30 days

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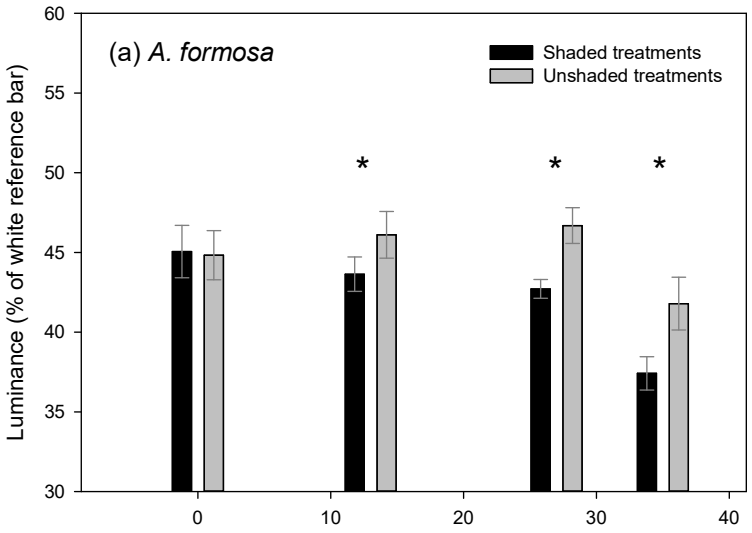
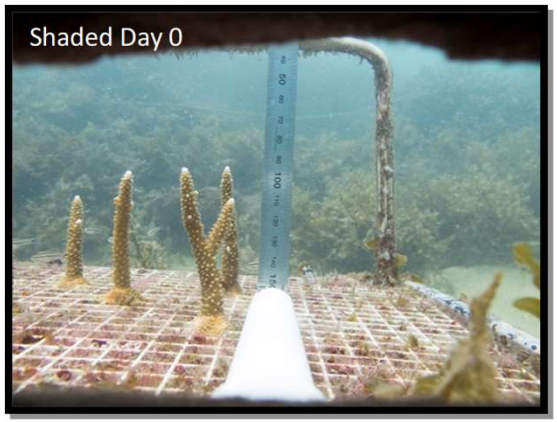
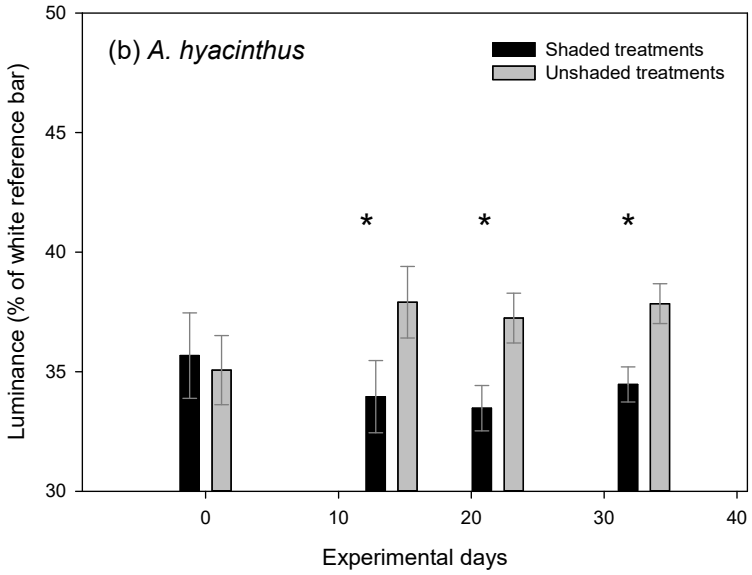
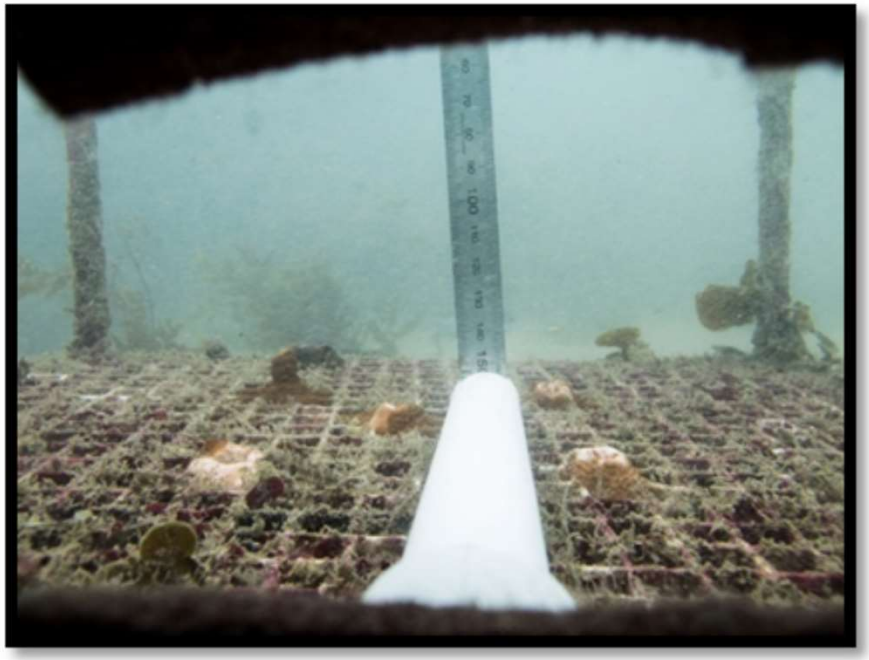


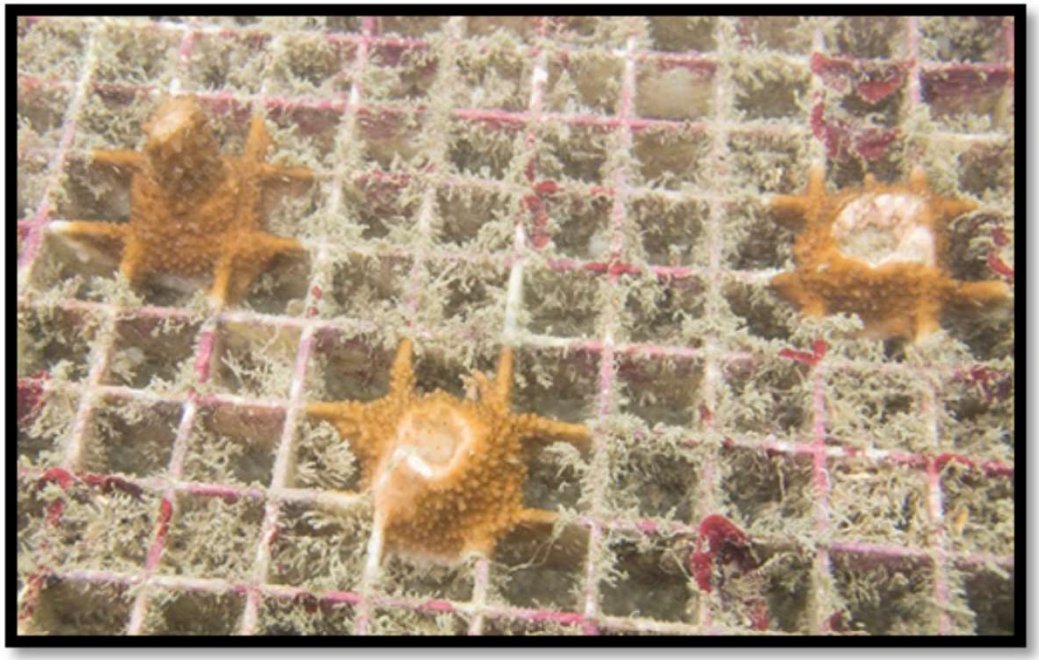




Pigment change

- *A. formosa*
  - >8% increase after 14 days of shading
  - >10% increase after 20 days of shading
- *A. hyacinthus*
  - >10% increase after 14 days of shading





- Grazing pressure
- >85% grazing for *A. formosa* shaded after 60 days
  - First observed after 22 days

- ~27% grazing for *A. hyacinthus* shaded after 60 days
  - First observed after 33 days

- Significantly higher grazing pressure for *A. formosa* compared to *A. hyacinthus*

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Future directions – fine tuning

- Minimum light levels for effect
- (20, 40, 60, 90% light reduction)
- Other suitable indicators
  - Lipid changes
  - Polyp (zooxanthellae) densities
  - Chlorophyll concentrations
- Other sensitive species

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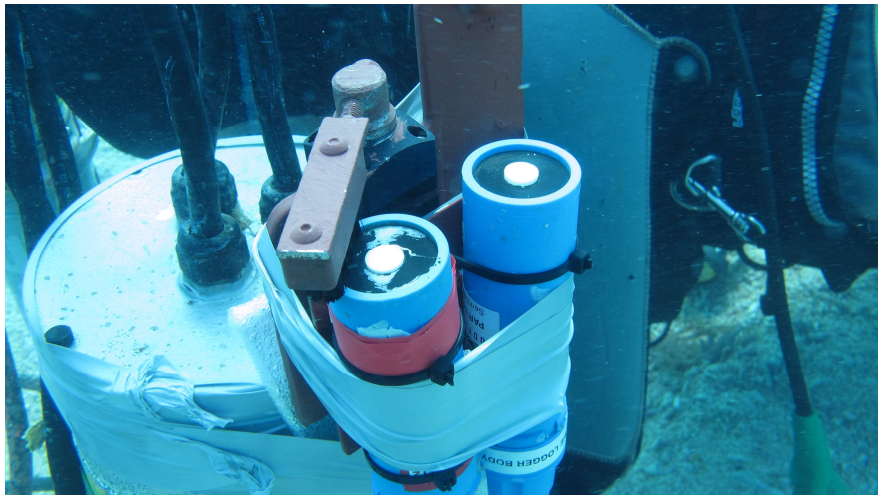
BUT WHAT DOES IT ALL MEAN, BASIL?

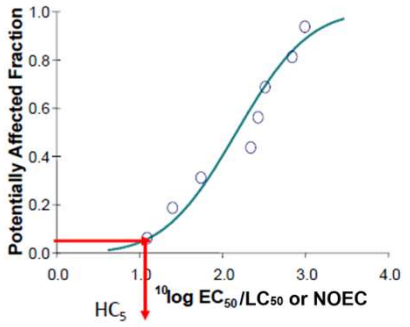
Example use of data

- 2 coral species showing similar sensitivities to measured endpoints
- Common in areas of potential dredge plumes (Spoil dumping sites)
- Fast growing corals
- Receptive to changes in water quality, inc. light availability

- 14 days required to observe change in apical growth and pigment change
- Sub lethal – chronic effects
- PAR a good use of light availability
- Other indicators of WQ inc. Turbidity, pH, DO, EC etc…
- Can adapt results from other light sensitive habitats, like seasgrass beds (Chartrand *et al*).

- In the past – Turbidity (WQ) as a percentile of pre-dredge conditions
  - Not representative of surrounding sensitive ecosystems
- Obtain threshold results from SSD's





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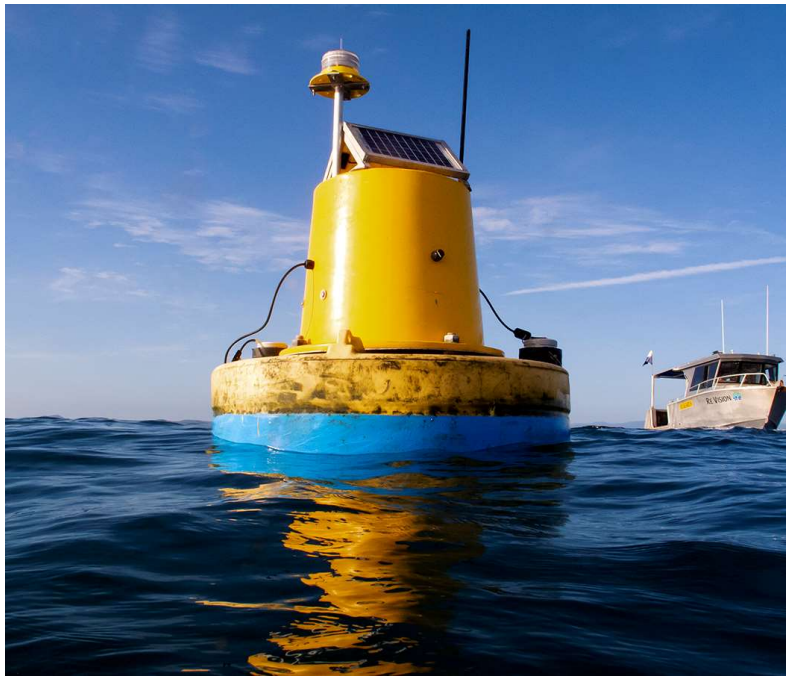
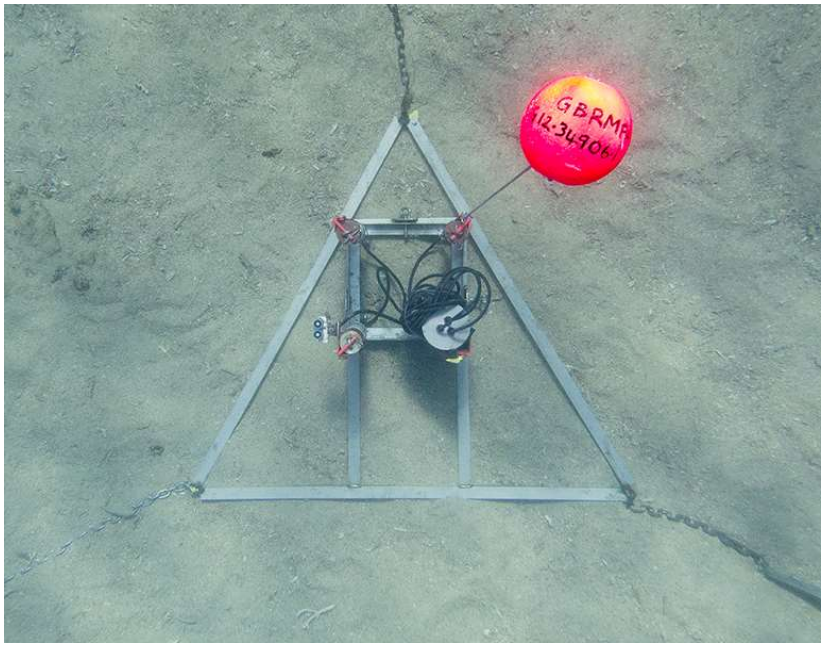
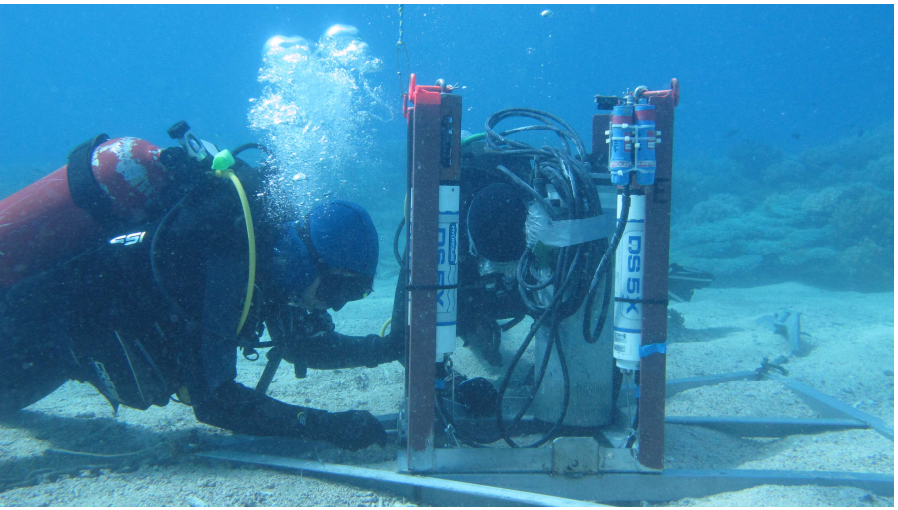


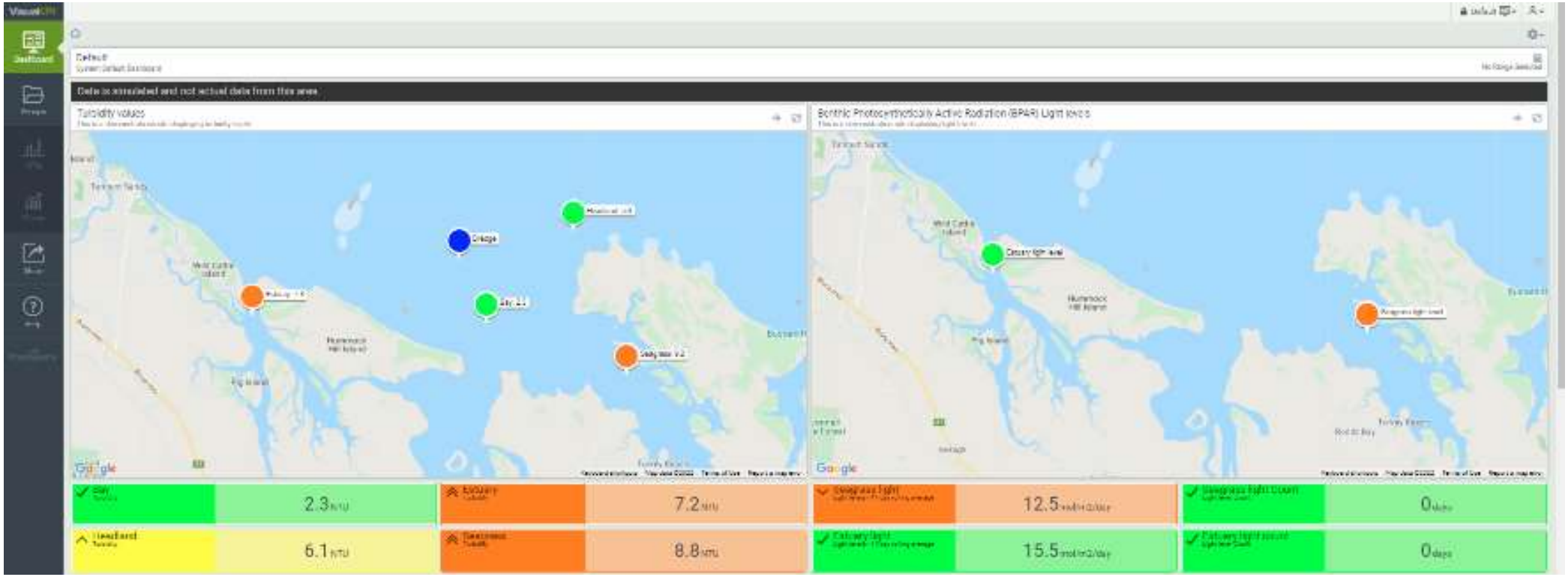

GBRMP



Example data thresholds based on experimental results

- PAR Rolling average – based on 50% reduction

- 7 days continuous light below 1 mol/m^2/day
- Using traffic light triggers for managers



- Turbidity (left), light (right)
- Traffic light system
- Site data and trigger value compliance is also summarized below the map in coloured blocks.

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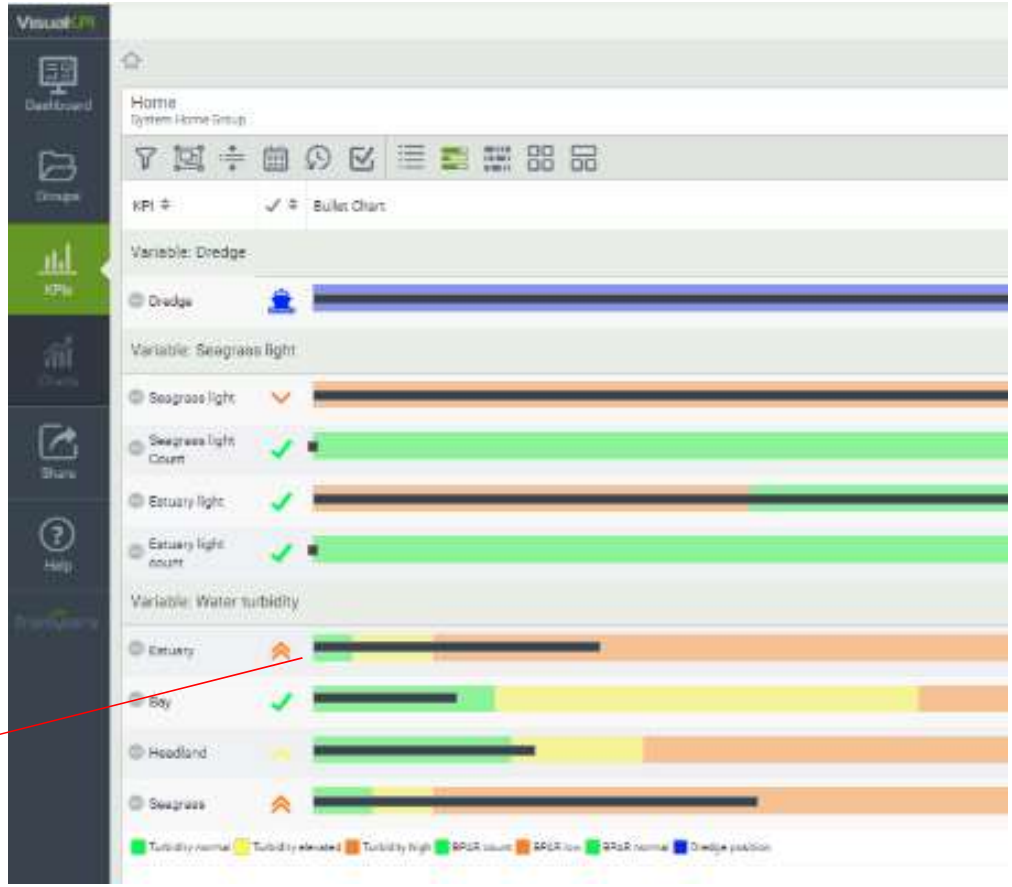
- SMS Capability when triggers activated
- Download summary daily dataset to clients
- Comparisons with metocean data



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Questions?

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