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Ningaloo Outlook Symposium - 2016

Ningaloo Outlook – A partnership between BHP Billiton and CSIRO

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Theme 2: Shallow reefs

Damian Thomson, Mick Haywood, Cindy Bessey, Mat Vanderklift & Russ Babcock, Anna Cresswell (PhD)

Why study the shallow reefs

- Increasing pressures
- 300000 visitors per year, 75% to shallow reefs
- Important habitat and physical protection
- Unlike the GBR

Partnership to build on long-term datasets and to contribute new knowledge.

Why study the shallow reefs

Circa 1974

2015

Aims

Annual assessment of the status of Ecological Values (corals, fish and sharks)

Establish partnerships with local community groups

- Promote understanding and ownership
- Regular updates on the latest research
- Guidance for monitoring programs
- Training

Research priorities for shallow reefs identified by Department of Parks and Wildlife

Priority research areas	Targeted research areas
1) Coral Reefs (Ningaloo)	Effects of recreational and commercial fishing. How have fishing effects changed?
2) Finfish (Ningaloo)	Best methods for assessing fish abundance in turbid waters?
3) Effects of fishing	

(Kendrick *et al. 2015*)

Aims

Annual assessment of the status of Ecological Values (corals, fish and sharks)

1) Benthic assessments

- Changes over time
- Develop new technology
- Hydrodynamic influences

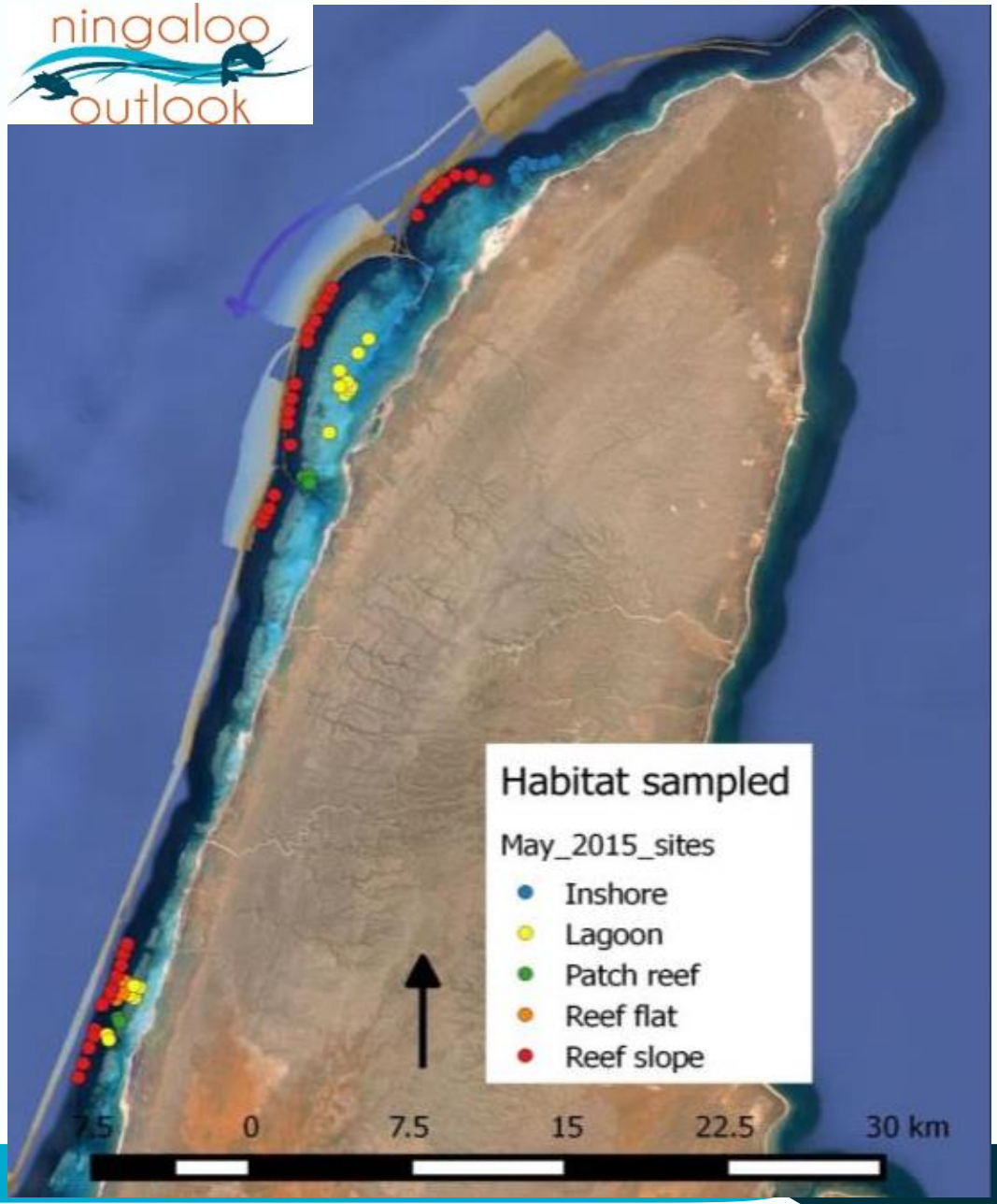
2) Zoning effects on fish communities (MH)

3) Fish abundances in turbid waters (MH)

Survey sites

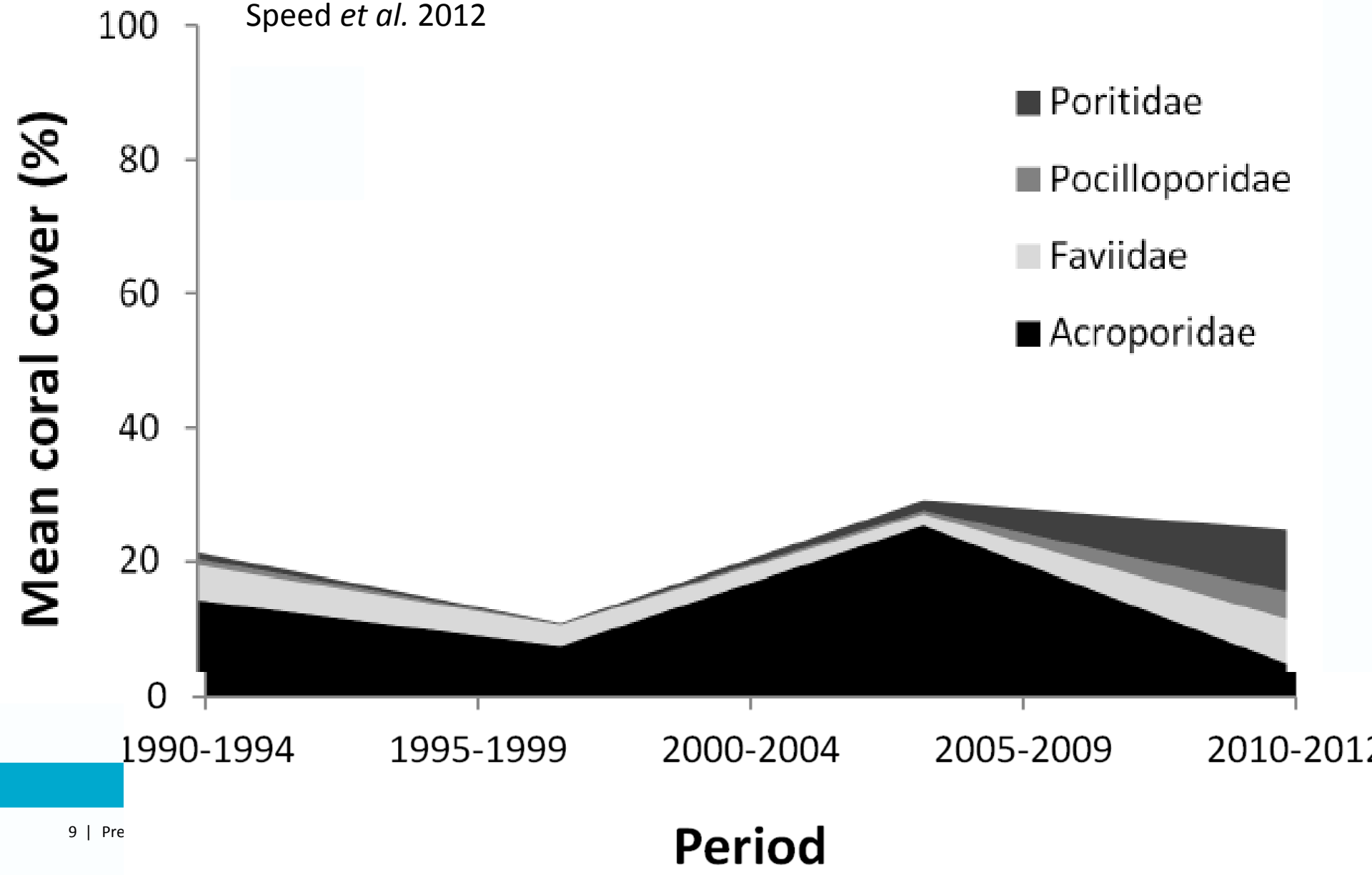
- 72 locations
- Fish surveys (100m & 25m)
- Benthic surveys (25m & 10x8m)

Region	Zoning	No. of sites
Jurabi	Sanctuary	8
Jurabi	General Use/ Rec.	8
Mangrove	Sanctuary	6
	General Use/ Rec.	22
Osprey	Sanctuary	17
	General Use/ Rec.	11
Total		**72**

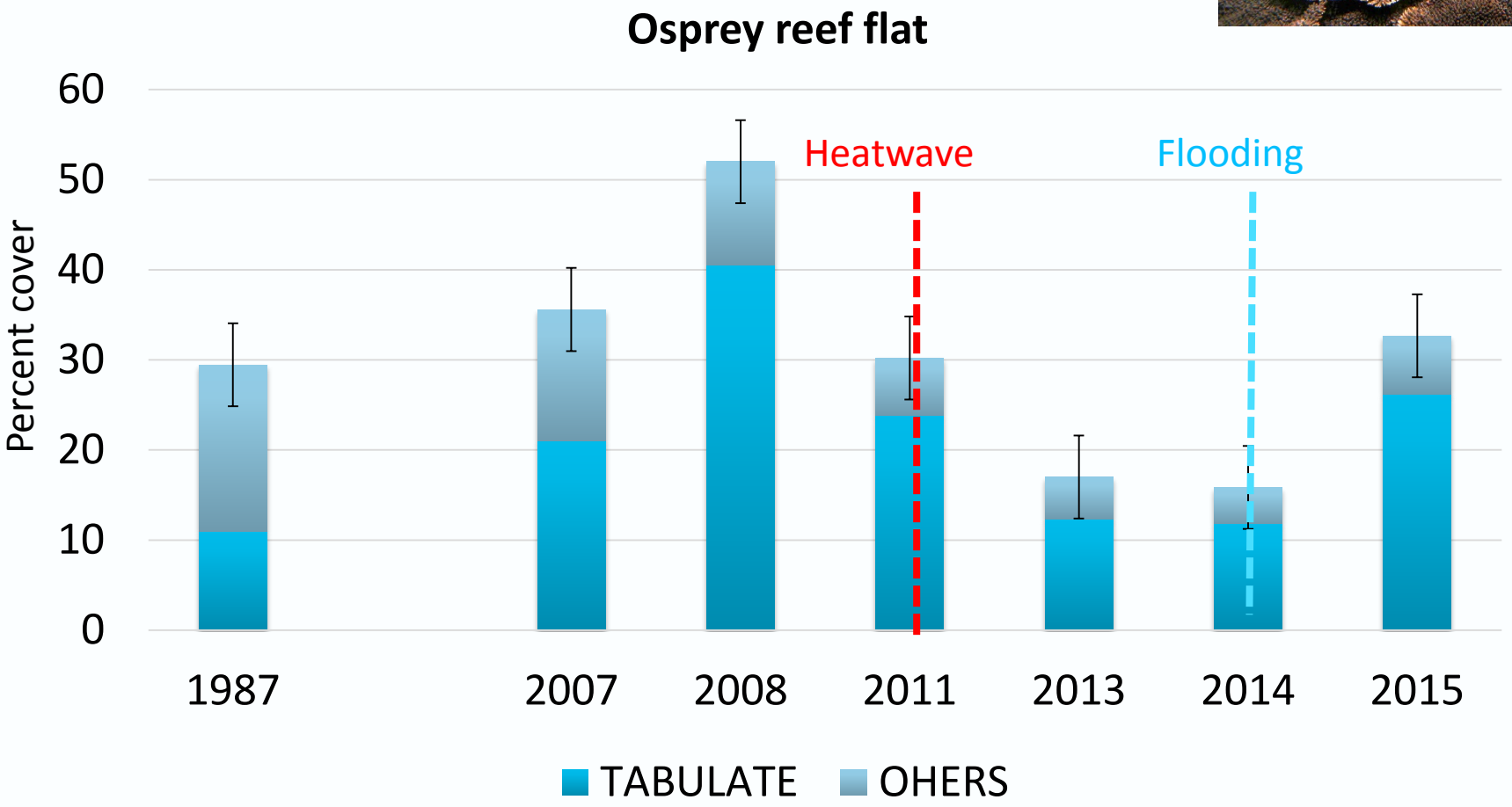


Benthic assessments (time series)

Speed *et al.* 2012



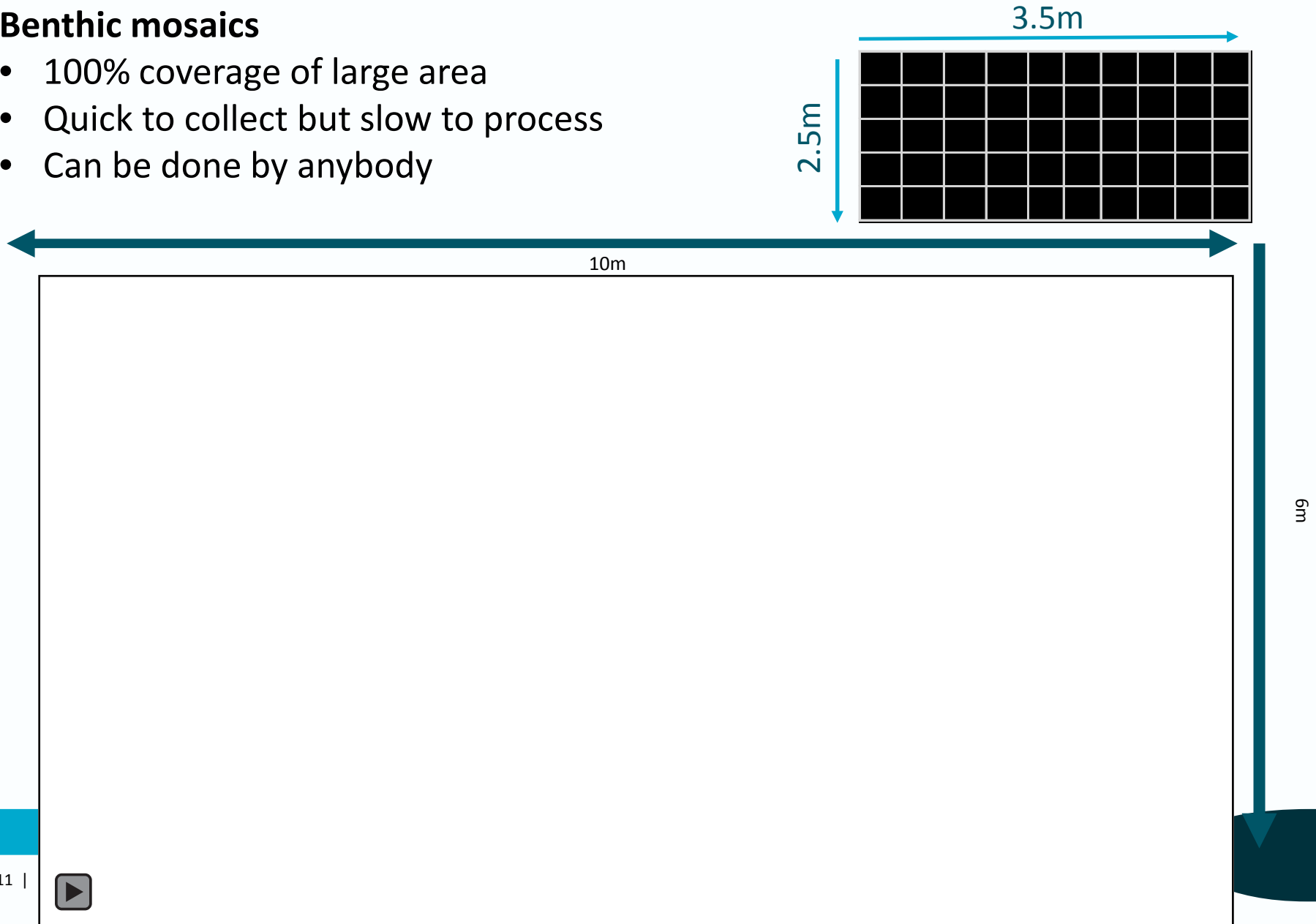
Benthic assessments (time series)



Benthic assessments (new technology)

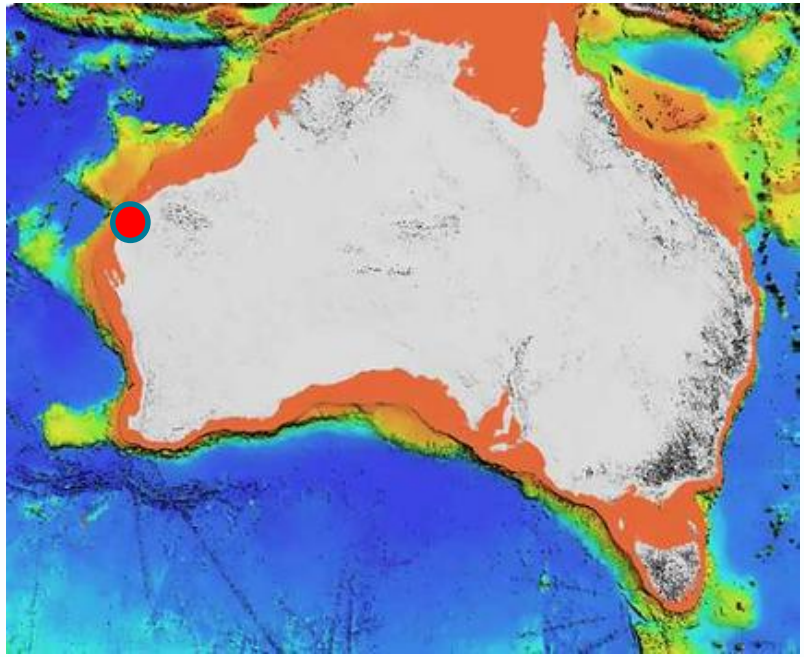
Benthic mosaics

- 100% coverage of large area
- Quick to collect but slow to process
- Can be done by anybody



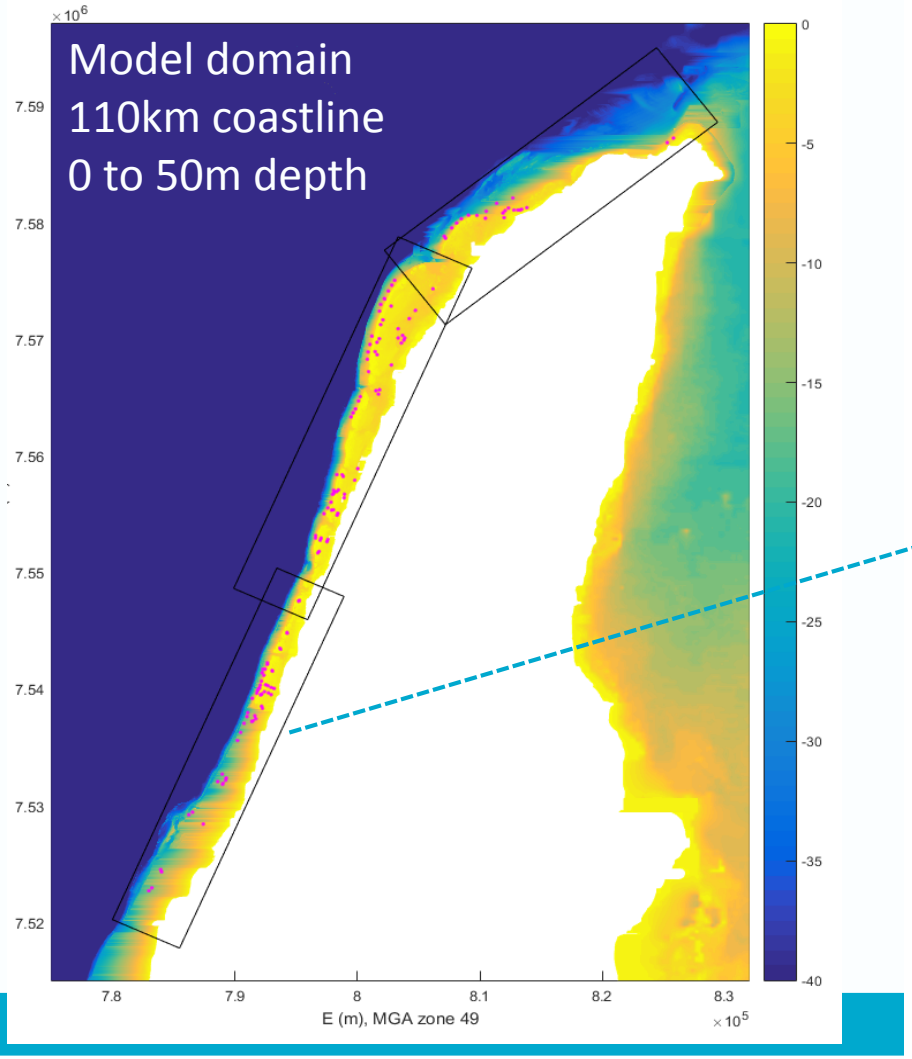
Benthic assessments (hydrodynamics)

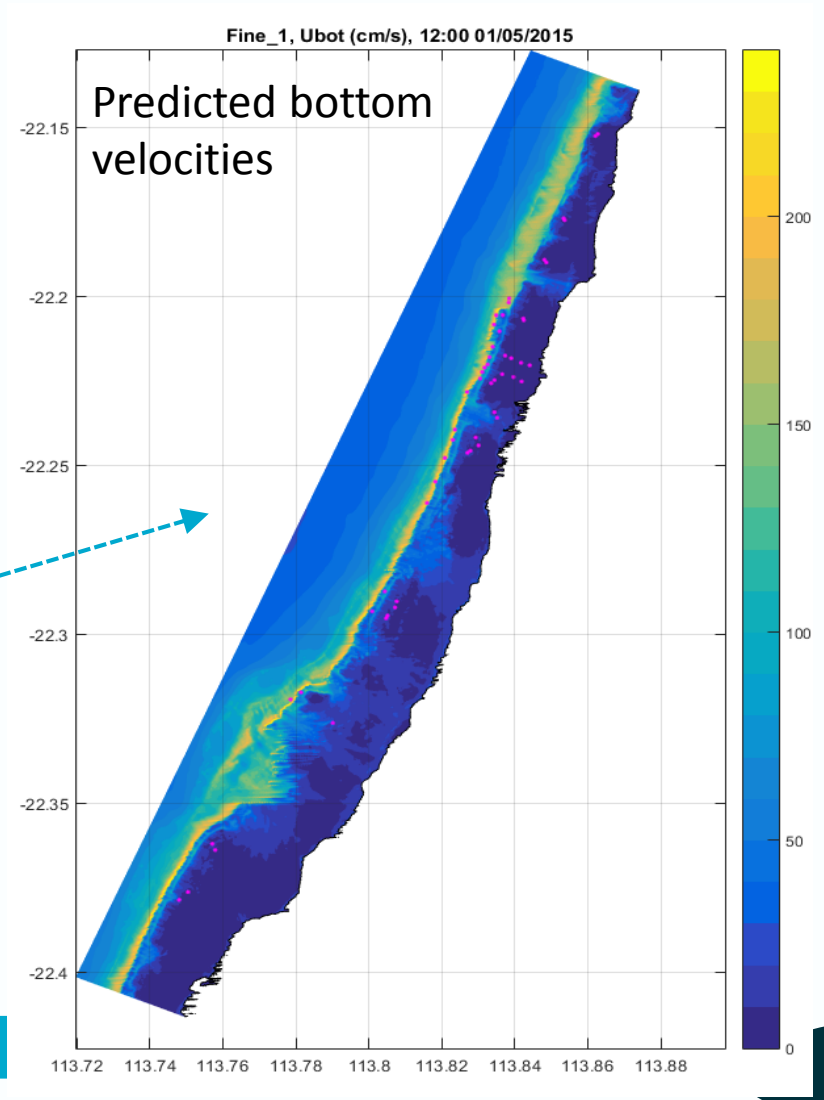
- Range of habitats across reef
- Range of locations along the reef
- Interested in what shapes benthic communities
- Previous work shown hydrodynamics important



Benthic assessments (hydrodynamics)

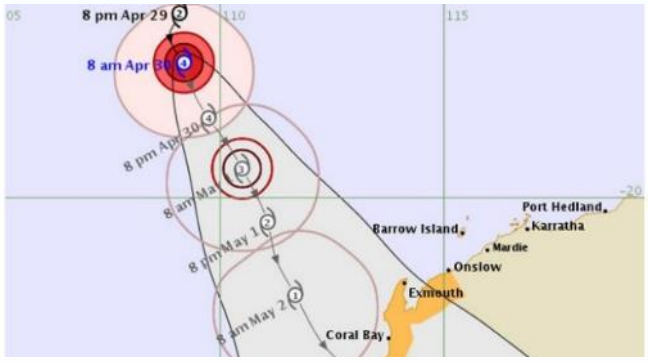
High resolution wave model

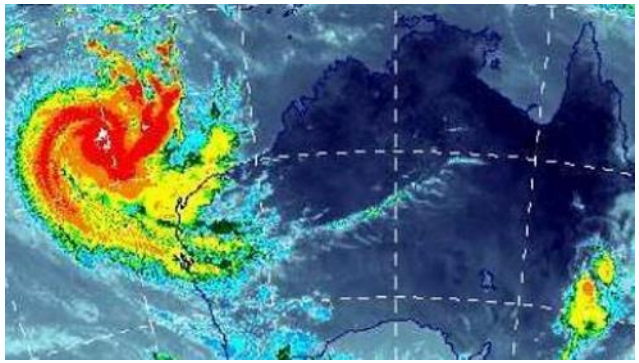




Benthic assessments (hydrodynamics)

Extreme versus average

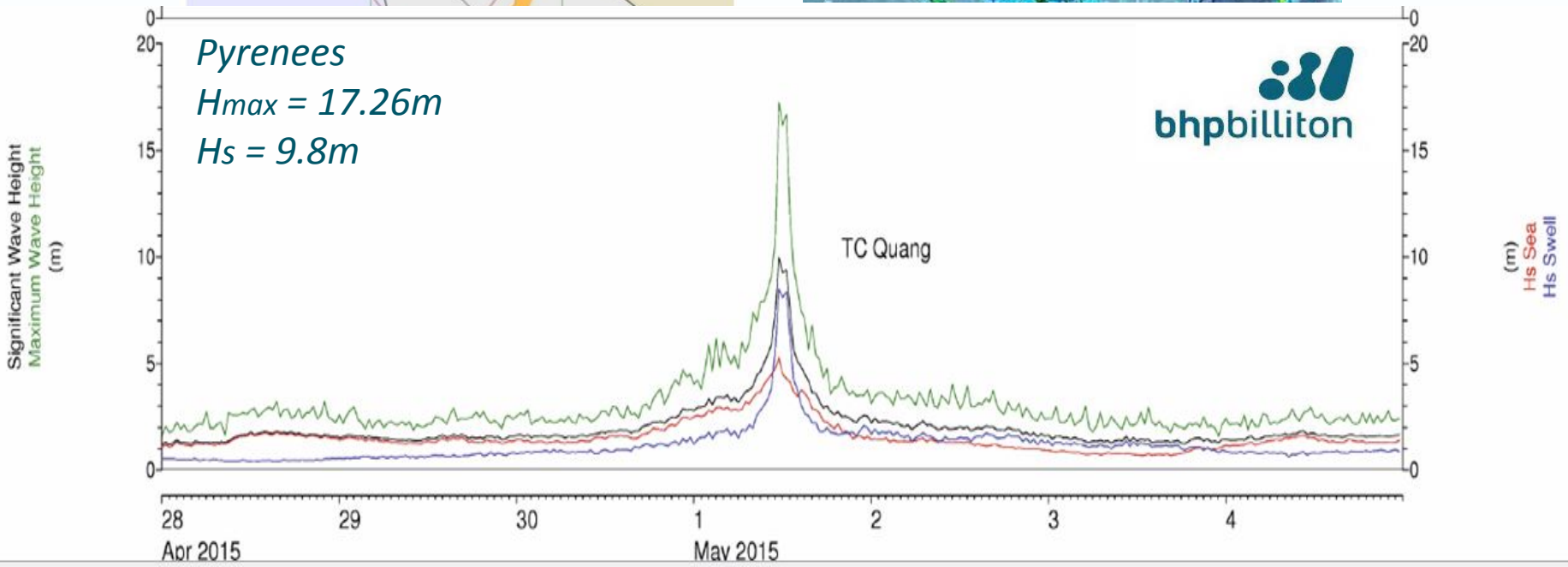




Pyrenees

Hmax = 17.26m

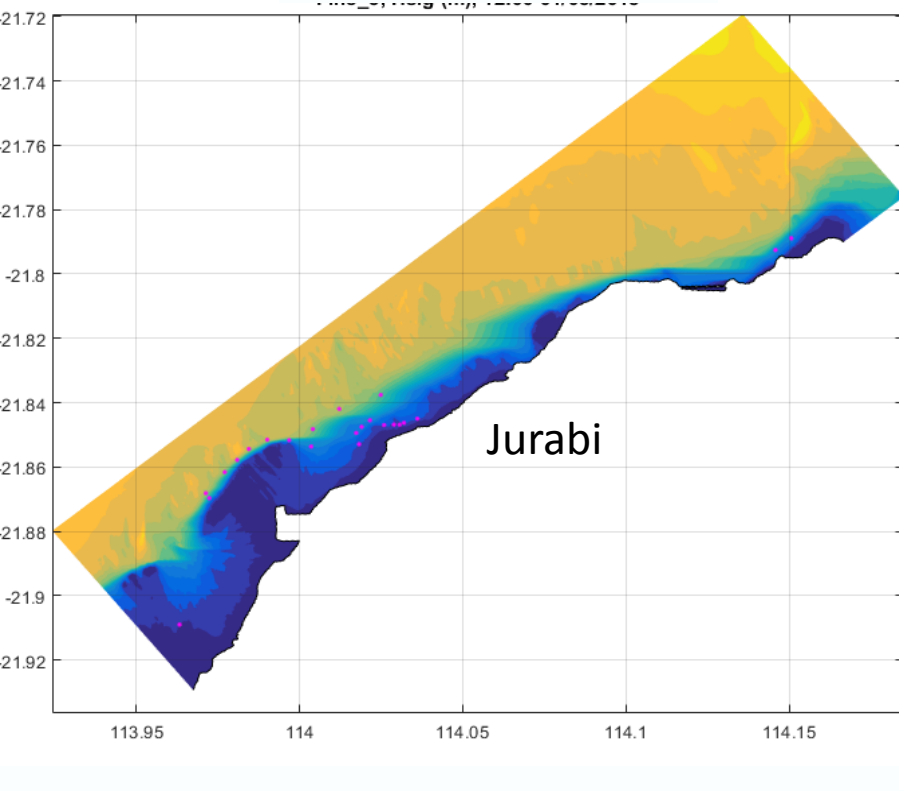
Hs = 9.8m



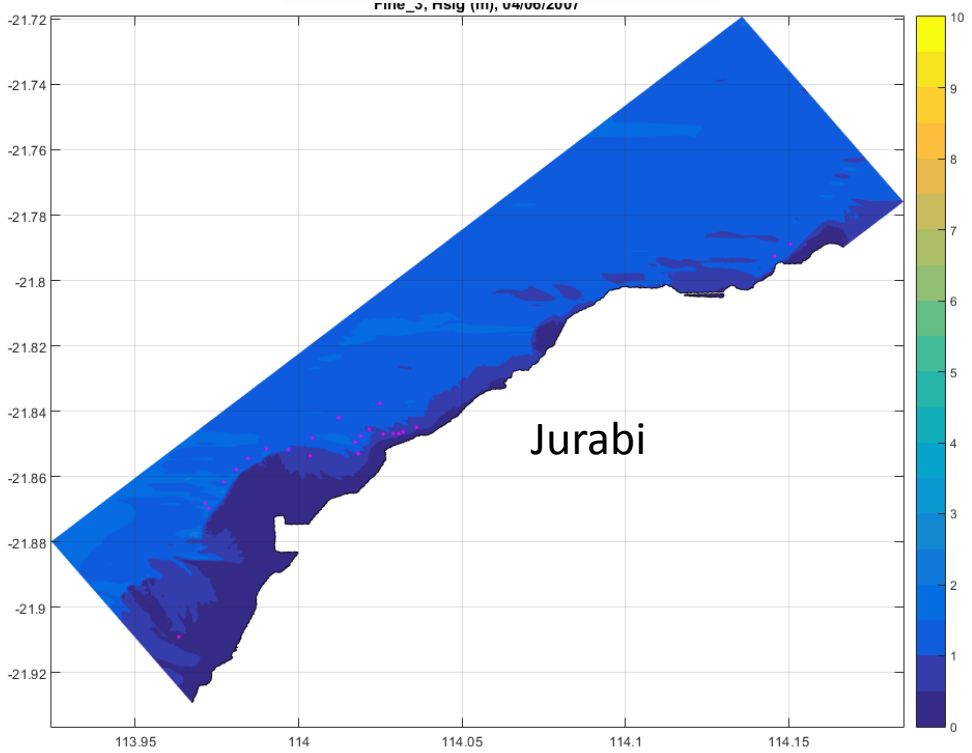
Benthic assessments (hydrodynamics)

Predicted wave heights (Hs)

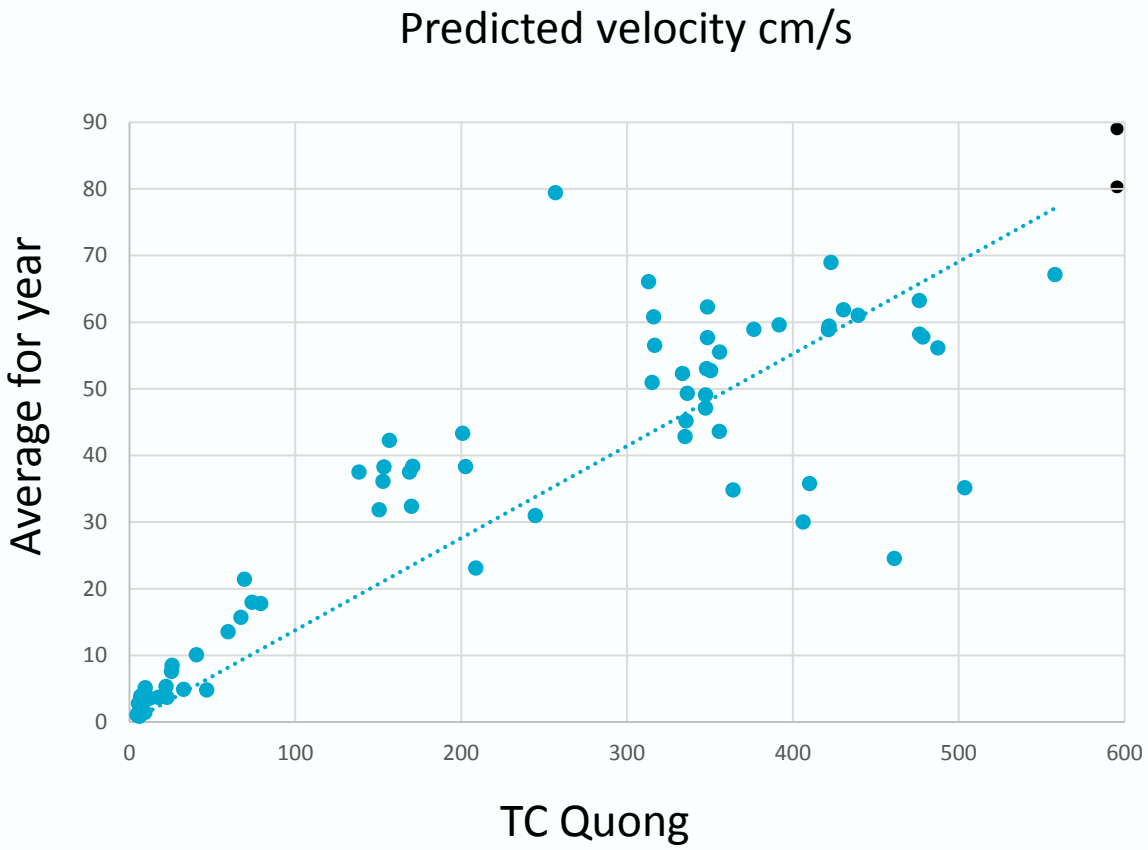
TC Quong



Yearly mean



Water velocities during TC Quong



- Maximum velocity = 580cm/sec
- Relationship between average and maximum velocities increasingly variable

Conclusions after first 9 months

Changes over time

Reef flat and reef slope benthic communities are stable or increasing in cover

Development of new technology

Progressing well. Automating the processing step will be key

Hydrodynamics

Wave model suggests cyclones very important in structuring benthic communities in northern Ningaloo.

Outline

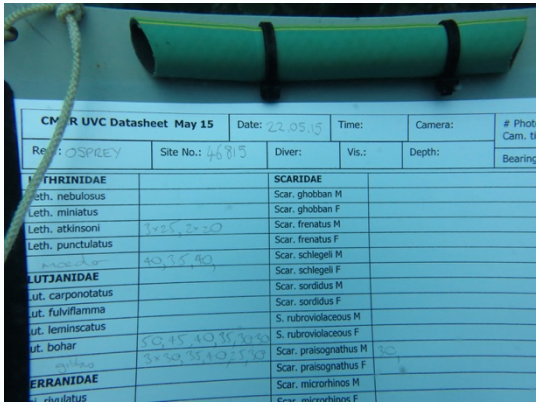
- Fish communities – Effects of fishing (Kendrick et al.)
  - Methods
  - Summary of results:
    - Environmental correlates
    - Spatial and temporal trends (3 families)
- Pilot study – Influence of divers
- Future directions

Underwater Visual Census (UVC)

- UVC is a practical and popular method used globally
  - Advantages:
    - Conducted by same researchers - minimizes diver variation
    - Non-destructive
    - Instantaneous data
    - Used at Ningaloo since 2006 - baseline for comparison

Underwater Visual Census (UVC)

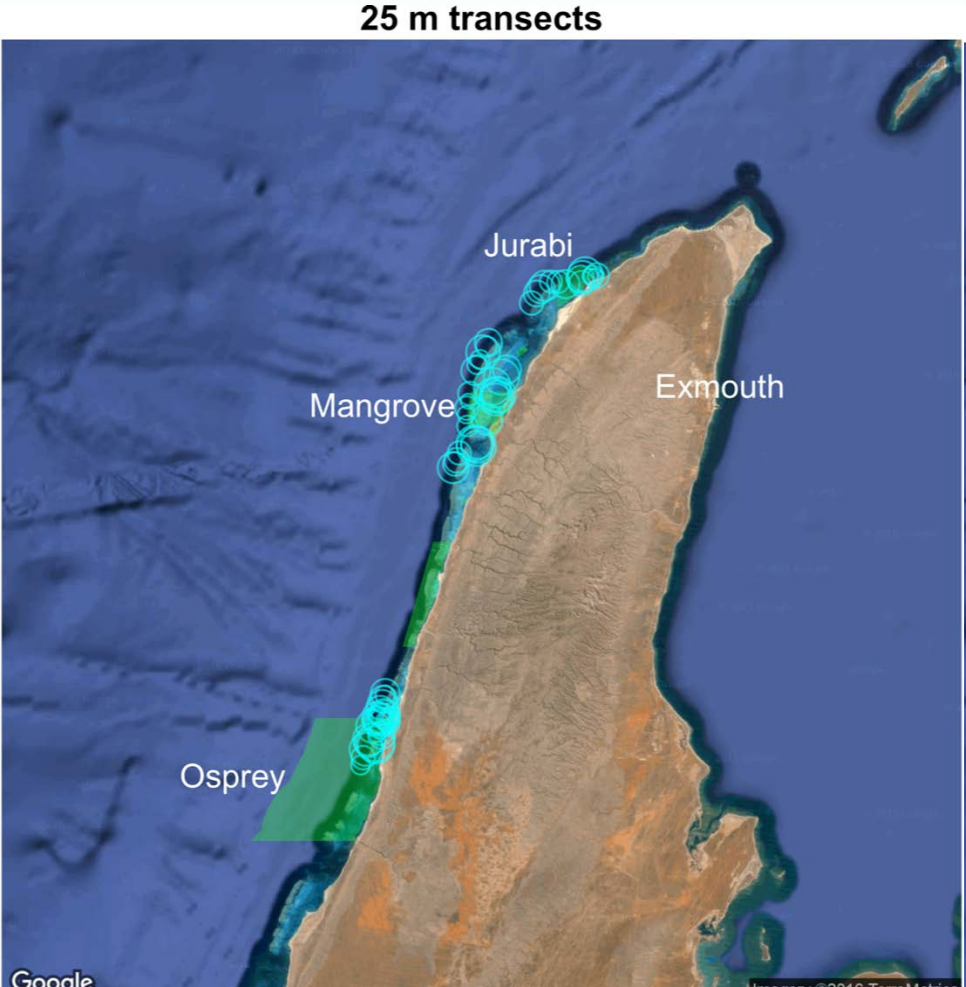
- Diver identifies, counts and estimates size of fish
- Visual estimate of rugosity, % cover of substrate types, coral & algae
- Short (25 x 5 m) and long (100 x 10 m) transects at each site

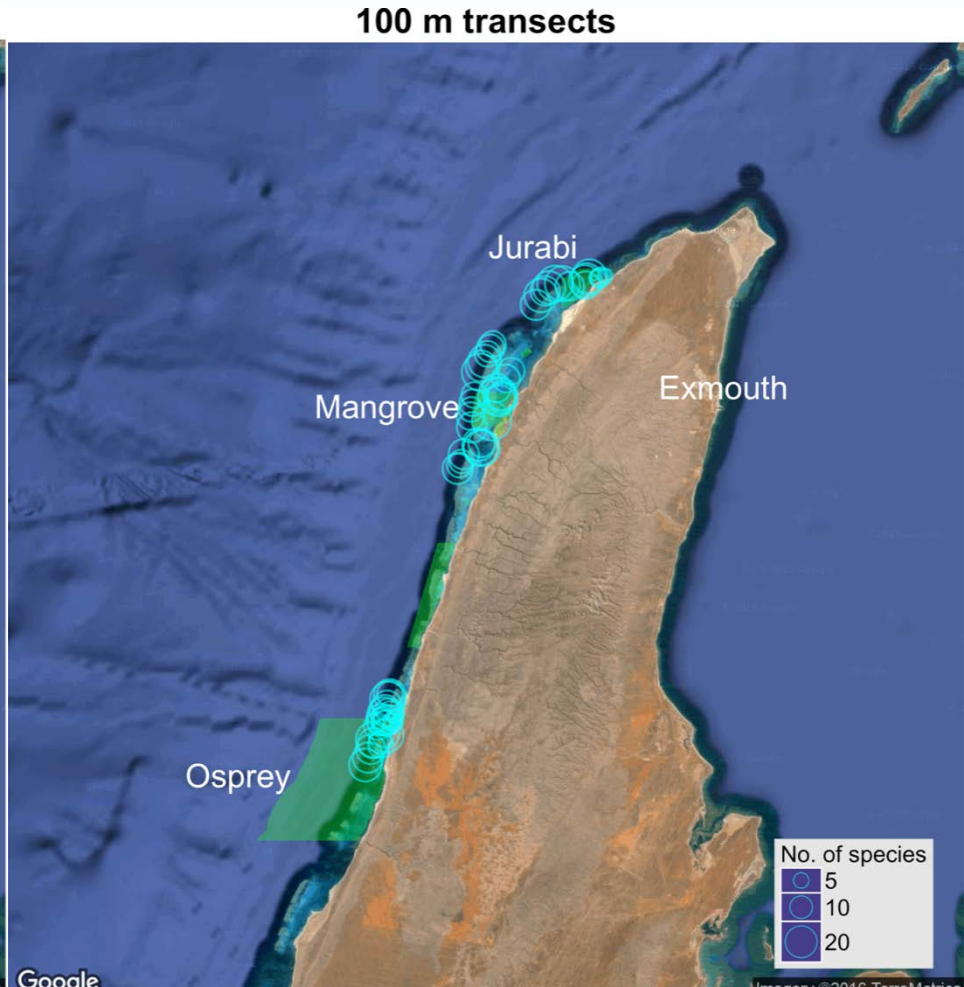


Summary of the 2015 fish data

- 23,979 fish recorded
- 208 different species from 45 families

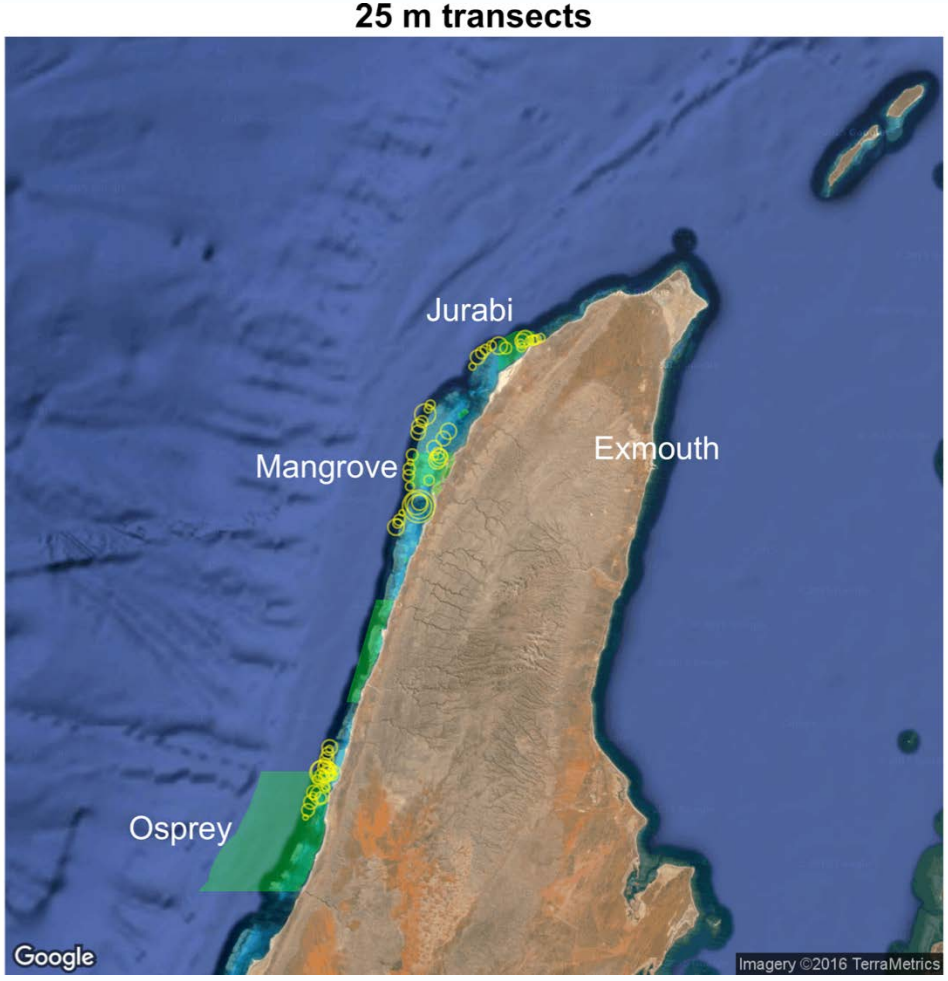
- ~41% of taxa identified from Ningaloo
- Species richness is similar on long & short transects

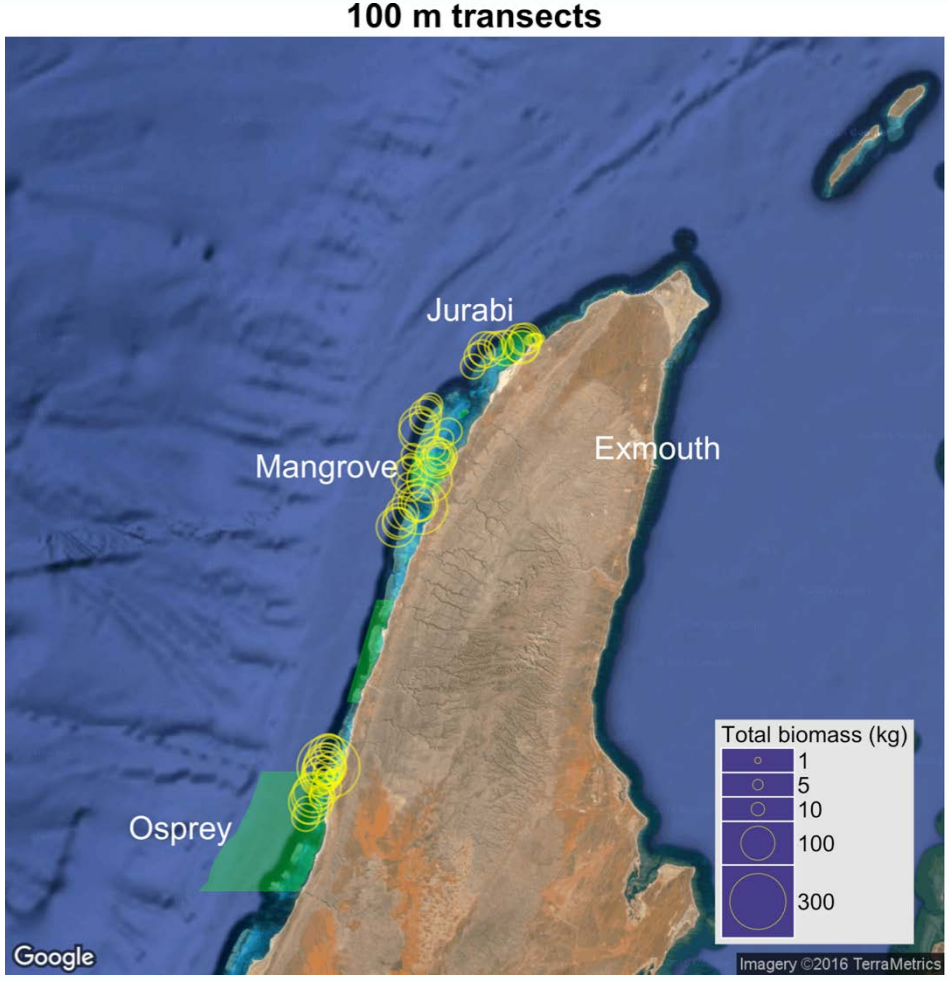




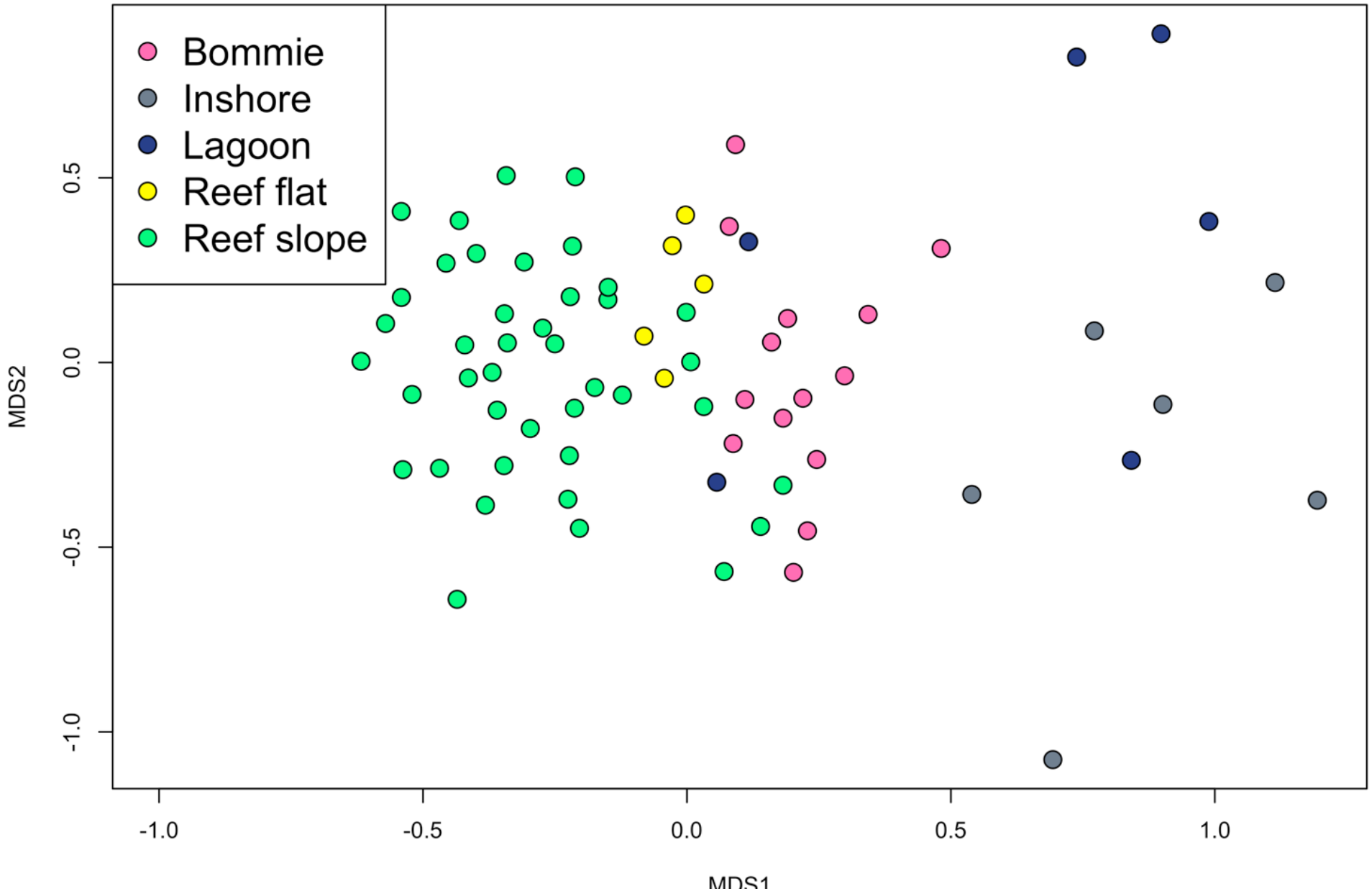
Summary of 2015 fish data

- Mean biomass:
  - 25 & 100 m transects: 777 kg ha^{-1}
  - c.f. Global unfished average: ~1,000 kg ha^{-1} (MacNeill et al. 2015)





Fish community: 100 m transects



Correlation between environment & fish community (100 m transects)

Variable	R^2	P
Depth	0.53	0.001***
Soft coral	0.33	0.001***
Predicted bottom velocity	0.31	0.001***
Algae	0.23	0.001***
Sand	0.21	0.002**
Live hard coral	0.20	0.002**
Rugosity	0.17	0.004**
Bommies	0.15	0.009**
Dead hard coral	0.05	0.207
Urchins	0.04	0.227
Seagrass	0.00	1

Correlation between environment & fish community (100 m transects)

Variable	R^2	P
Depth	0.53	0.001***
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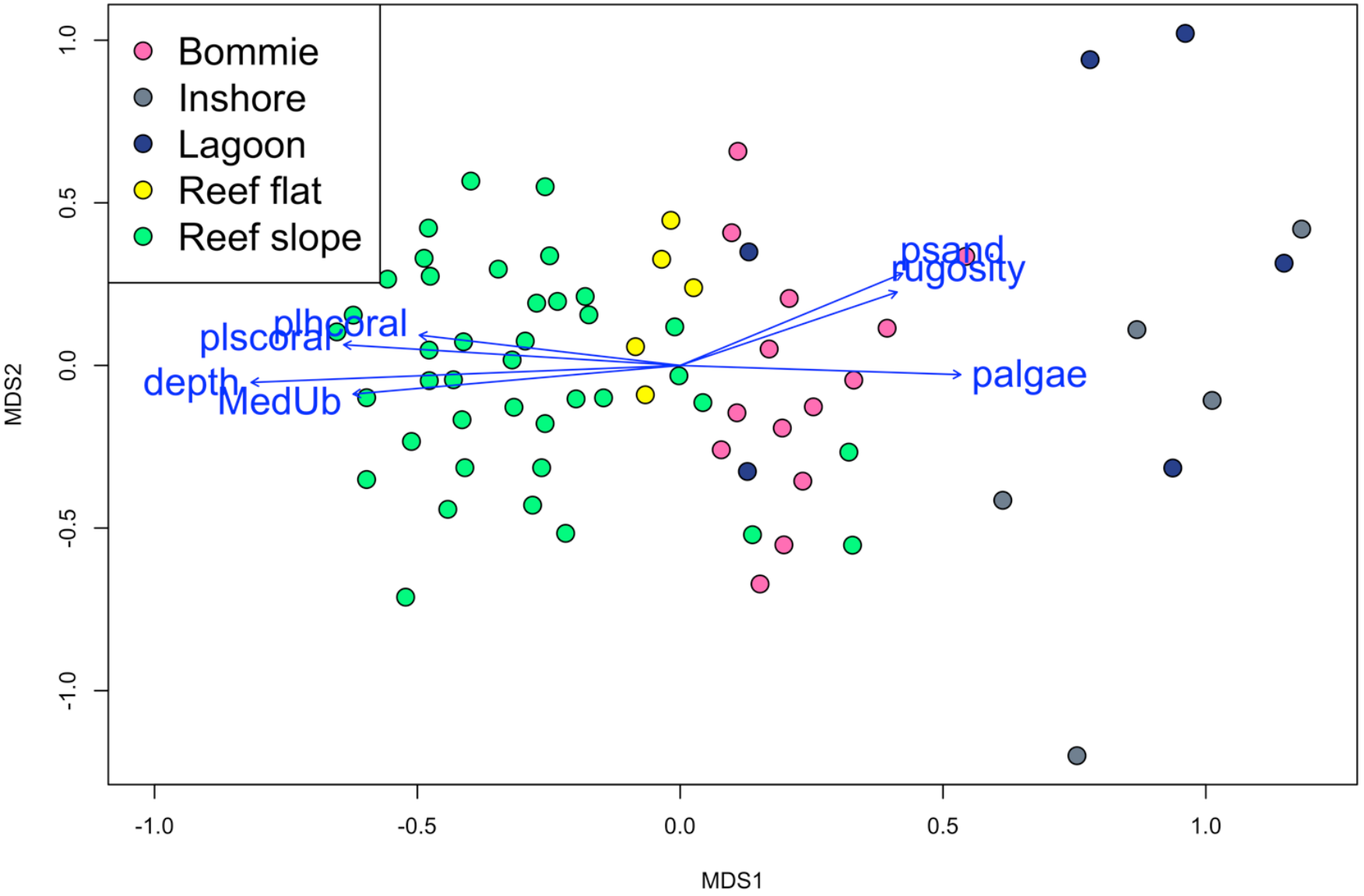
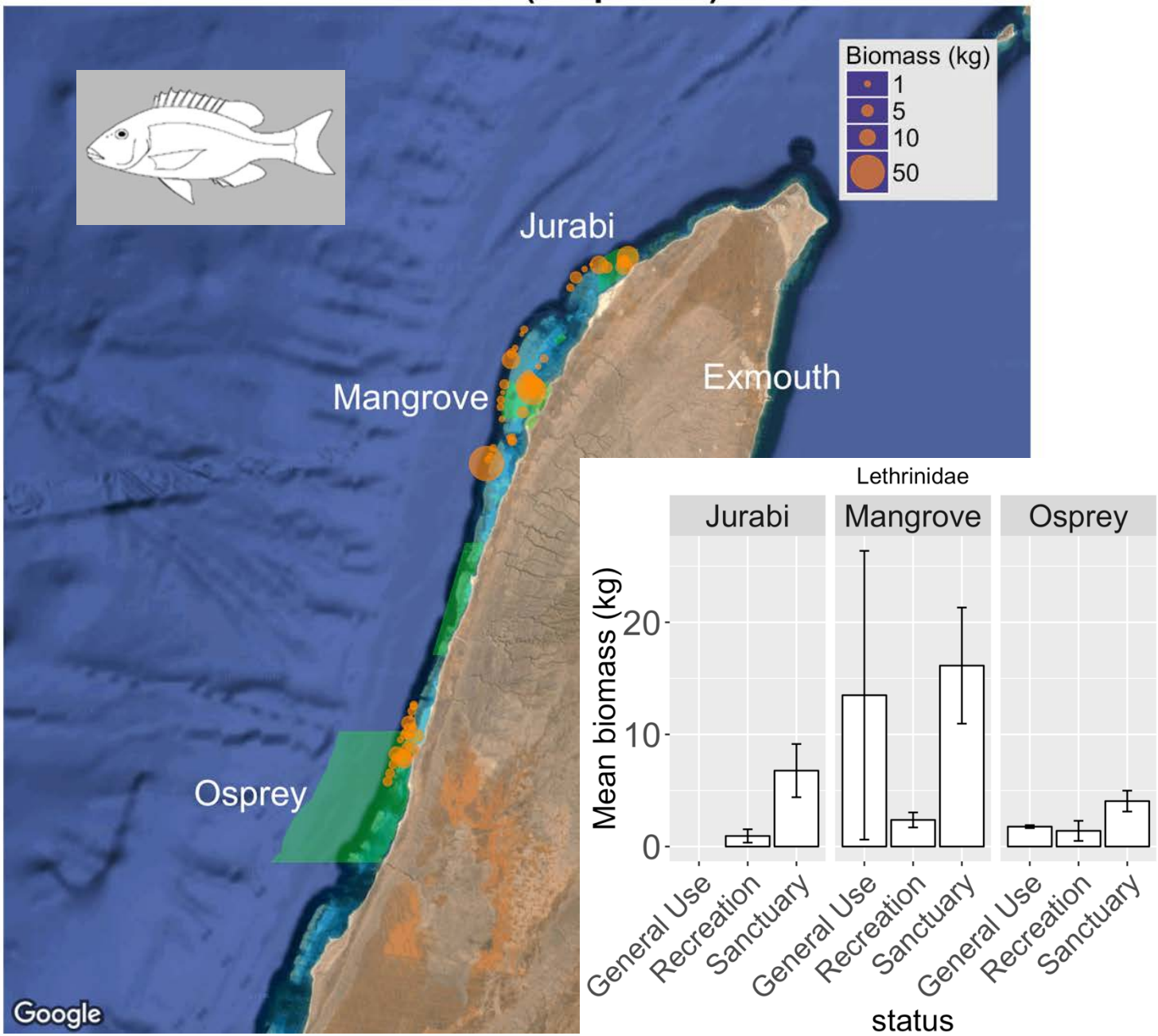
Predicted bottom velocity	0.31	0.001***
Algae	0.23	0.001***
Sand	0.21	0.002**
Live hard coral	0.20	0.002**
Longitude	0.18	0.004**
Rugosity	0.17	0.004**
Bommies	0.15	0.009**
Latitude	0.07	0.076
Dead hard coral	0.05	0.207
Urchins	0.04	0.227
Seagrass	0.00	1

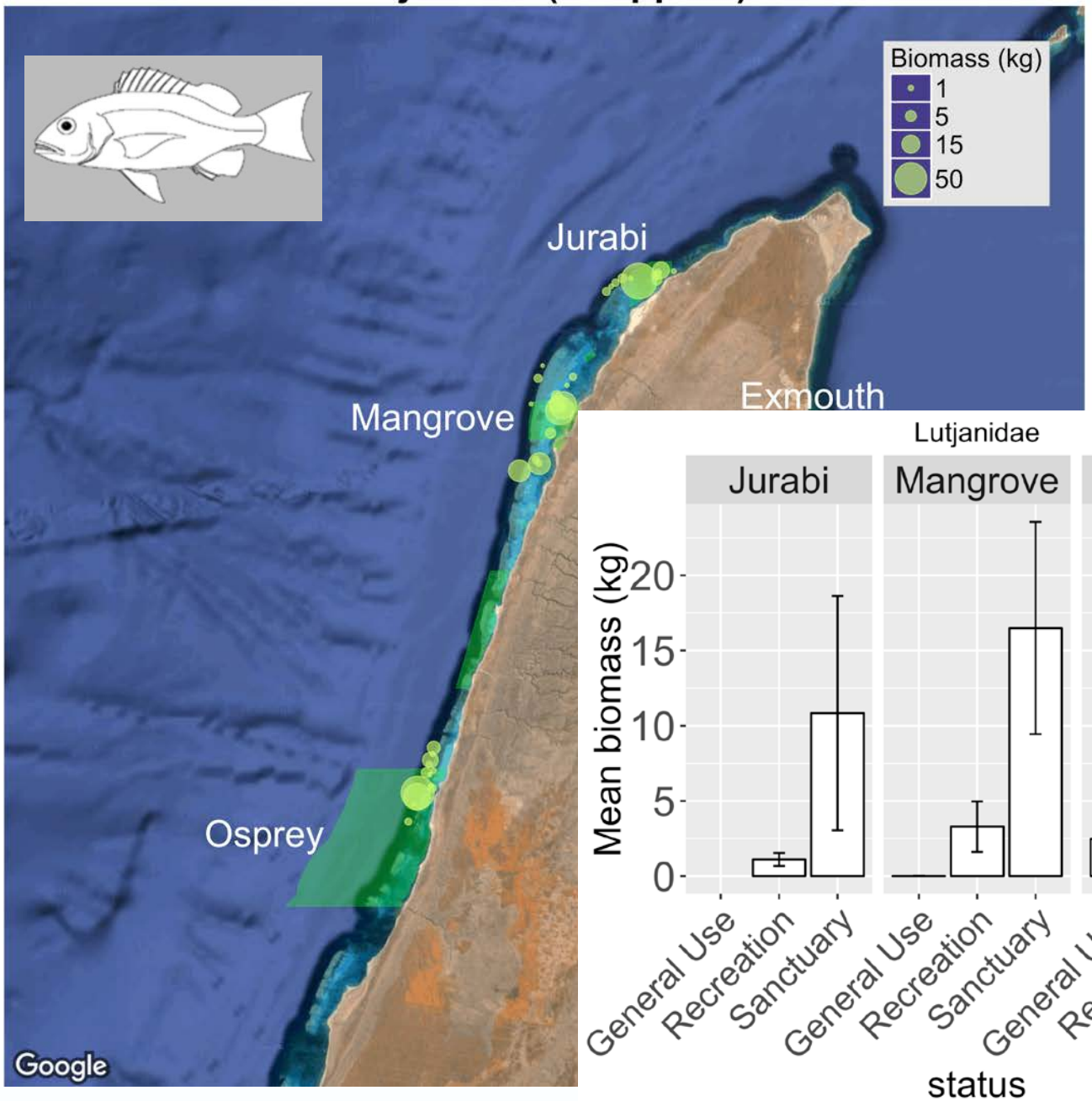
Correlation between environment & fish



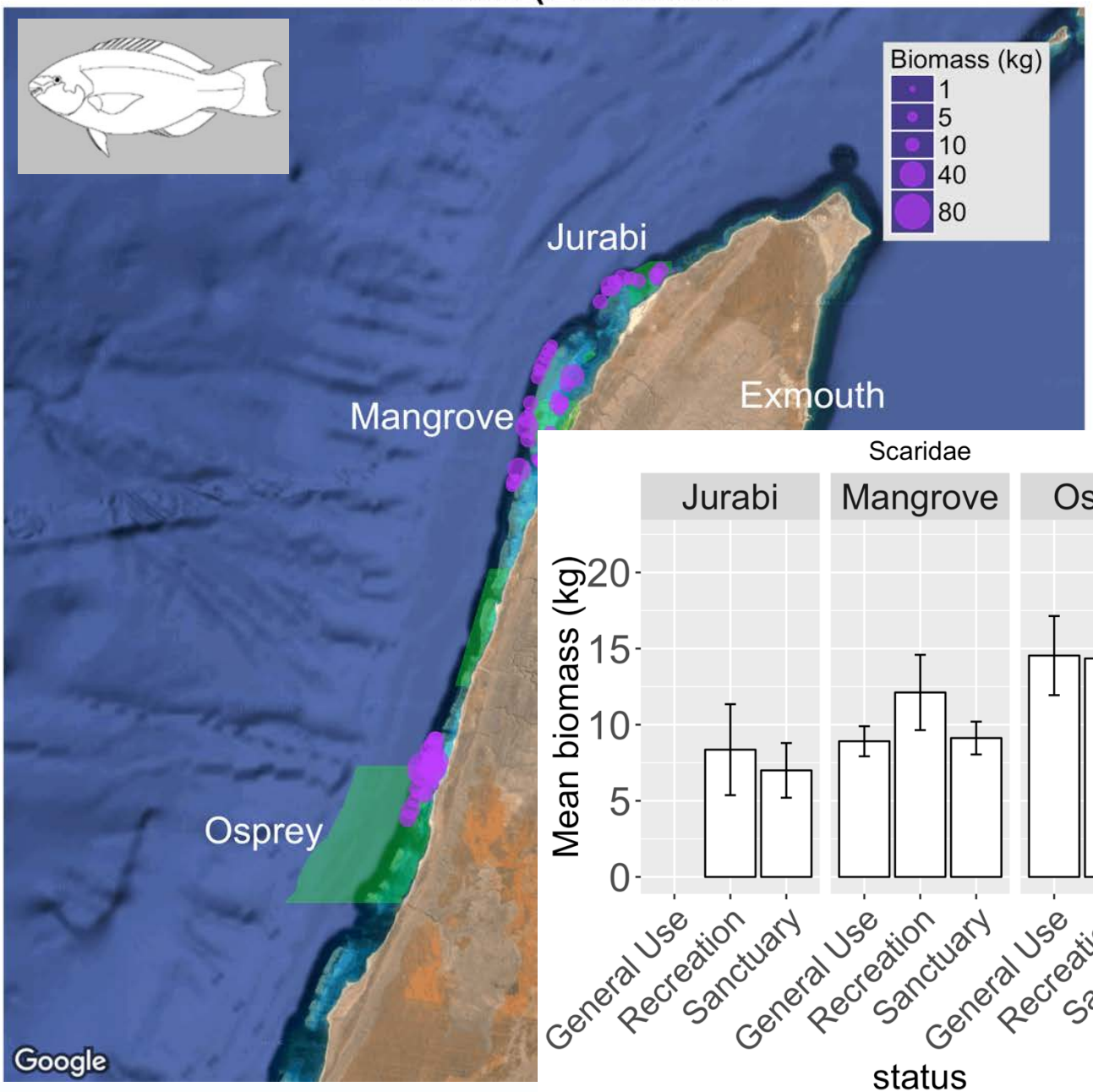
Lethrinidae (Emperors)



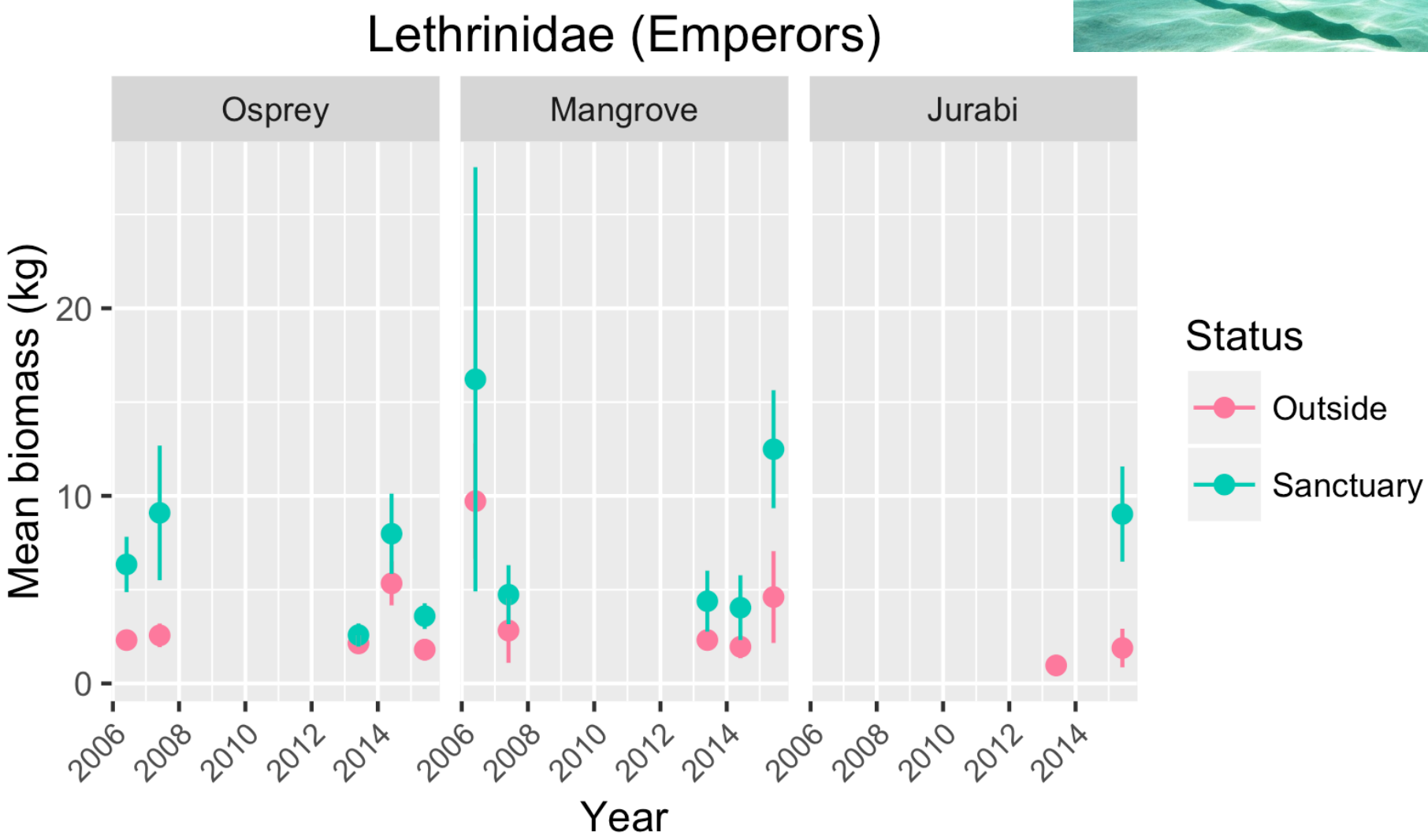
Lutjanidae (Snappers)



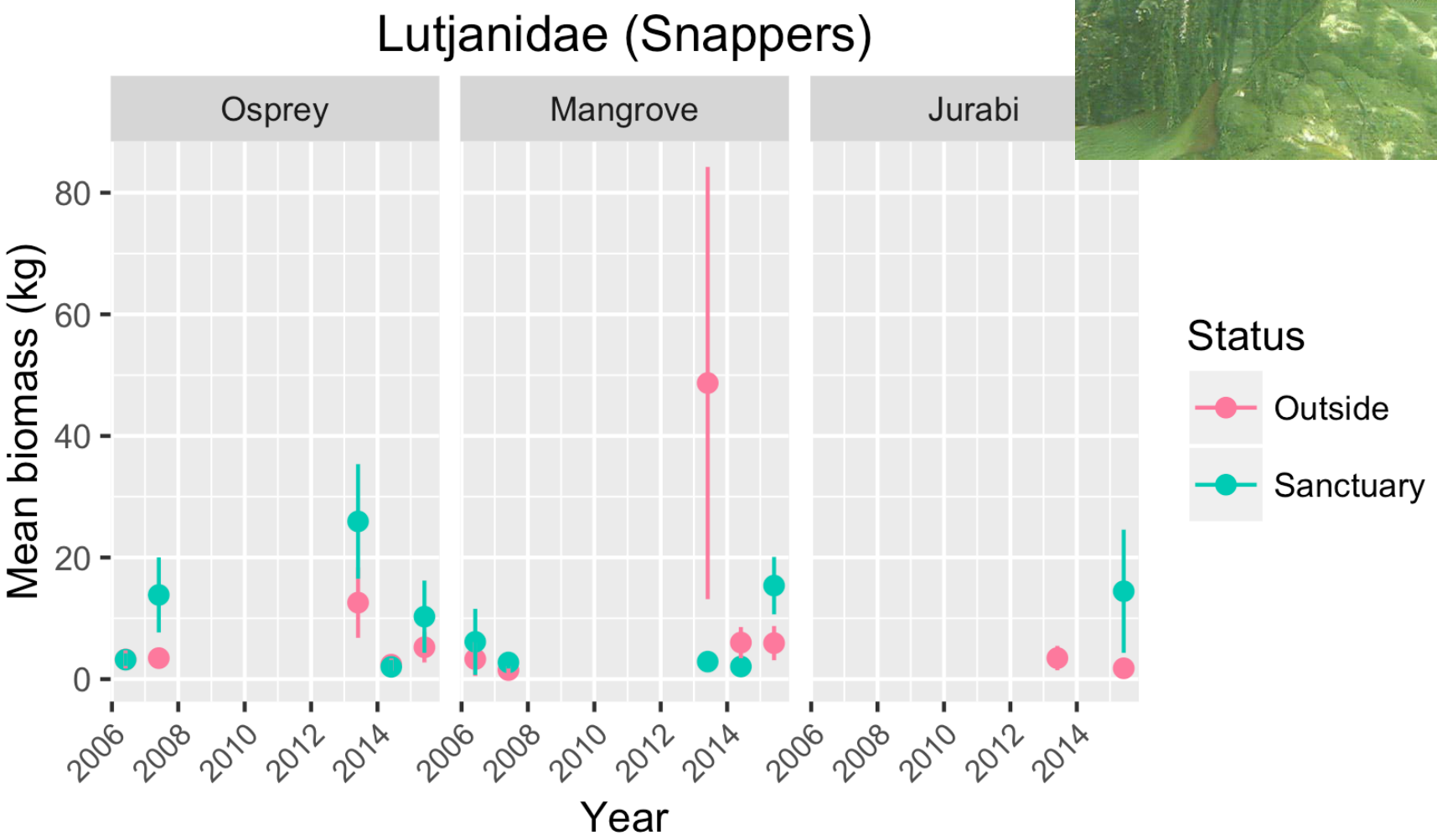
Scaridae (Parrotfish



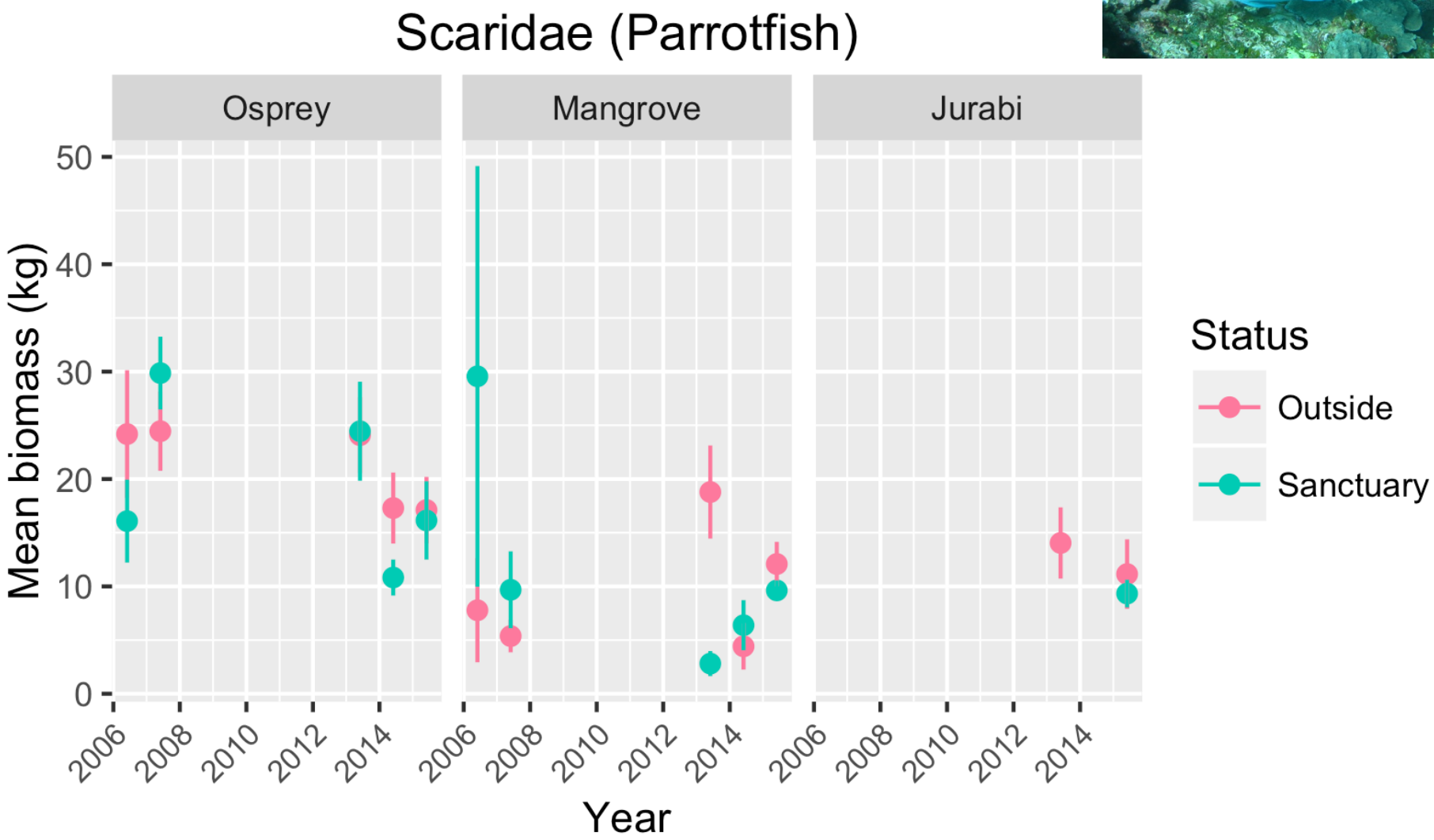
Long term trends



Long term trends



Long term trends



Pilot study

- UVC estimates may be biased due to fish behaviour
  - Fish may avoid or be attracted to divers
    - Underestimate or overestimate of fish counts
    - Potentially cause erroneously inferred impacts

Why Tuskfish?

- Family Labridae; Genus *Choerodon*

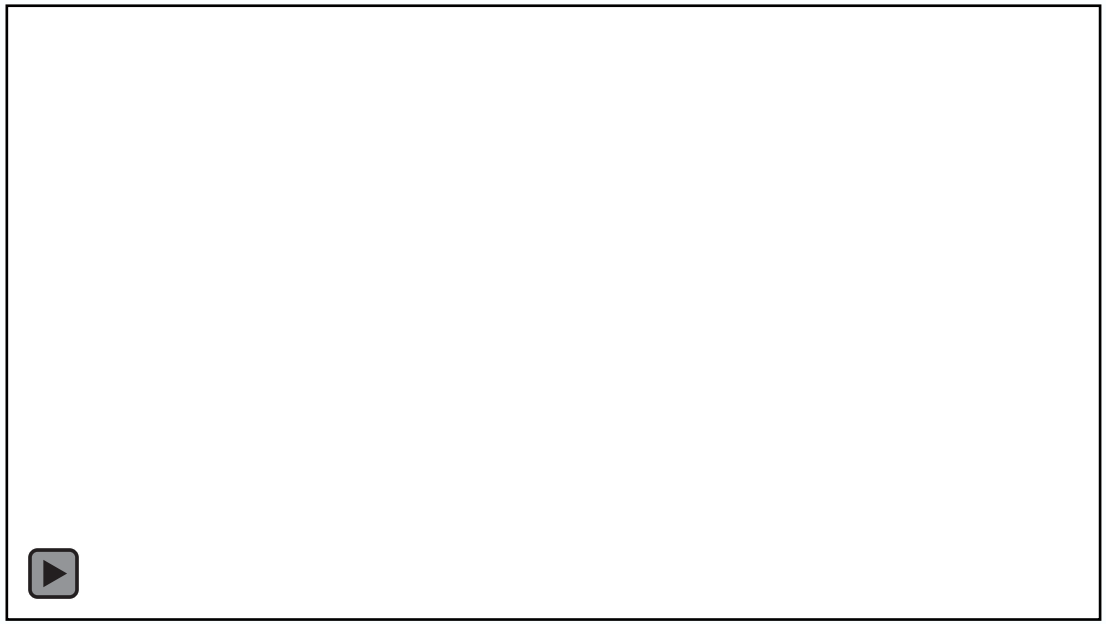
LATIN NAME	COMMON NAME
Choerodon cyanodus	Blue Tuskfish
Choerodon schoenleinii	Black-spot Tuskfish
Choerodon cauteroma	Blue-spotted Tuskfish
Choerodon monostigma	Dark-spot Tuskfish
Choerodon rubescens	Baldchin Groper

- Pilot:
  - 6 sites (3 inside & 3 outside)
  - Filmed 15 min with & without divers

Future directions

- Benthos:
  - Surveys in May 2016
  - Calculate drag forces on different colony morphologies
  - Measurements of substrate strength
  - Automate photographic meshing

- Fish:
  - Continue UVC surveys
  - Develop effect of diver presence work



Theme 2 Contacts:

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PhD: Long-term change and trophic interactions on Ningaloo's shallow reefs

Anna Cresswell

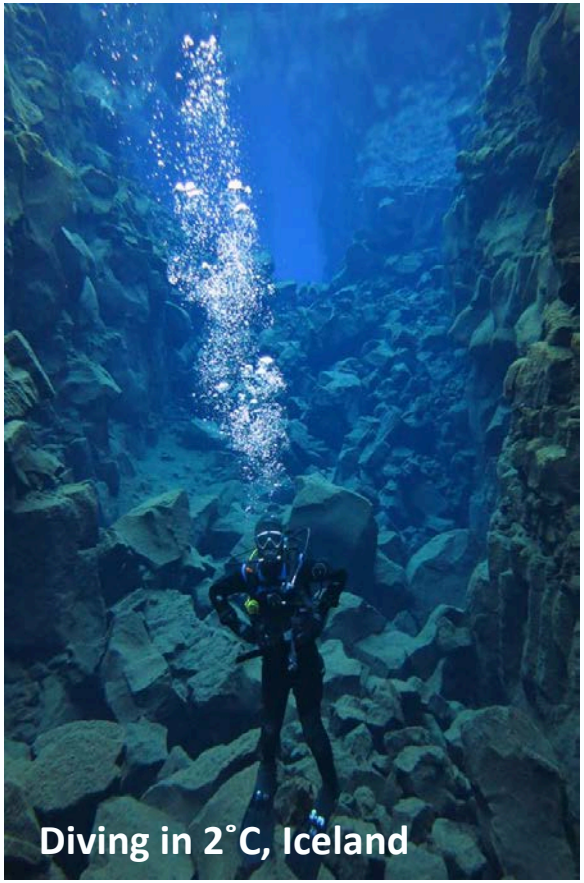
Supervisors: Dr Tim Langlois and Dr Gary Kendrick (UWA), Damian Thomson (CSIRO)

About me

- Anna Cresswell
- BSc (Applied Mathematics and Zoology)
  - University of Tasmania
- Hons (Marine Science)
  - Institute of Marine and Antarctic Studies and UTAS

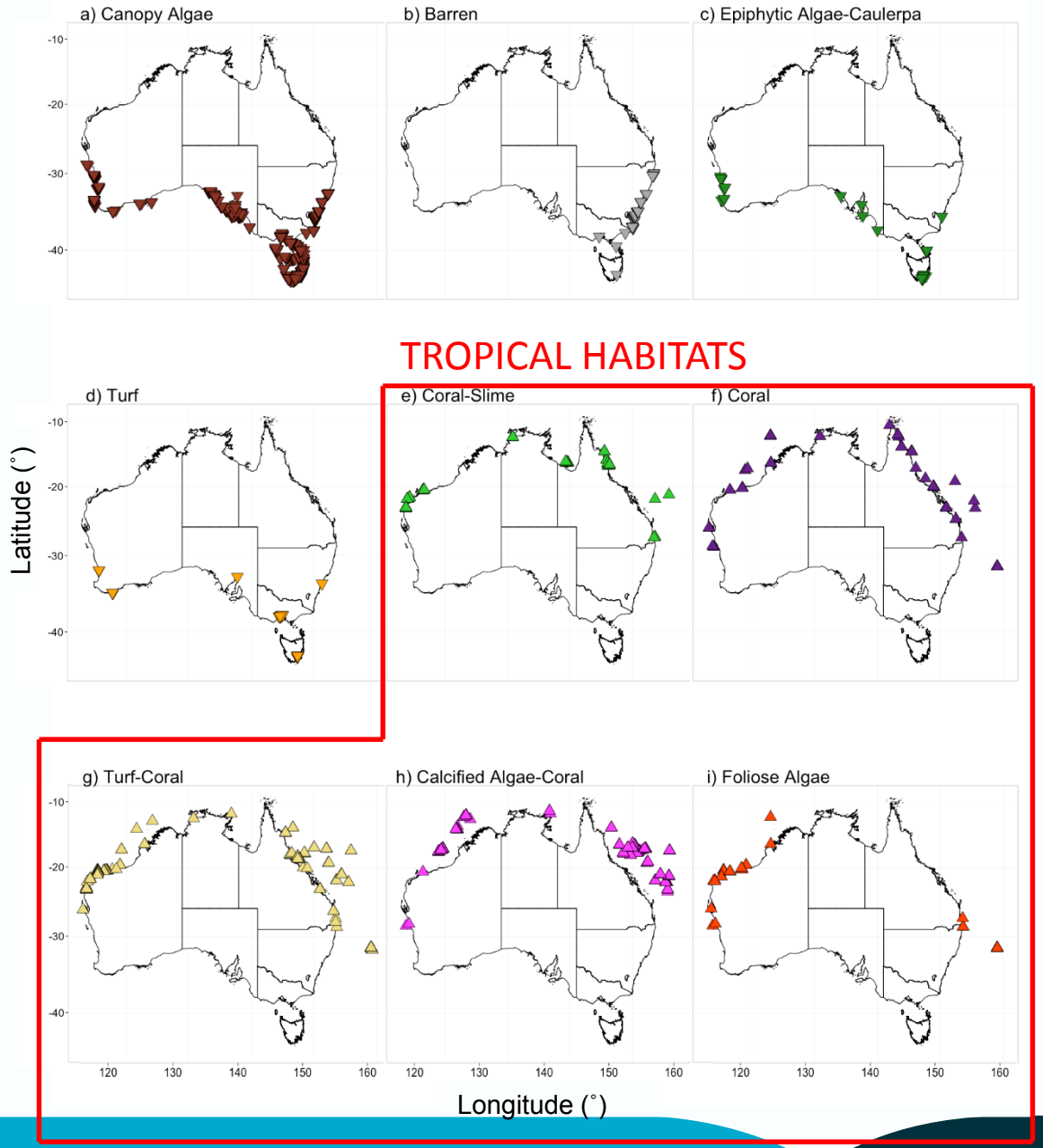

Kelp forest, Tasmania


Hiking, Tasmania


Diving in 2˚C, Iceland

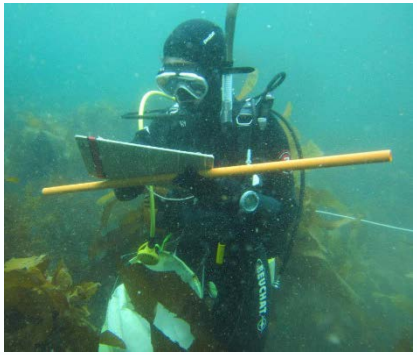
Past research: Honours

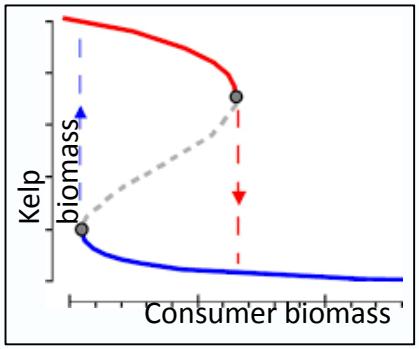
- Broad habitat types on shallow reef benthos
- Photoquadrats from Reef Life Survey
- Linking habitats to biological, environmental and anthropogenic variables

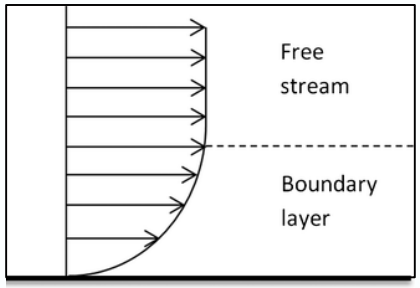


Past research

- Climate responses of *Niveoscincus ocellatus,* the spotted snow skink
- Impacts of the long-spined sea urchin, *Centrostephanus rodgersii,* inside and outside a marine reserve
- Modelling consumer-driven phase shifts in Tasmanian and Nova Scotian kelp beds
- Modelling carbon chemistry in the boundary layer of benthic plants versus in the bulk ocean







Motivation to study Ningaloo Reef

- Unique fringing reef
- Previous work in tourism on Ningaloo Reef
- Sustainable use, effective management

Future research

PhD Research: Long-term change and trophic interactions on Ningaloo Reef

1. Change to fishes, invertebrates and benthic assemblages
2. Anthropogenic stress to major trophic levels and trophic interactions
3. Resilience of Ningaloo Reef to key events: floods, cyclones, bleaching
4. Predictive model of future changes

CONTACT DETAILS:

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