



National Environmental
Research Program

Shifted ecological baselines on the nearshore Great Barrier Reef

Two Millennia of Great Barrier Reef Ecology

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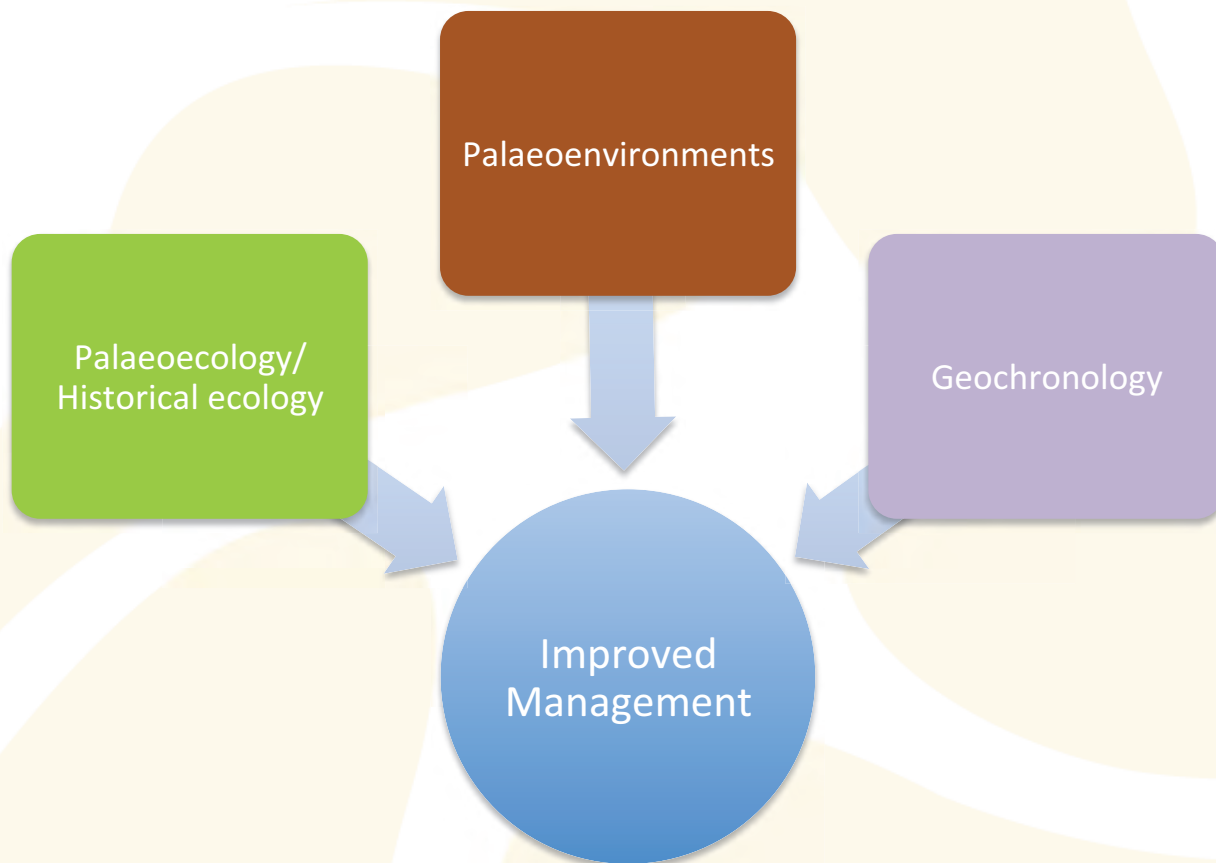
GBRMPA - L. McCook



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NERP PROJECT 1.3

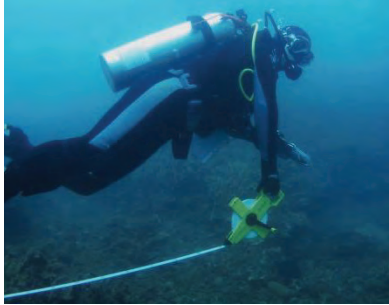
Characterising the cumulative impacts of global, regional and local stressors on the present and past biodiversity of the GBR



METHODS

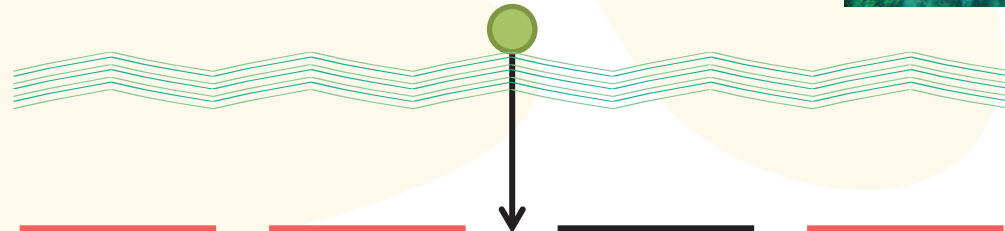
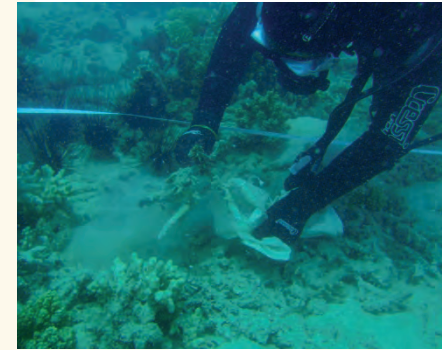
Live Benthic Assemblage

Line Intercept Transect



Death Assemblages

- 5 × grab samples per transect



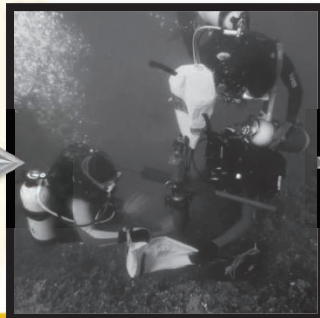
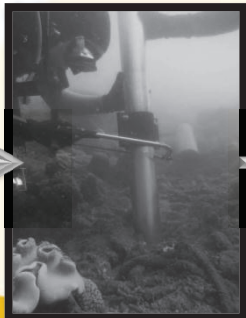
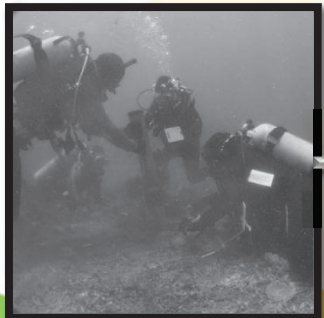
6 x Reef Matrix Cores

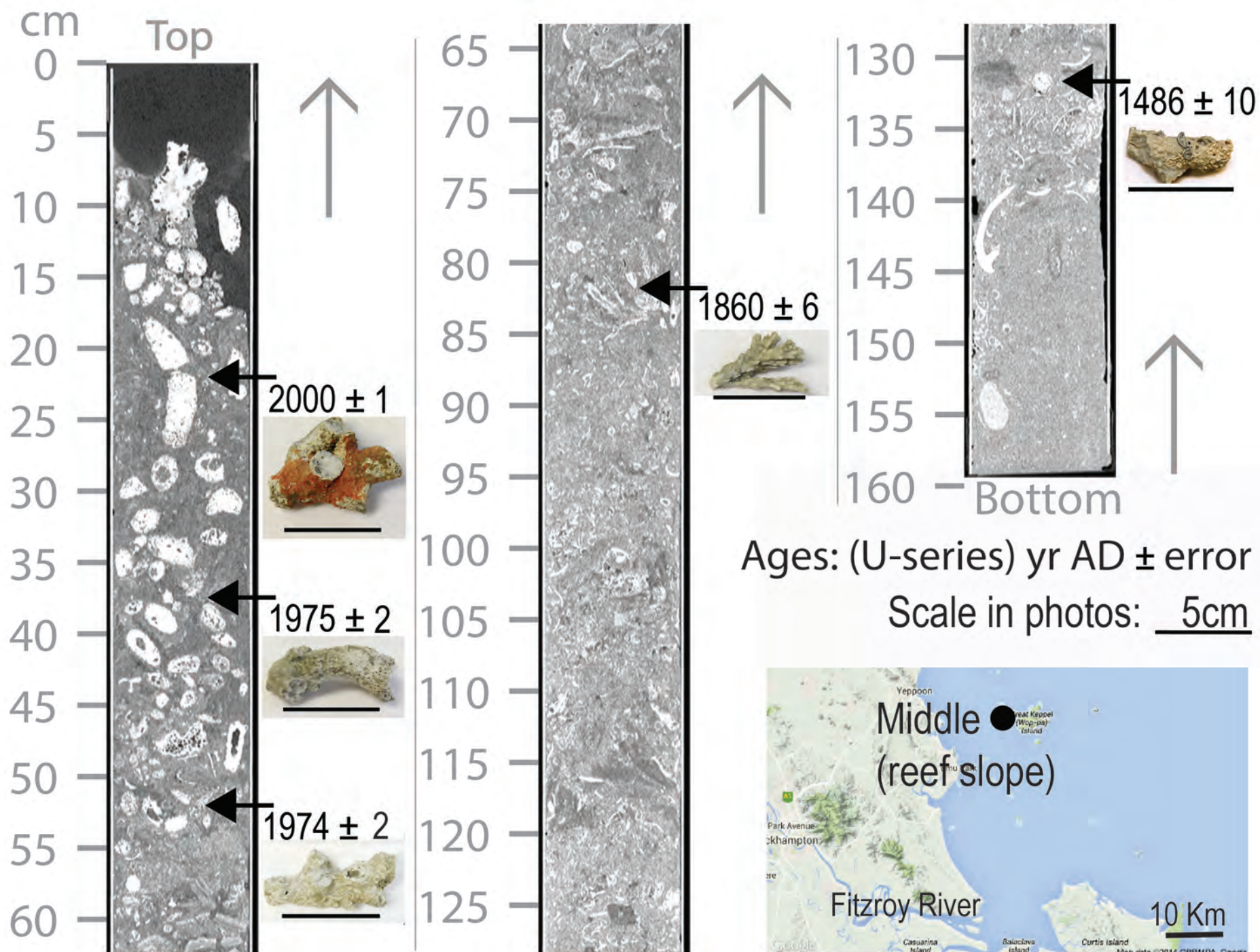


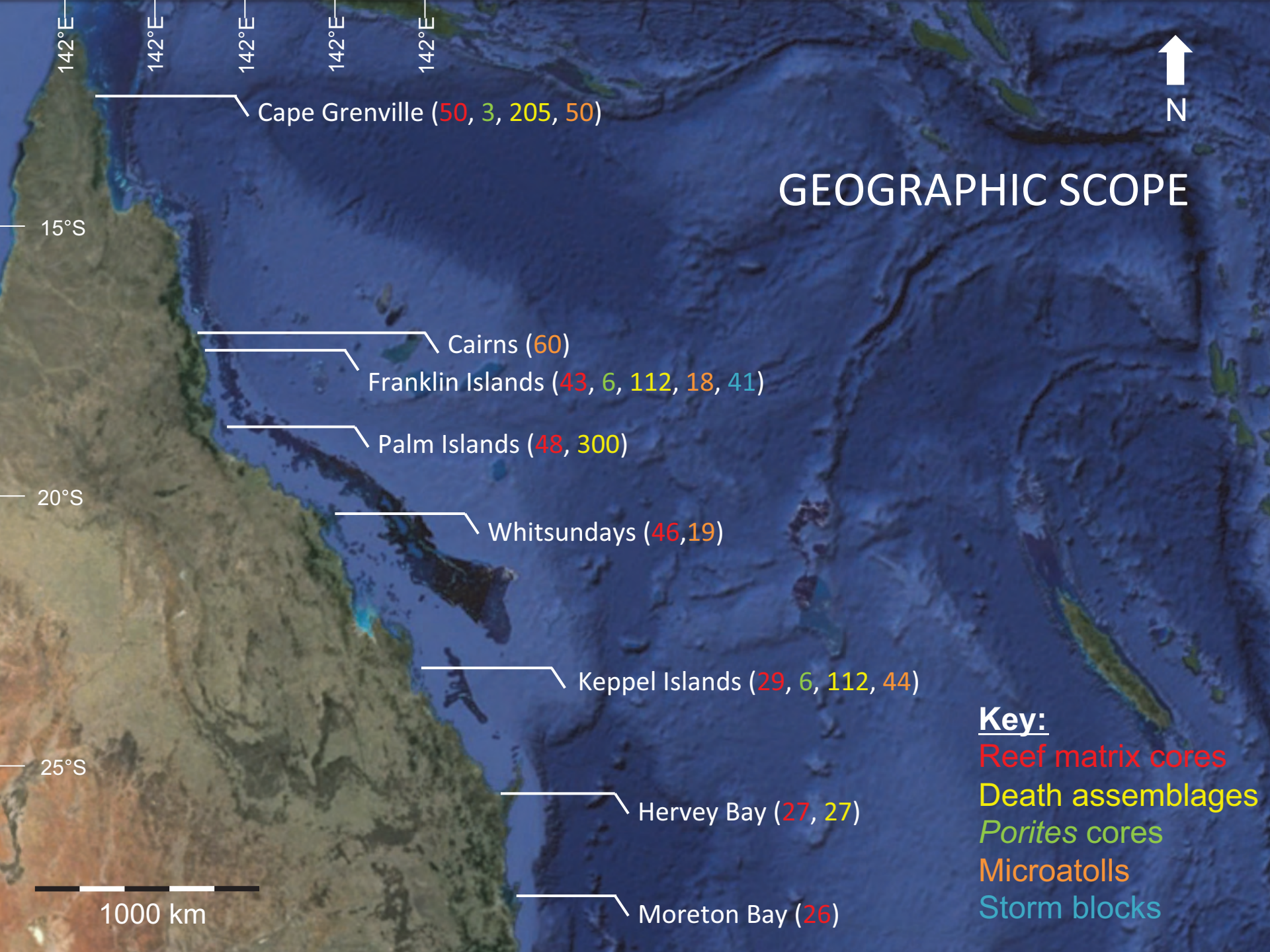
4 x 20m transects

Fossil Assemblages

Reef Matrix Cores







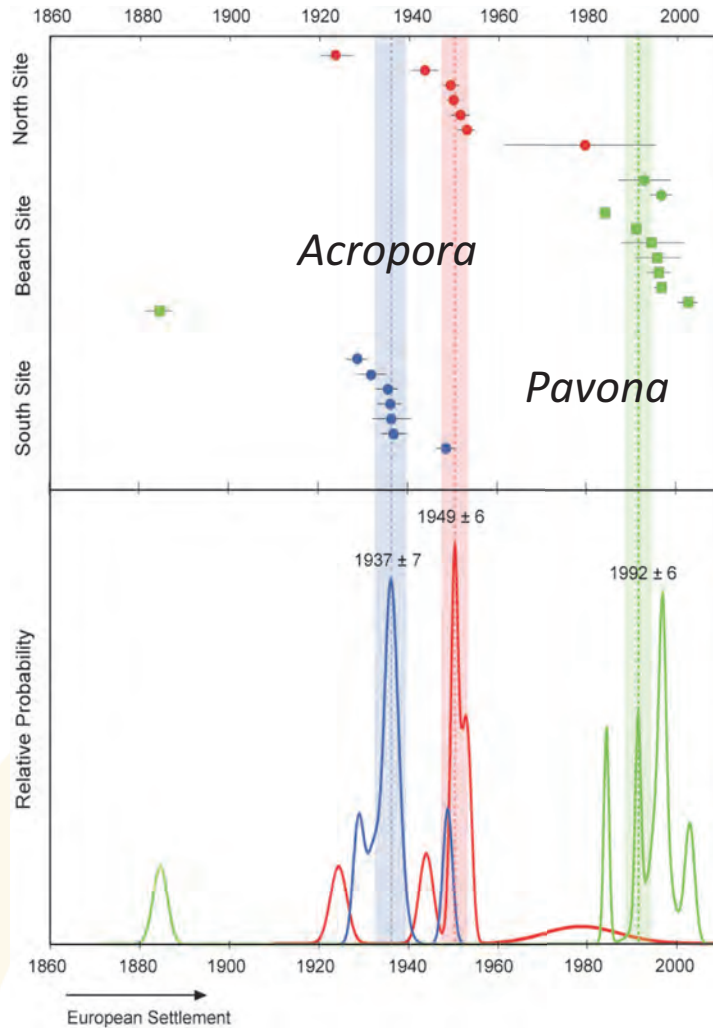


KEY FINDINGS

- ‘Whole of inner GBR’-scale variation in ecological history
 - Example 1: Pelorus Island vs Cape Grenville (death assemblages)
 - Example 2: Pelorus Island vs Keppel Islands (reef matrix cores)
- Loss of *Acropora* at regional scales on the inshore GBR
 - Palm Islands (death assemblages)
- ‘Reef’-scale variation in ecological history
 - Variation in *Acropora* loss at sites in Franklin Islands (reef matrix cores)

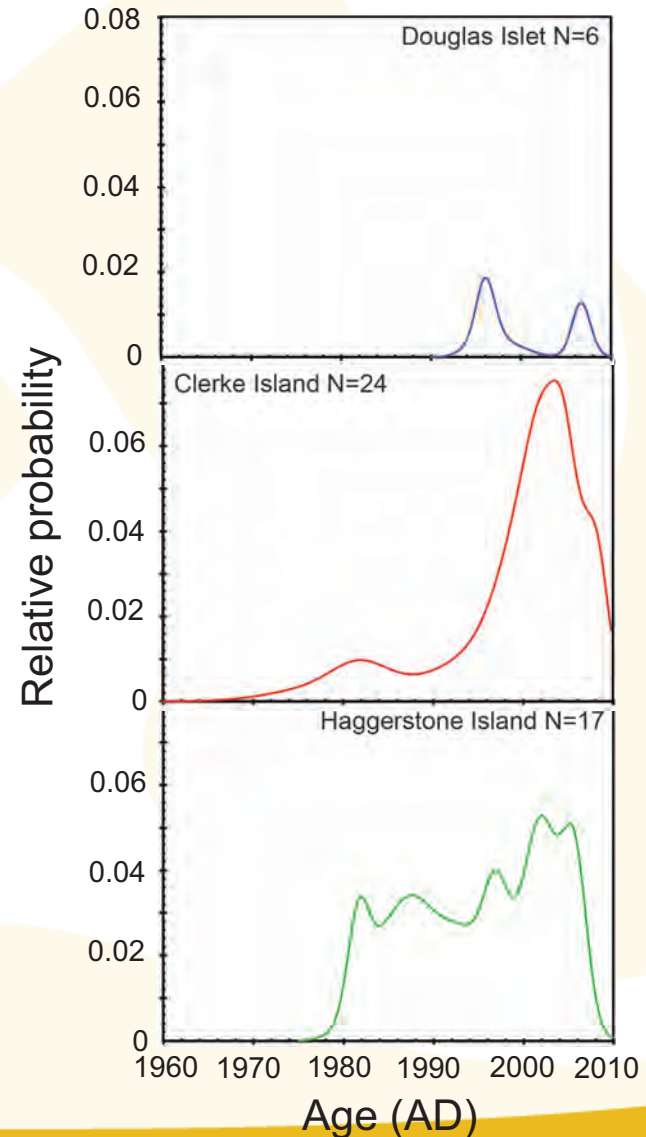
Example 1: Age of death assemblages: Pelorus Island vs Cape Grenville

Pelorus Island, central GBR



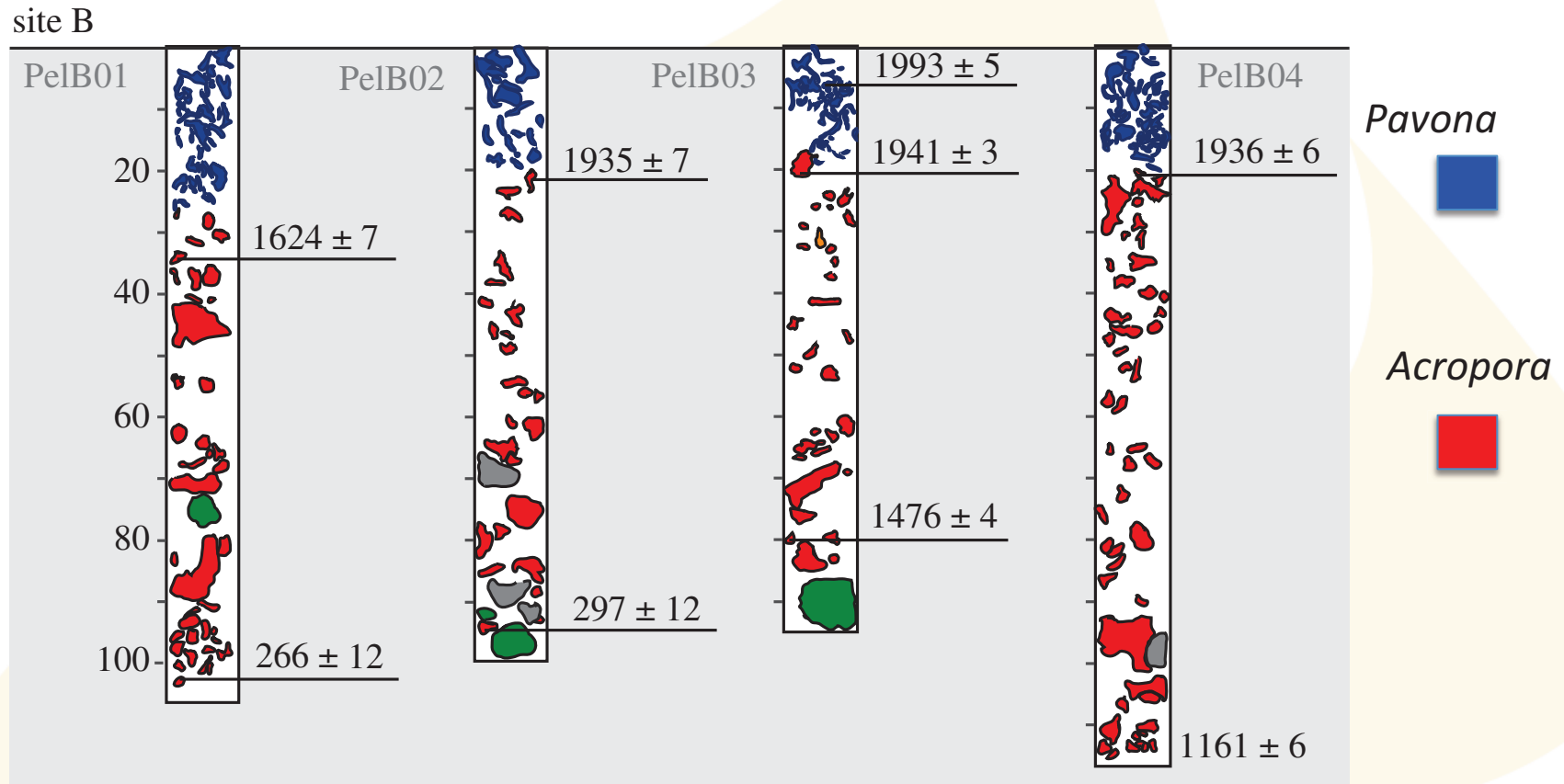
Roff et al. 2013 Proc Roy Acad Sci

Far Northern GBR

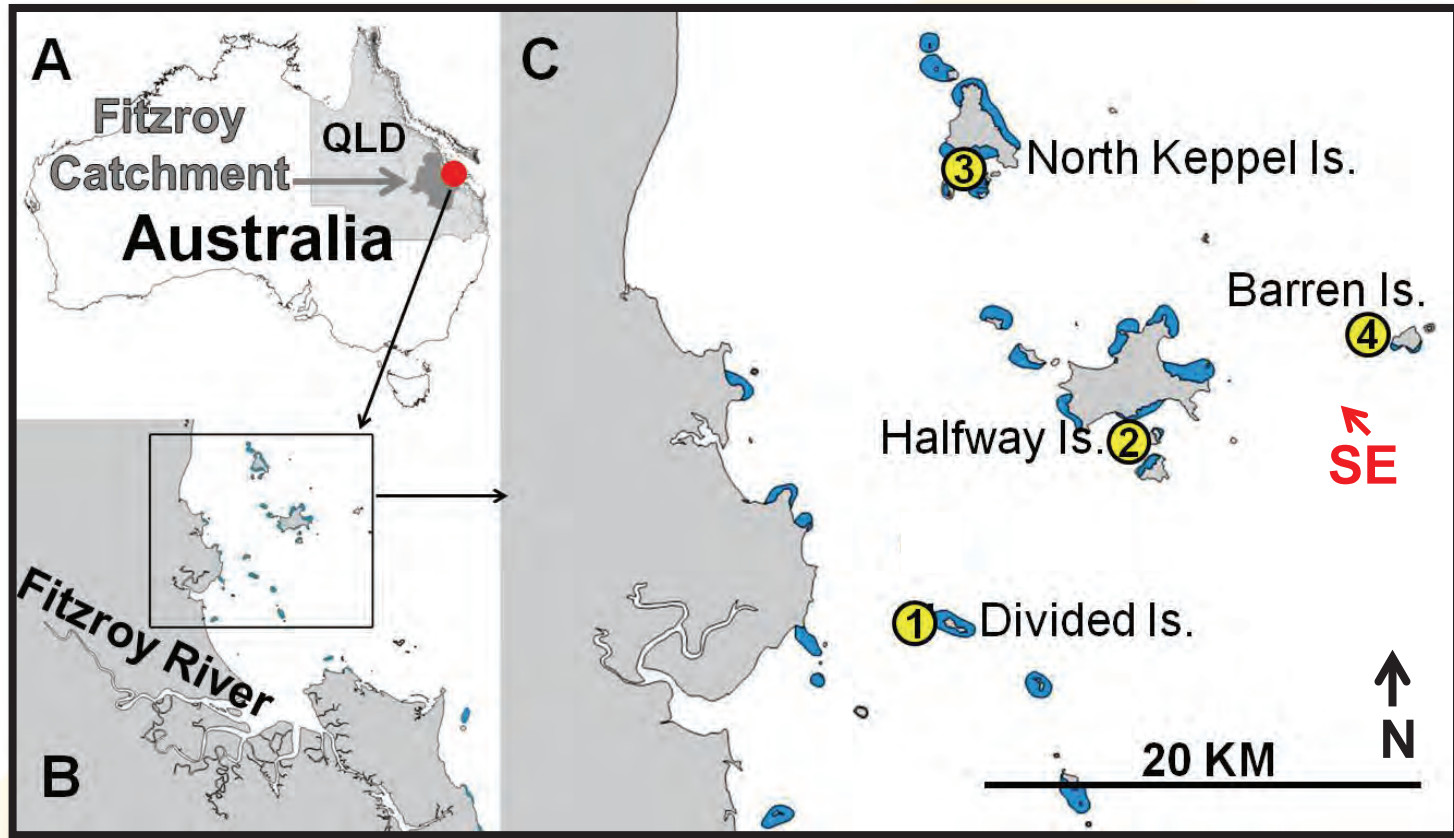


Example 2: Coral community shifts in reef matrix cores: Pelorus Island vs Keppel Islands

Pelorus Island:



Example 2: Coral community shifts in reef matrix cores: Pelorus Island vs Keppel Islands



■ Reefs



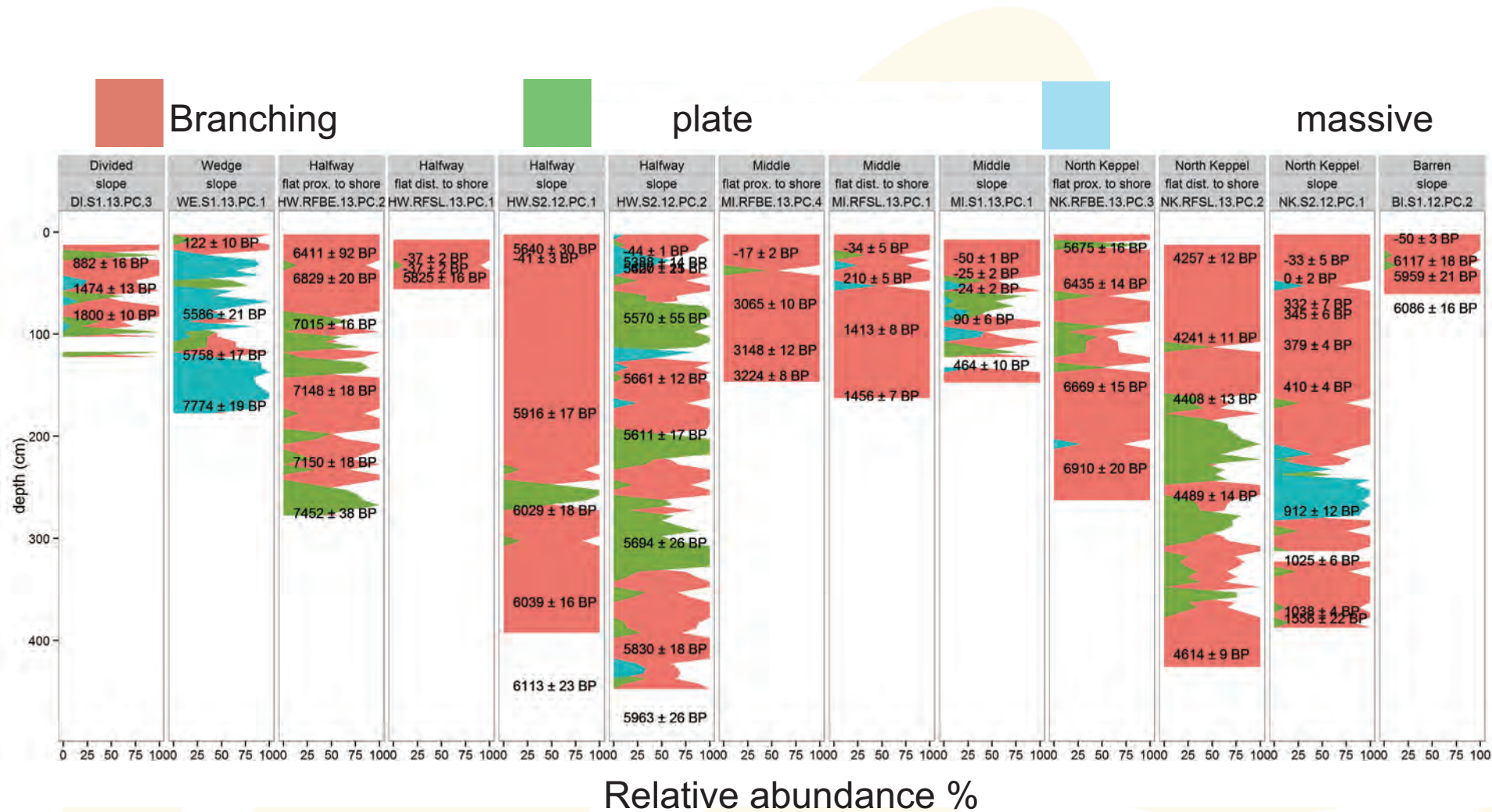
Sampling locations



Predominant swell direction

Keppel Islands

Example 2: Coral community shifts in reef matrix cores: Pelorus Island vs Keppel Islands



Relative abundance of coral growth forms from the Keppel Islands

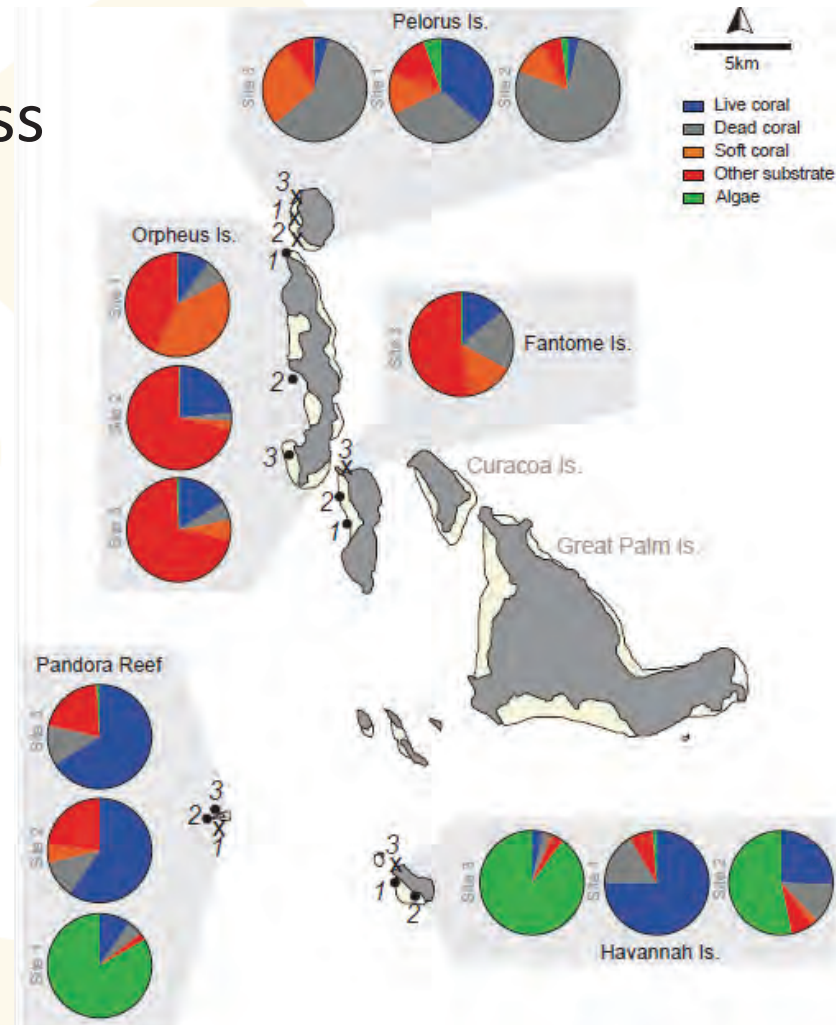


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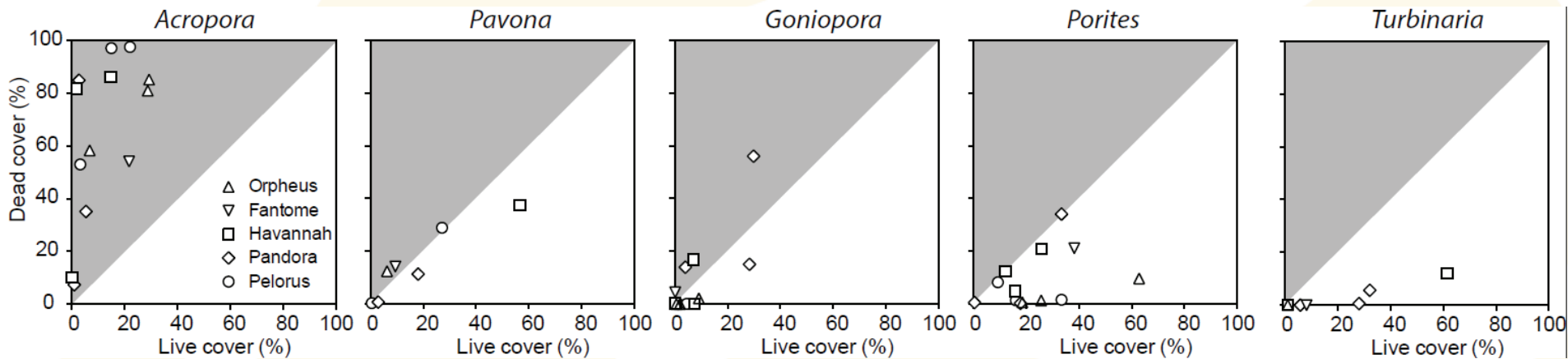
Regional scale loss of *Acropora* in the Palm Islands

Benthic assemblages vary across 5 reefs



Regional scale loss of *Acropora* in the Palm Islands

- Disparity in living vs death assemblages
 - *Acropora* dominant in the death assemblage
 - *Porites* and *Turbinaria* abundant in life, but not death assemblages
- Our principal metric for understanding changes to the GBR is coral cover, but the kinds of corals that are now dominating many inshore reefs are very different from those that characterized pre-European colonization
- Decadal-scale monitoring programs are not providing a complete picture
- Historical range of variation provides ‘measure of success’ framework for managing inner Great Barrier Reef ecosystems

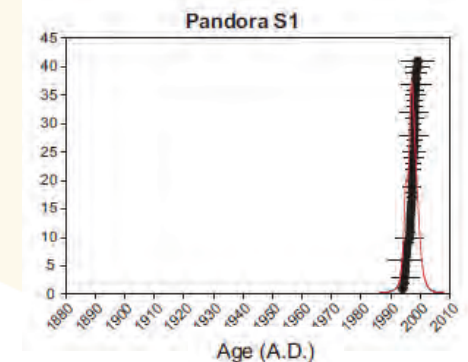
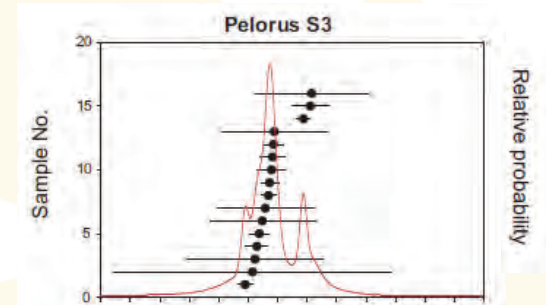
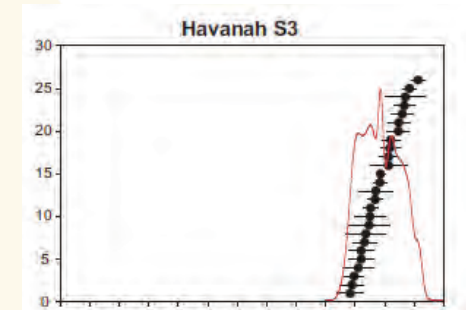


Living *Acropora* cover low

Living *Porites* and *Turbinaria* cover high

Regional scale loss of *Acropora* in the Palm Islands

- Timing of mortality in *Acropora* asynchronous among reefs
- Timing of degradation constrains potential drivers
- What drivers inhibit recovery?
 - Same as mortality? – not necessarily

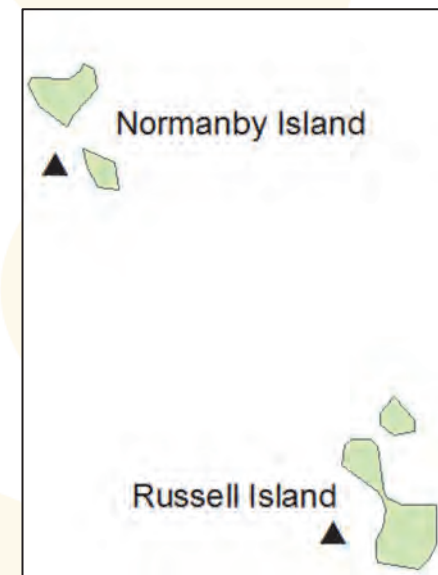
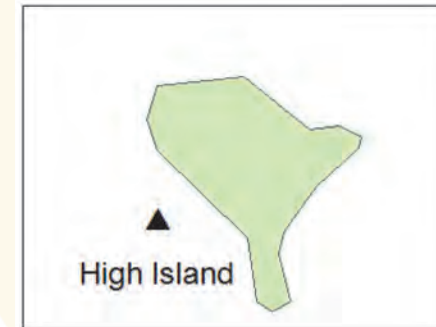
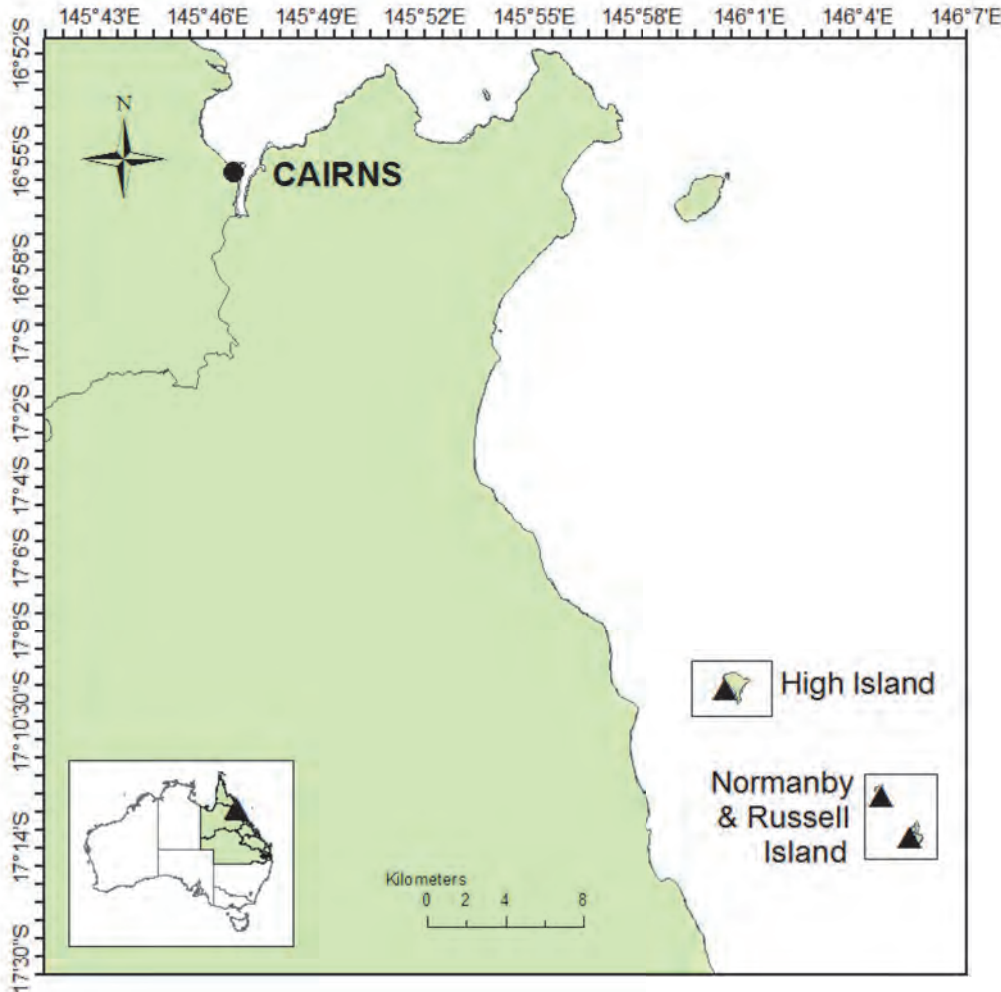




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Regional scale loss of *Acropora* in the Franklin Islands



Regional scale loss of *Acropora* in the Franklin Islands

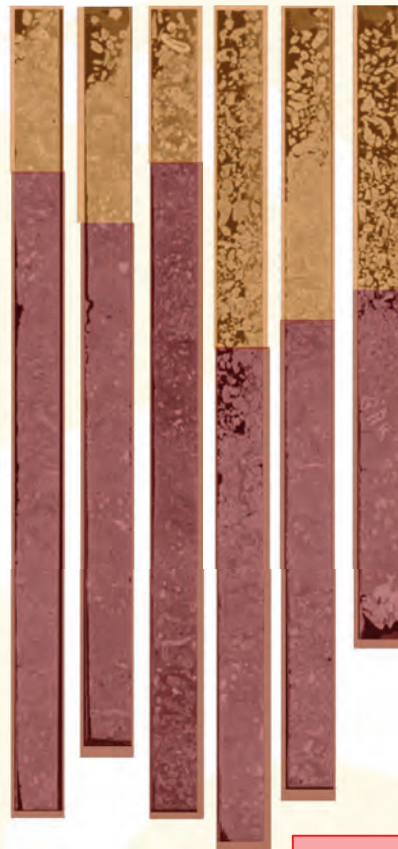
Reef-scale transition from mixed assemblage to branching *Porites* dominated coral community

Mixed coral community

Normanby Island



Russell Island



High Island



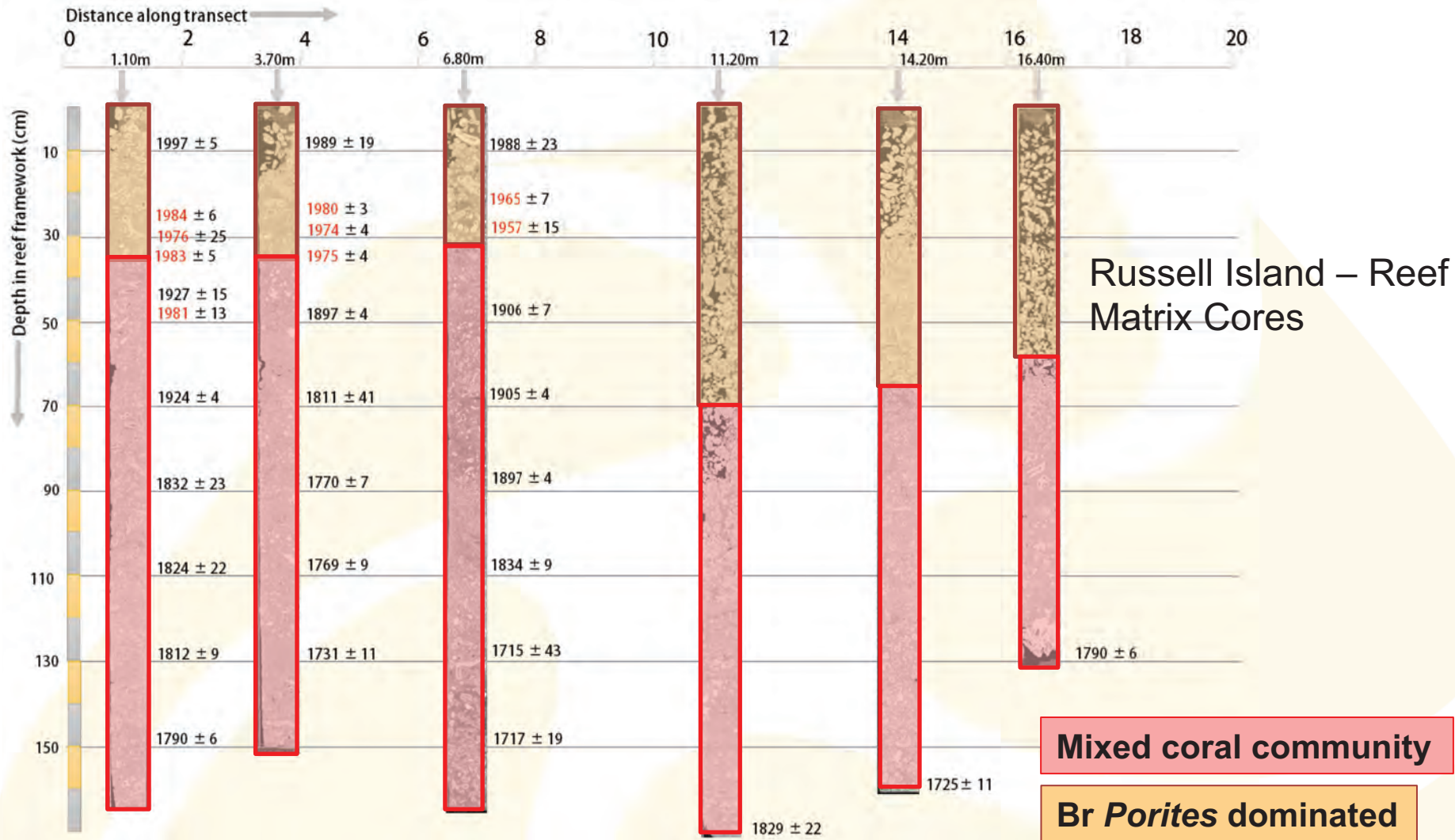
Coral Composition of Reef
Matrix Cores

Mixed coral
community

Br *Porites* dominated

Regional scale loss of *Acropora* in the Franklin Islands

Reef-scale transition occurred since the middle of the last century (U-series dating)





CONCLUSIONS

- Variability at multiple spatial scales adds complexity to the underlying effects of a shifted baseline in Great Barrier Reef coral communities
- Land-use changes since European colonization have depleted abundances of *Acropora* on inshore reefs of the GBR
 - Many drivers kill corals (bleaching, COTS, storms), but lack of recovery on inshore reefs appears to be related to water quality;
 - At impacted sites, historical community composition differs markedly from that derived from present-day and decadal-scale monitoring surveys



CONCLUSIONS

- Identifying timing and drivers of change is important, but so is identifying drivers for lack of recovery
 - One size does not fit all on the GBR – there are many sources of mortality, but we need to focus on the drivers inhibiting recovery
 - So we need to get away from the idea of ‘what’s the biggest threat on the reef’ and start managing for actual drivers of change at appropriate spatial scales
- Palaeoecological studies can provide a quick assay to determine timing of ecological change at sites on individual GBR reefs
 - 50-100 dates in a few weeks
 - about the cost of a week’s ship time on the *Cape Ferguson*



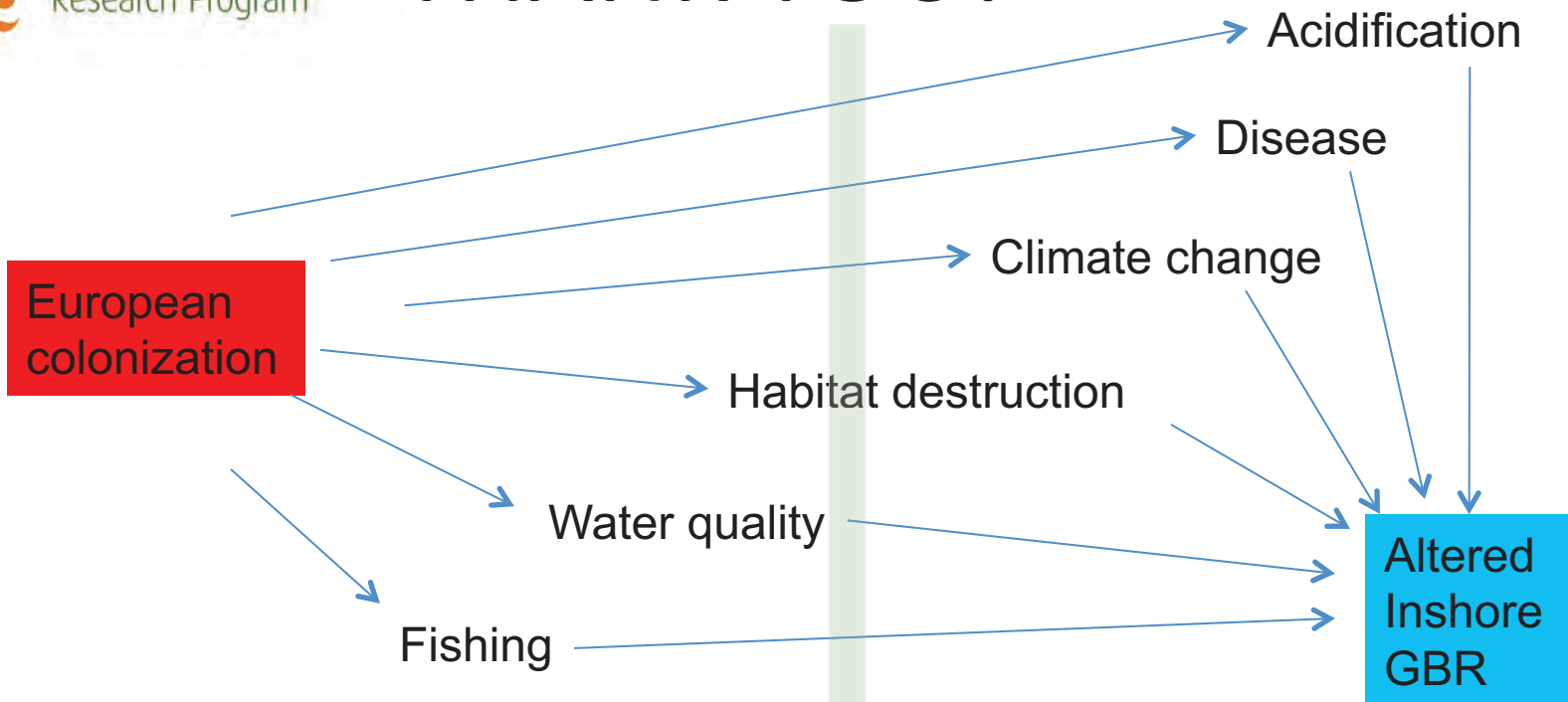
FUTURE DIRECTIONS

- **Look for evidence of historical macro-algal dominance in reef sediments**
 - Using Ancient DNA from our sediment cores
- **Understanding the cumulative effects of stressors on calcification over a broad range of taxa**
 - Using CT-scans from corals that occur in our reef matrix cores
- **Understanding fishing intensity over time using historical archives**
- **Develop predictive tools (models) for predicting winners and losers from reduced water quality over time using a traits-based approach**



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THANK YOU!



“Now”



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