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Applying new methods to measure and model coral growth on the Ningaloo Reef slope

Anna Cresswell, Melanie Trapon, Michael Renton, Michael Haywood, Ana Giraldo Ospina, Dirk Slawinski, Rachel Austin, Damian Thomson

Ningaloo Outlook – A partnership between BHP and CSIRO

WESTERN COASTAL/OCEAN & ATMOSPHERE
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Ningaloo Outlook is a BHP-CSIRO Industry-Science Marine Research Partnership investing A$5.4 million over five years to gather new knowledge on the Ningaloo reef and its important ecological values

1. Measuring coral growth

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OPINION PIECE

Urgent need for coral demography in a world where corals are disappearing

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ABSTRACT: Coral reefs have long attracted attention because of their biological and economic importance, but this interest now has turned to examining the possibility of functional extinction

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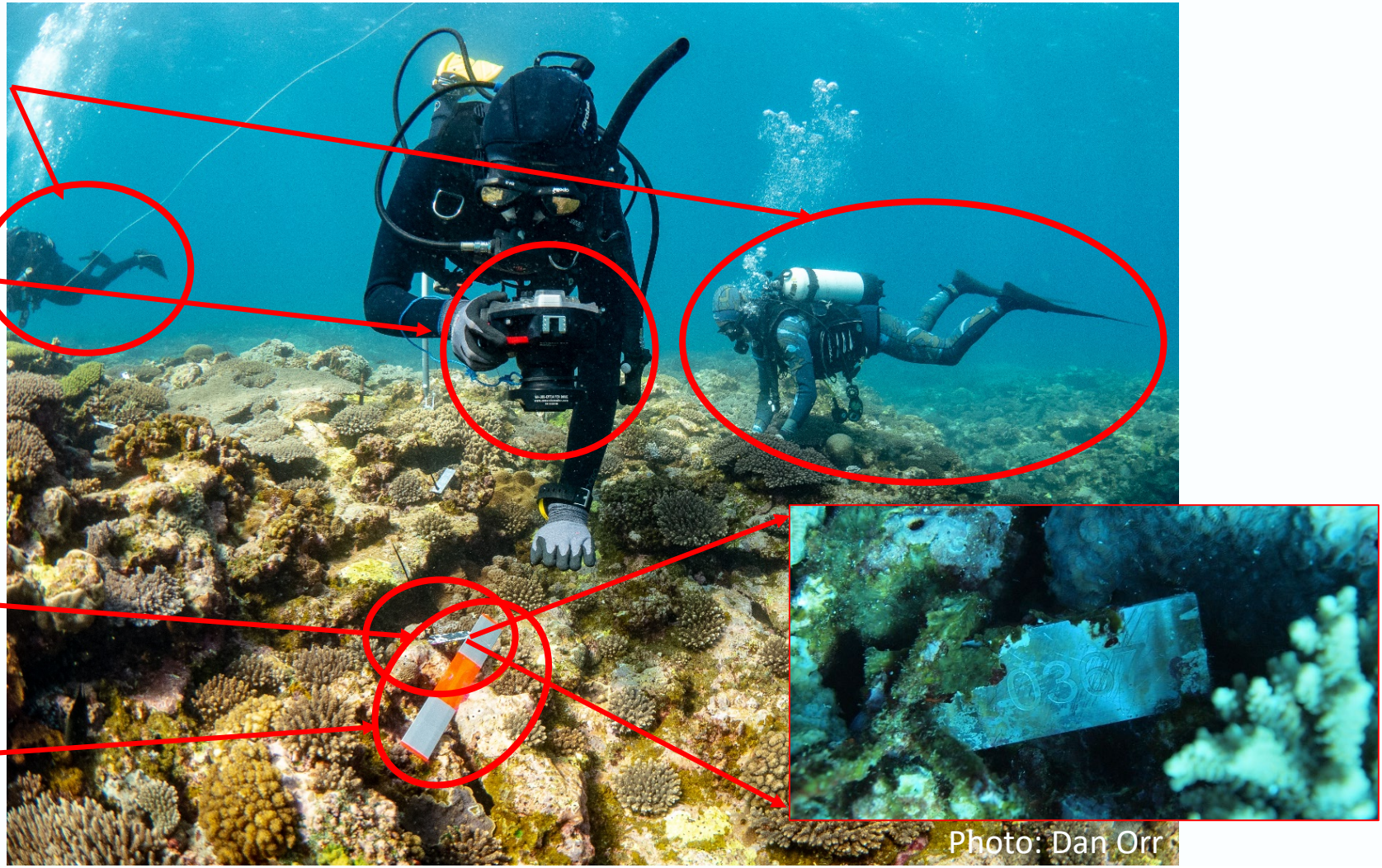
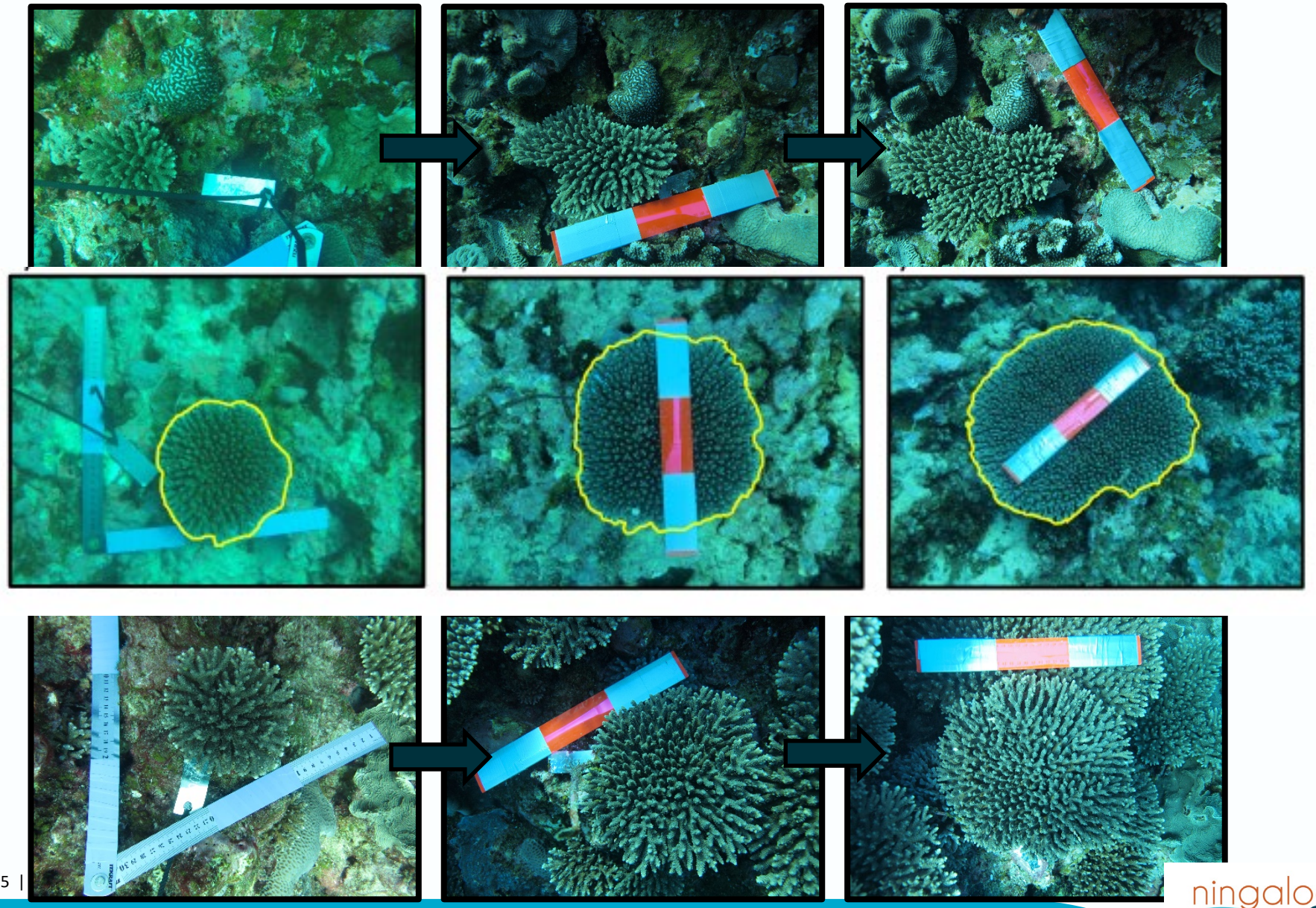
Reef slope

Cresswell et al. 2020
Acropora, Stylophora, Platygyra
Depth 5-12m

Tagging and photographing corals for growth



2017 2018 2019



Anna Cresswell | @A_K_Cresswell

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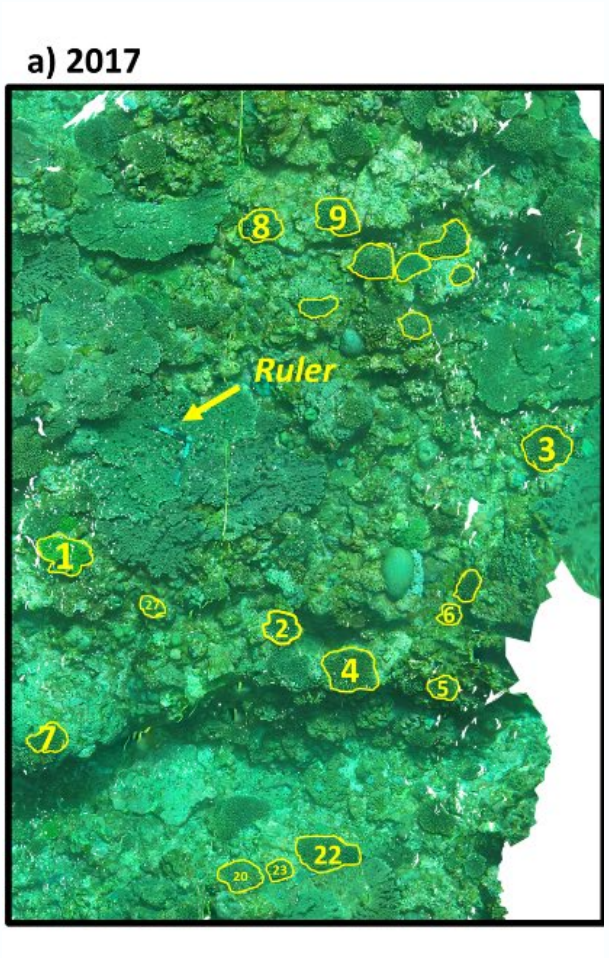
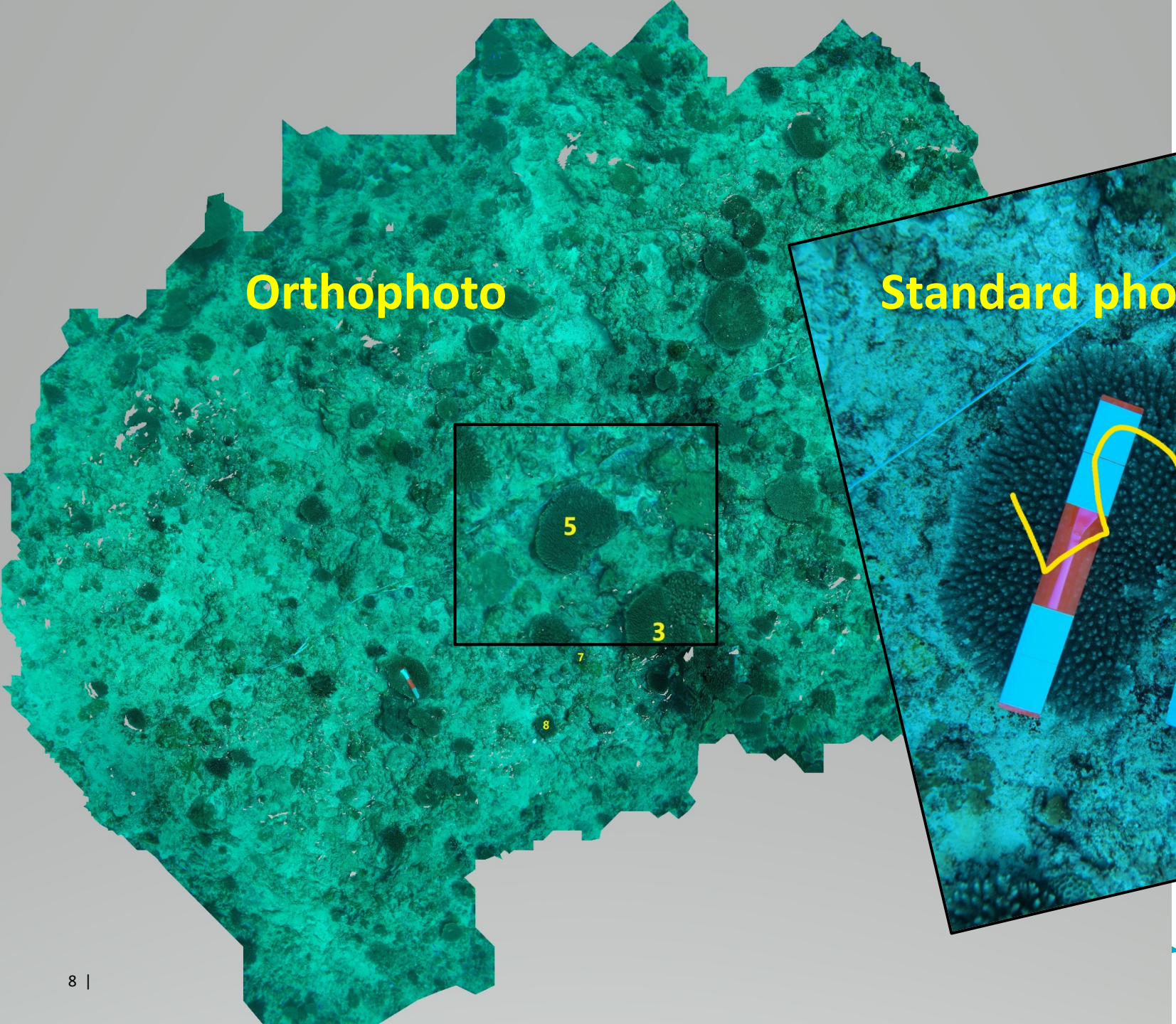
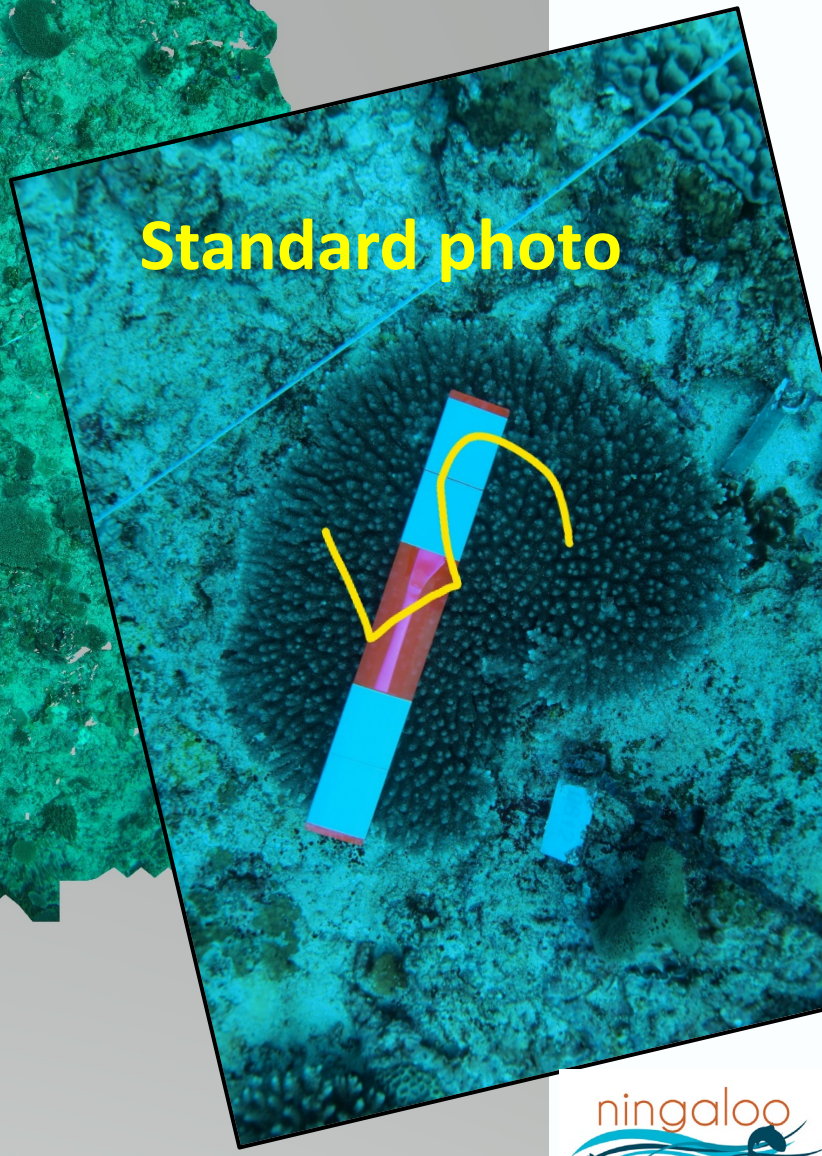
Structure-from-motion photogrammetry

Structure-from-motion orthophotos







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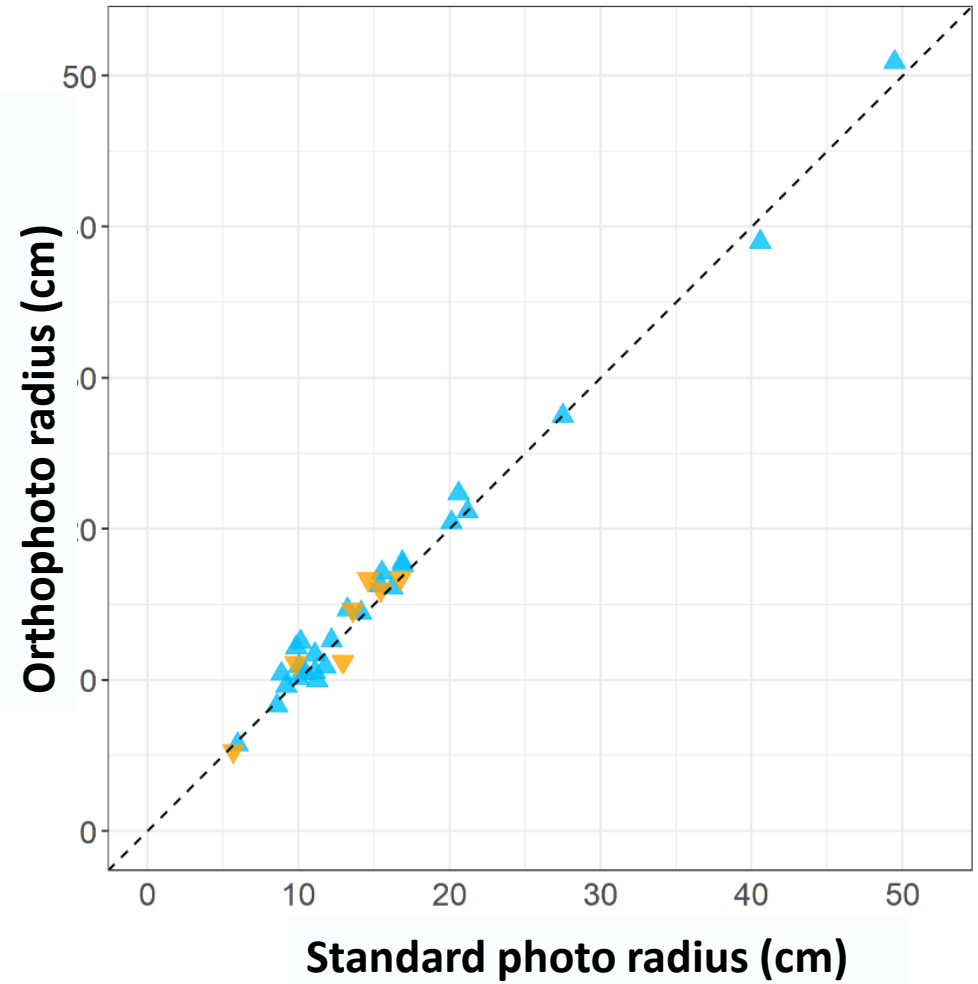
Structure-from-motion vs individual tags



Genus

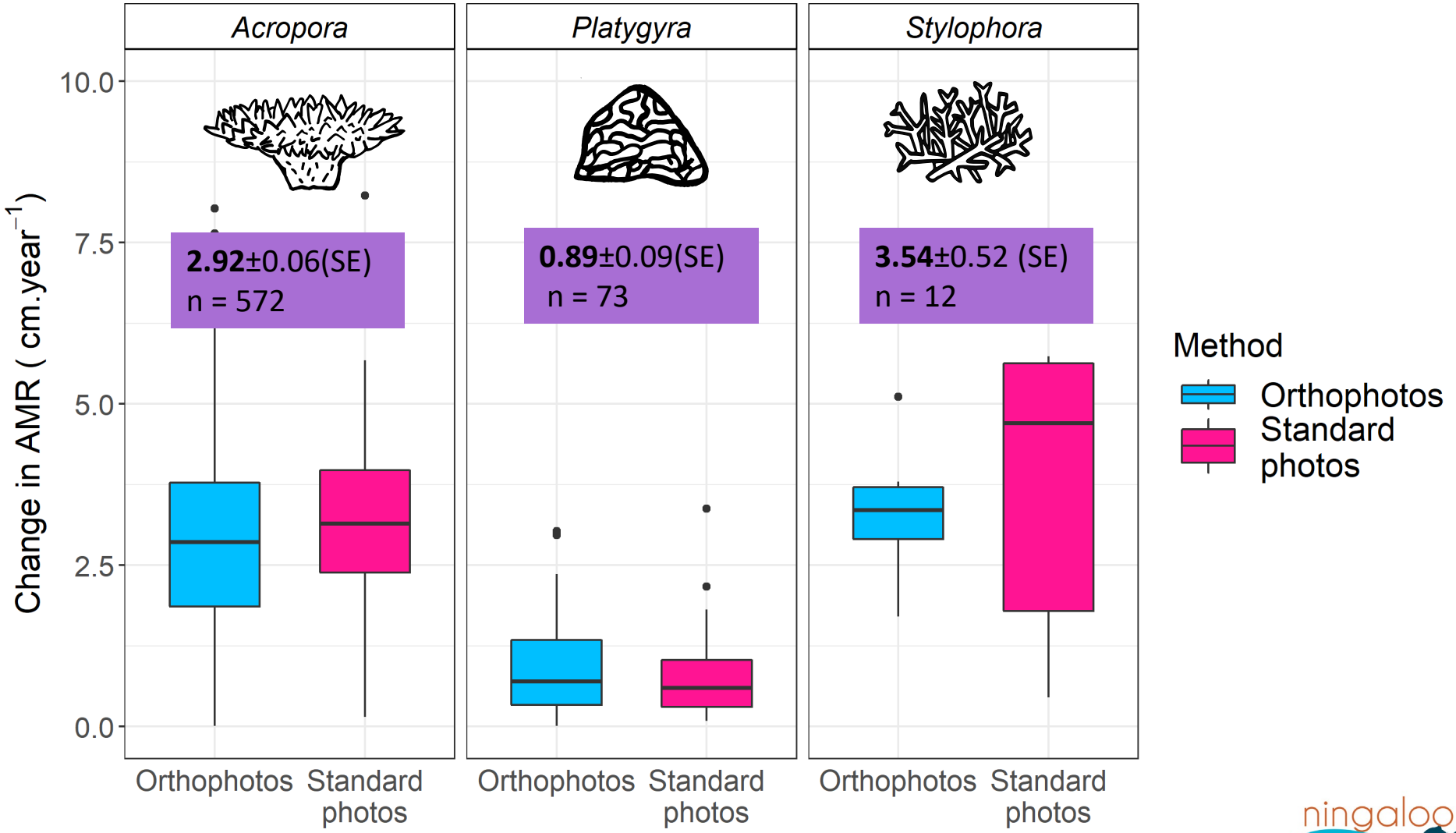
Acropora

t = -1.77, df = 34, p = 0.09

Stylophora

t = -1.08, df = 7, p = 0.32

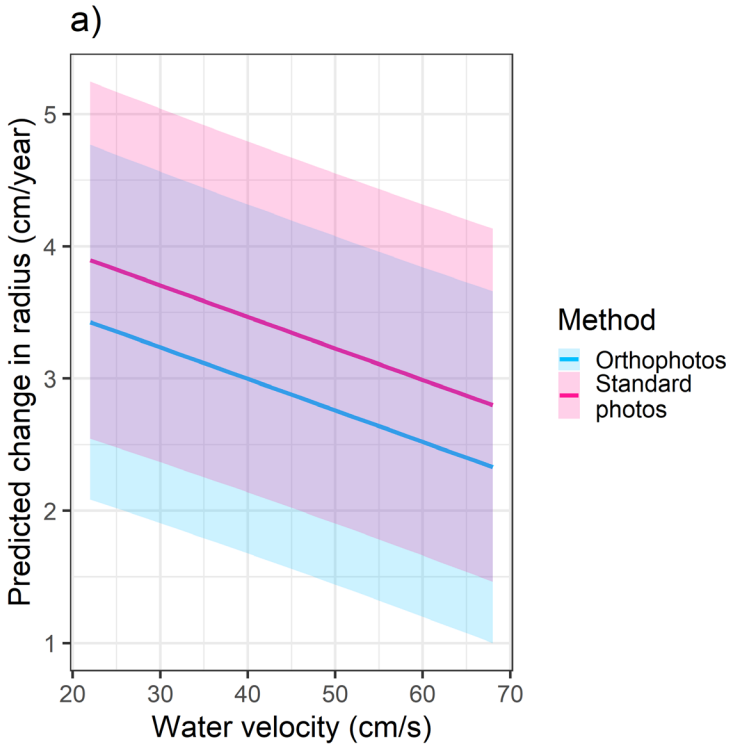
Growth rates (cm/year)

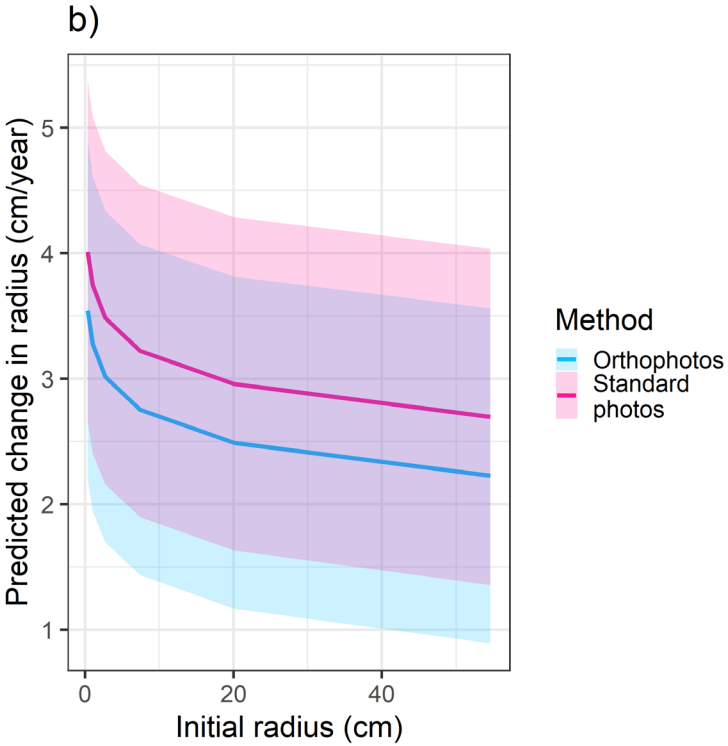


Growth rate variability *Acropora*

- growth rate ~ method + year + depth + coral size + water velocity

Variable	Estimate	Std. Error	P-value
mean centred intercept	2.80	0.14	<0.001
(log) **coral size**	**-0.26**	0.10	**0.009**
water velocity	**-0.02**	0.01	**0.021**
method (tags)	**0.47**	0.19	**0.012**





Summary coral growth

Special thanks to Olivia Wei An Seow, Cindy Bessey Christopher Doropoulos, Dan Orr, Ryan Crossing, Nick Gust, Margaret Miller, Jim Gunson, Emma Westlake

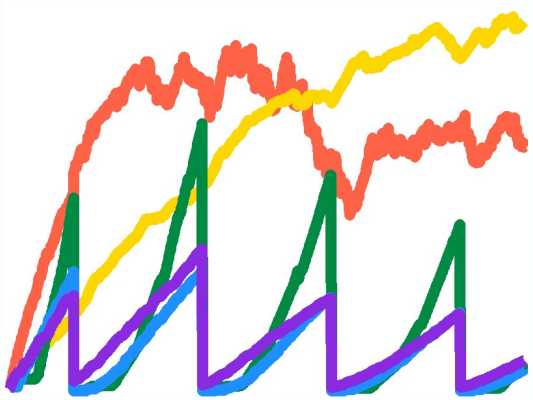
Biological/ Ecological

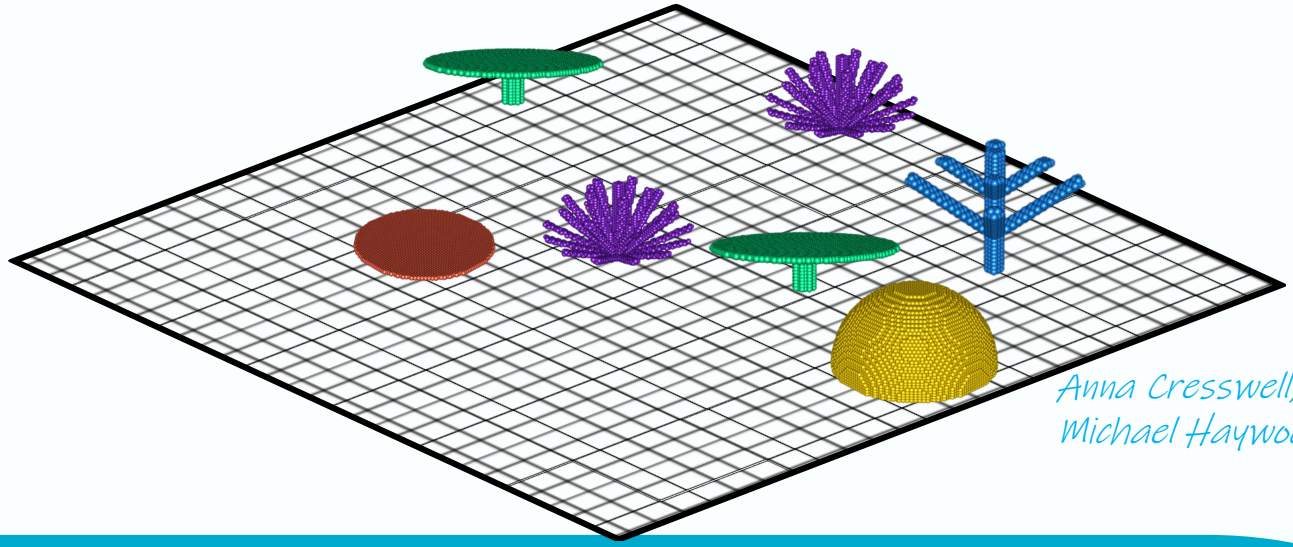
- New planar growth estimates for *Acropora* and *Stylophora*
- *Acropora* growth slower than previous estimates
- For *Acropora:* Coral size and wave exposure dependency

Methods comparison

- Useful demographic information can be obtained from orthophotos
- Very high sample sizes
- 3D potential
- Slower growth rate orthophotos than standard photos

2. Modelling coral growth (and competition and disturbance)





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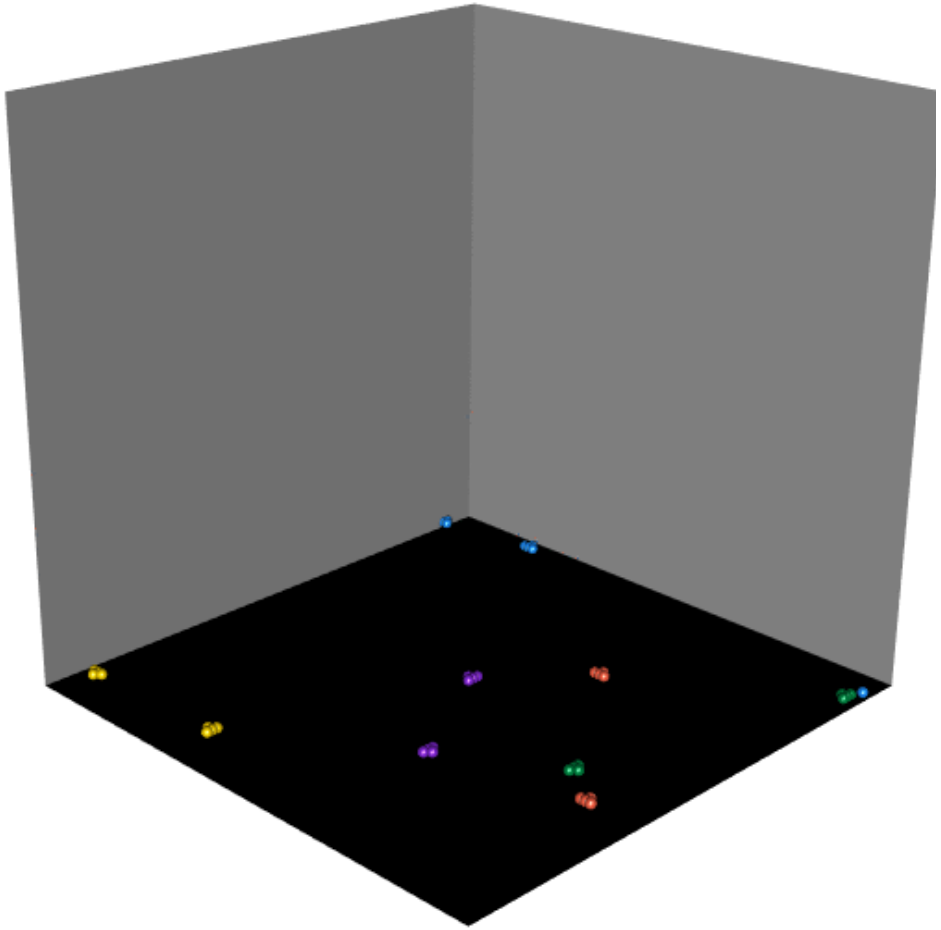
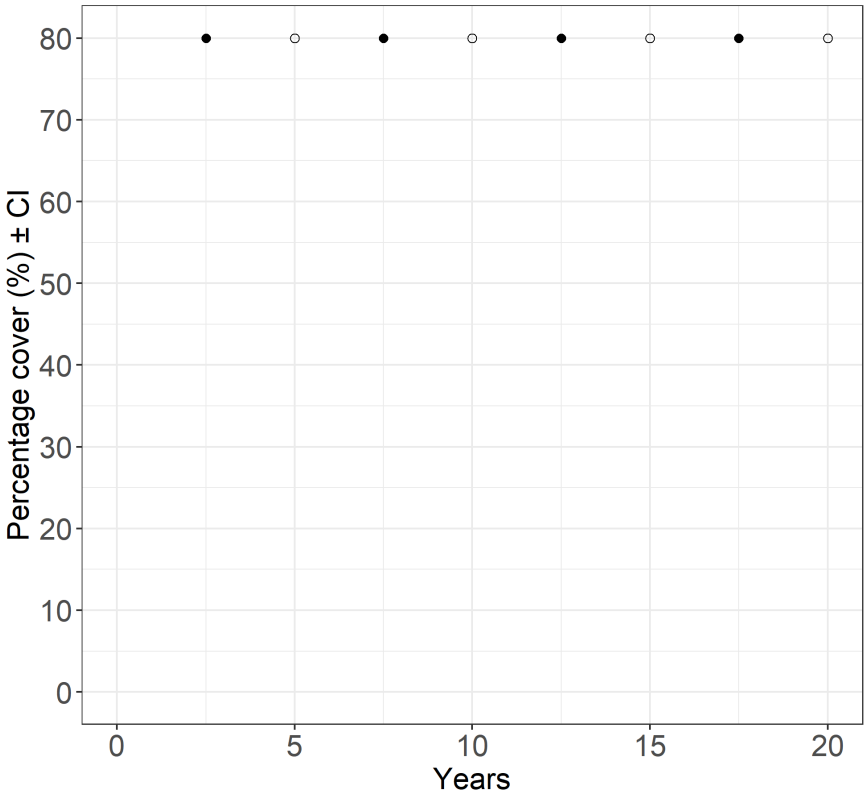
Coralcraft

Disturbance ○ Low intensity ● High intensity

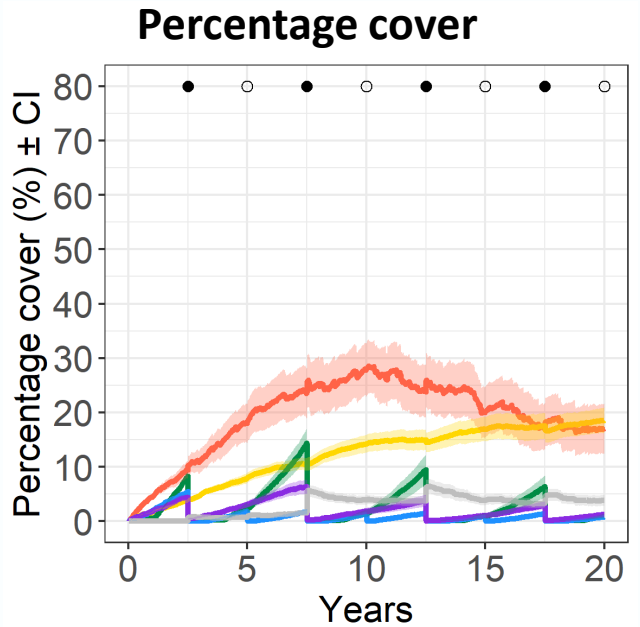
Growth form Encrusting Hemispherical Tabular Branching Corymbose

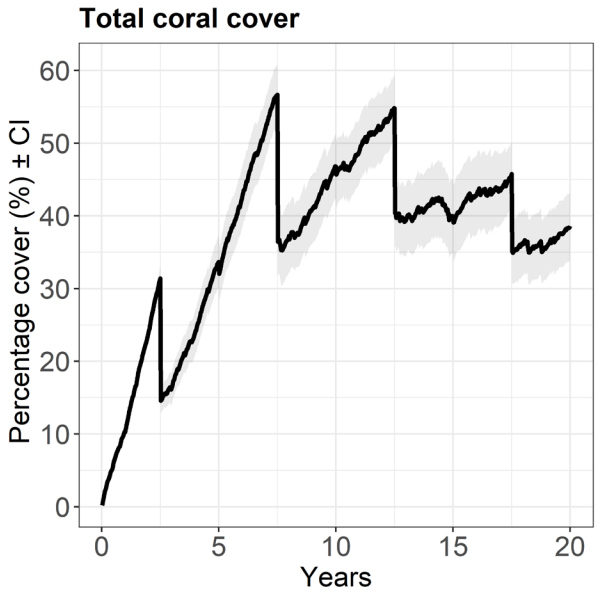


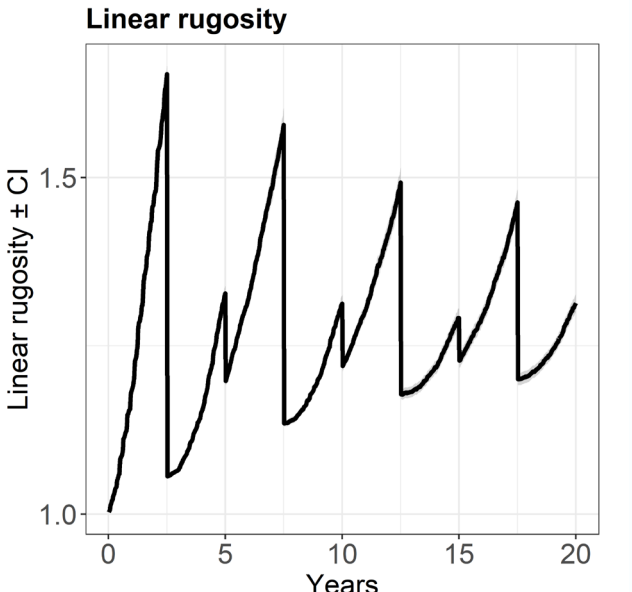
Time step 2

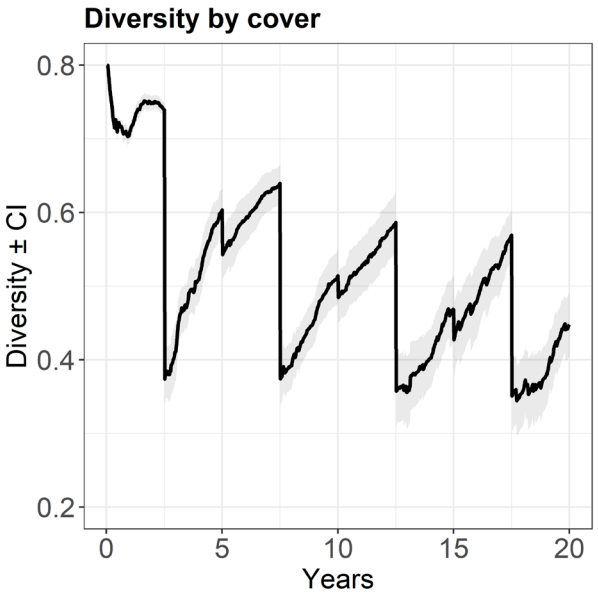


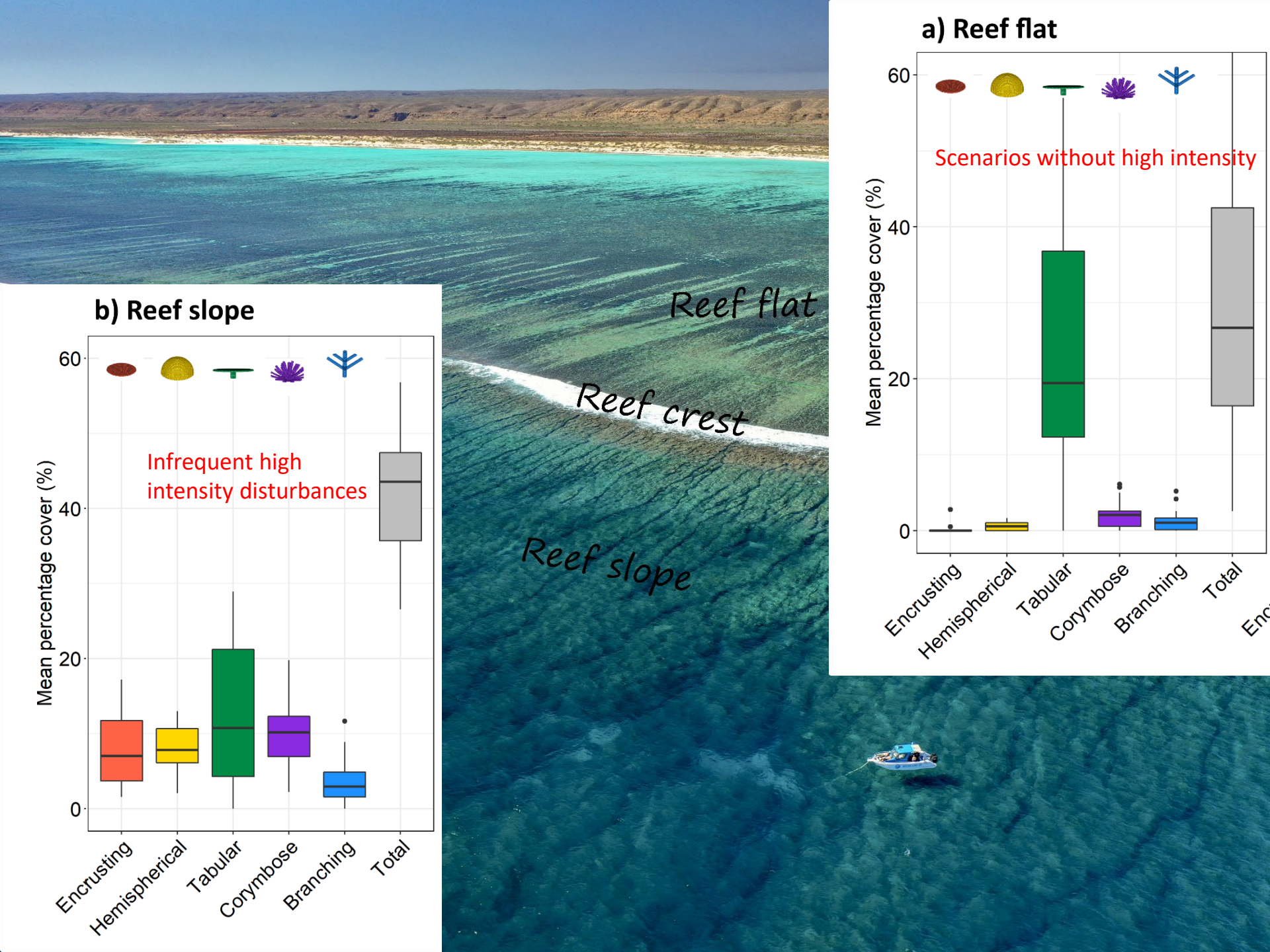
Note:
Hydrodynamic disturbances occur every 130 timesteps
Spawning every 52 timesteps


Percentage cover
Percentage cover (%) ± CI
80
70
60
50
40
30
20
10
0
0
5
10
15
20
Years


Total coral cover
Percentage cover (%) ± CI
60
50
40
30
20
10
0
0
5
10
15
20
Years

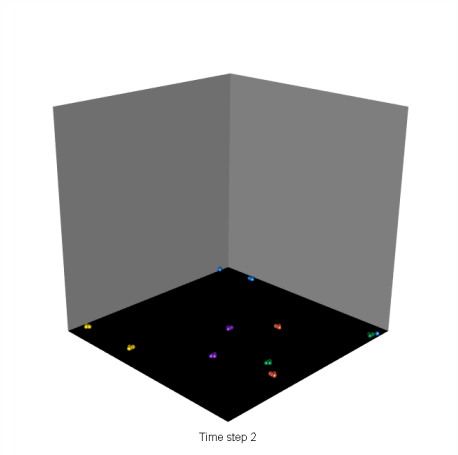

Linear rugosity
Linear rugosity ± CI
1.5
1.0
0
5
10
15
20
Years


Diversity by cover
Diversity ± CI
0.8
0.6
0.4
0.2
0
5
10
15
20
Years


Reef flat
Reef crest
Reef slope
a) Reef flat
Scenarios without high intensity
Mean percentage cover (%)
0
20
40
60
Encrusting
Hemispherical
Tabular
Corymbose
Branching
Total
b) Reef slope
Infrequent high intensity disturbances
Mean percentage cover (%)
0
20
40
60
Encrusting
Hemispherical
Tabular
Corymbose
Branching
Total

Summary coral modelling

- **Multiple metrics** simultaneously: number of colonies, percentage cover, volume, structural complexity, linear rugosity
- 3D community - novel
- Investigate **scenarios** and **visualise** dynamics



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UWA School of Biological Sciences

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Claire Smallwood

Mat Vanderklift

Harri Davies

Claire Butler

Russell Vines

Bev Pether

Brett Molony

Cindy Bessey

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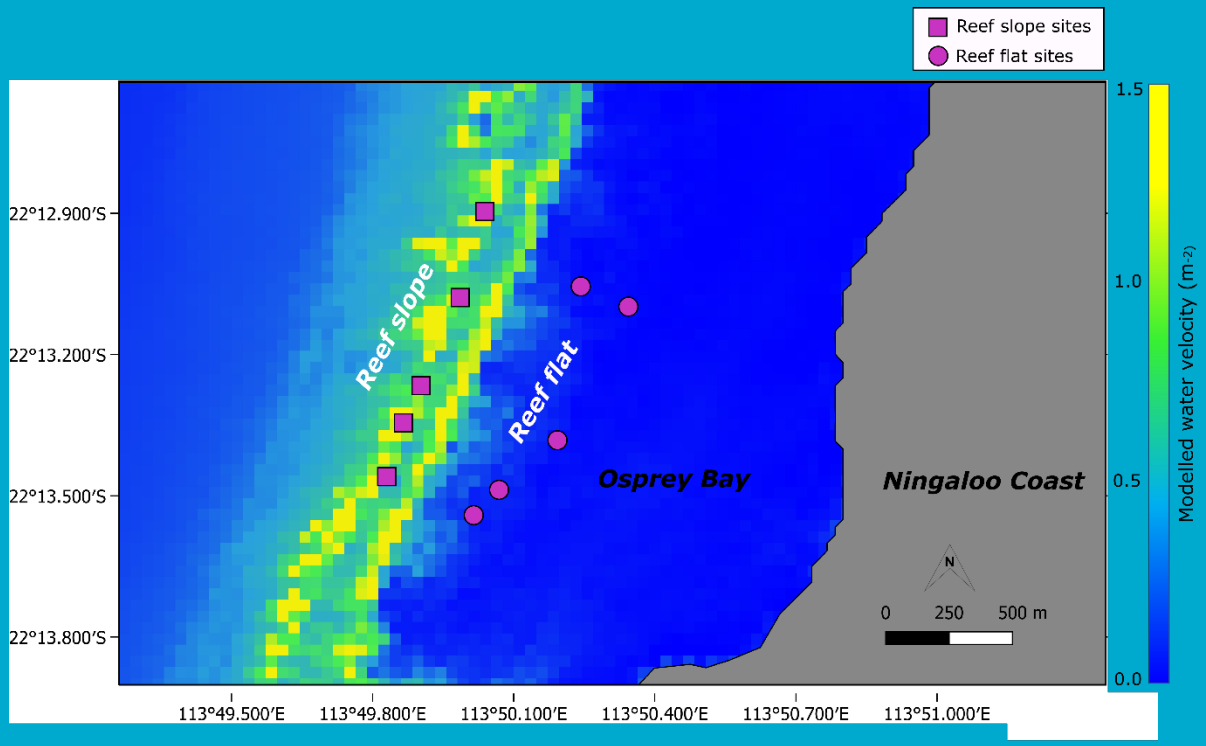
Reef slope sites
Reef flat sites
Reef slope
Reef flat
Osprey Bay
Ningaloo Coast
N
0
250
500 m
22°12.900′S
22°13.200′S
22°13.500′S
22°13.800′S
113°49.500′E
113°49.800′E
113°50.100′E
113°50.400′E
113°50.700′E
113°51.000′E
1.5
1.0
0.5
0.0
Modelled water velocity (m-2)