



Impacts and Achievements of the MTSRF

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Showcasing the Australian Government's investment
in the MTSRF for improved sustainability of the
North Queensland region, and Australia

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Abstract

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Historical ecology of coral communities from the Palm Islands region (inshore central Great Barrier Reef)

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Since European settlement of the Queensland coastline in the mid-18th century, extensive changes in land usage within in the Great Barrier Reef (GBR) catchment region have occurred, resulting from increases in grazing, agriculture and land clearance. Yet, the link between terrestrial discharge, water quality and the decline of coral reefs at a regional scale, and the contribution of anthropogenic influence to the disturbance regimes of inshore reefs remains highly controversial. Through palaeoecological reconstructions and high-precision U-Series dating, we examined changes in coral communities of inshore coral reefs from the Palm Islands region (central inshore GBR) across decadal and centennial scales. Our results from Pelorus Reef indicate a historical collapse of *Acropora* corals occurred in the early 20th Century, with no evidence of recovery in recent times. Analysis of core samples revealed a shift from *Acropora* corals to monospecific assemblages in the late 20th Century, which is without precedence in 800yrs of history. Our results from Pandora and Havannah Reefs revealed rapid and continuous reef growth throughout the last 1000 yrs. Comparisons of reef accretion (m / ka^{-1}) from cores with published reef accretion rates from early-mid Holocene inshore GBR show that reef slope environments are accreting at rates equal to and exceeding that of the last 8000 years, and cautions against assumptions that inshore reefs are undergoing or have undergone natural trajectories of geomorphic decline. Using a Bayesian approach, we determined that coral communities from Pandora and Havannah cores exist in stable states (upwards of 400yrs), punctuated by periods of instability. Despite variability in community structure, growth rates of inshore reefs (mm / yr^{-1}) were independent of diversity. From a management perspective, our results of this thesis provide a vital starting point with which to ameliorate impacts and provide a baseline for the restoration of coral communities at local and regional scales.



Historical ecology of coral communities from the inshore central Great Barrier Reef: Preliminary evidence for a shifted baseline?

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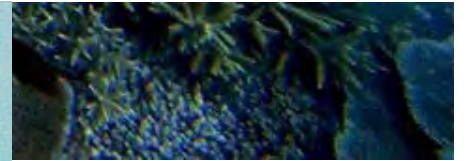
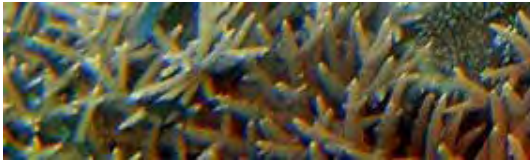
3 Radio Isotope Facility, University of Queensland;

4 School of Earth Sciences, University of Queensland;

Shifting baselines – background and significance

- Perception of "baseline", natural, pristine condition changes as the condition changes (Pauly, Dayton, Jackson);
- As environments are degraded/ fish stocks depleted, the degraded condition is considered "normal";
- Scientifically, may depend on i. Earliest survey/data or ii. Current scientists earliest observations...
- These are often shifted baselines: i.e. condition changed *before* these descriptions.
- Critical to management as the baseline against which degradation or stability and effectiveness of management actions may be measured;
- e.g. abundance of seaweeds on inshore reefs of GBR:
- symptom of eutrophication vs already there when Terry Done arrived...







Historical ecology of the inshore GBR





Green Island, Cairns

1966



2004



Decline in inshore coral reefs following European settlement?



Direct evidence

- Historical photographs- confounded;
- Monitoring data largely non-existent prior to 1980, limited until >1990;
- (The "elders" opinions...)

Indirect evidence

- Correlations with reef condition, coral cover & diversity, seaweed abundance, etc; Epidemiological approach.
- Increase in sediment flux (x8 - 10)
- Increase in nitrogen loading (x4 – x15)
- Increases in pesticides and herbicides
- Increased fishing pressure & trophic disruption, loss of large herbivores
- Coral bleaching and disease unknown in the historical record
- Enough to warrant concern, & responses from management.... Prevention...
- Yet...
 - Highly contentious subject – value in more, robust direct evidence for shifts
 - Timing and extent of shifts (if any) largely unknown

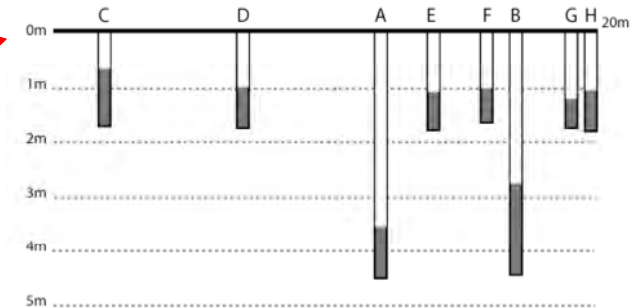
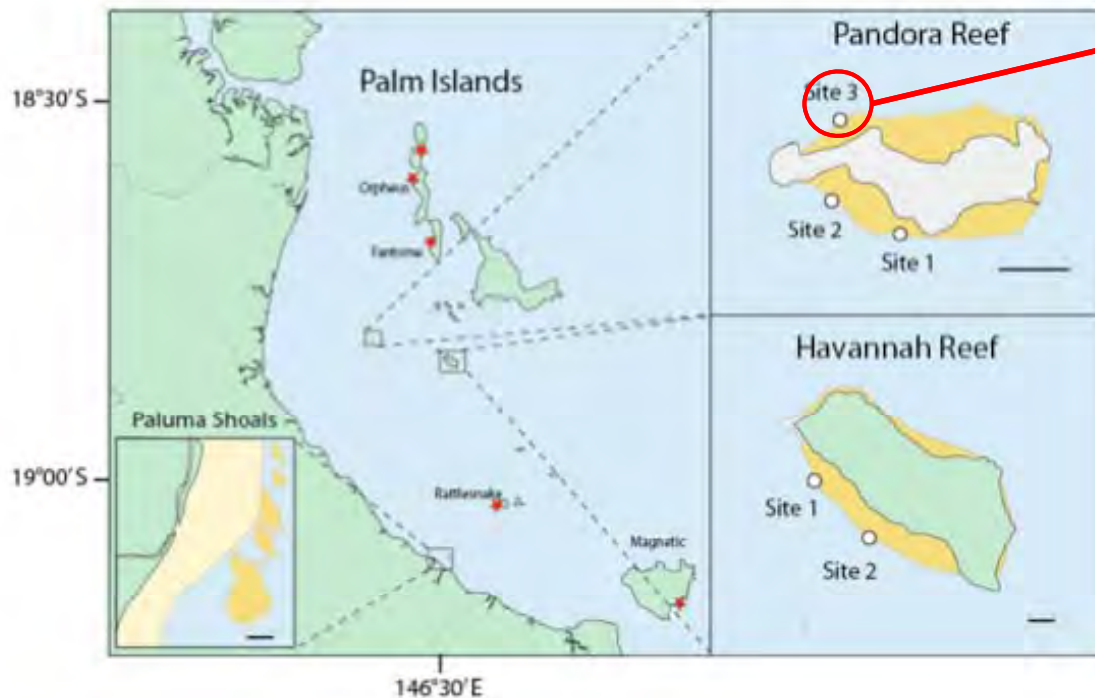


Outline

- 1) Late Holocene growth rates of two inshore fringing reefs from the Palm Islands region, central Great Barrier Reef
- 2) Palaeoecological evidence of a historical collapse of Acroporid corals on the inshore Great Barrier Reef following European settlement



1) Late Holocene growth rates of two inshore fringing reefs from the Palm Islands region, central Great Barrier Reef



Sampling protocol:

Two reefs, 40 cores in total:

- x10 5m cores
- X30 2m cores



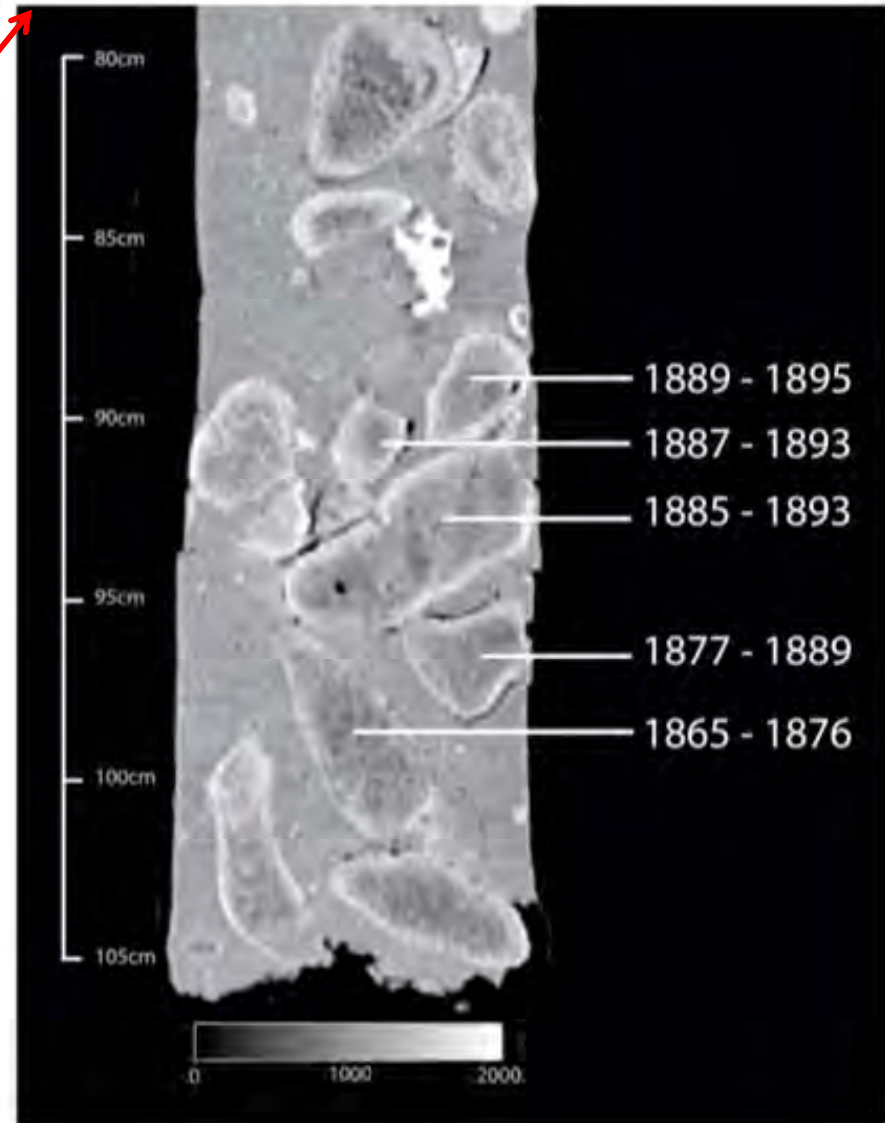
- Ecological studies are underpinned by age-dating of individual coral colonies using high precision U-Series dating
- 140 U-Series dates across all cores

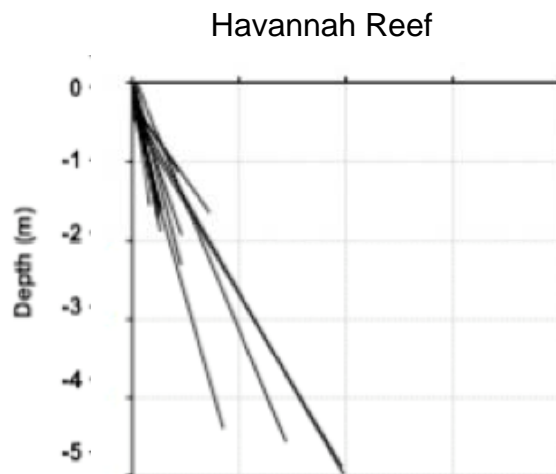
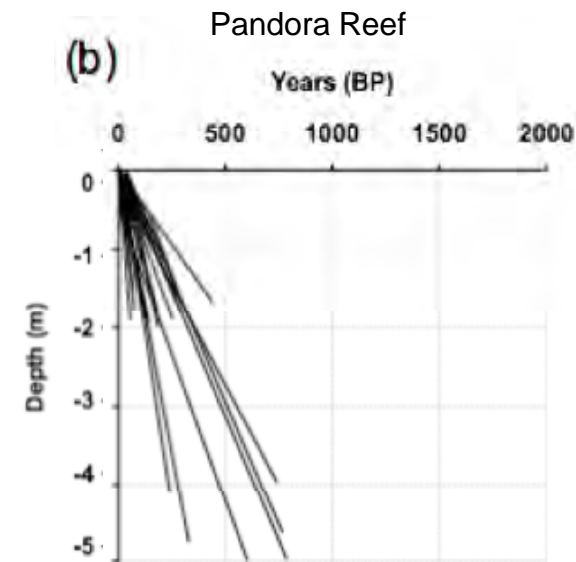




CT Scans reveal
Intact coral framework

U-Series dating of
individual coral fragments
reveals detailed growth
records





- U-Series dating reveals rapid and continuous reef slope growth throughout the last 1000 yrs at both reefs

- Reef accretion rates were highly constrained through time ($R^2 > 0.9$) and rapid (7.2 ± 1.2 to 18.9 ± 2.6 m / ka⁻¹)

- No evidence of age reversals, suggesting continuous accretion throughout the late Holocene

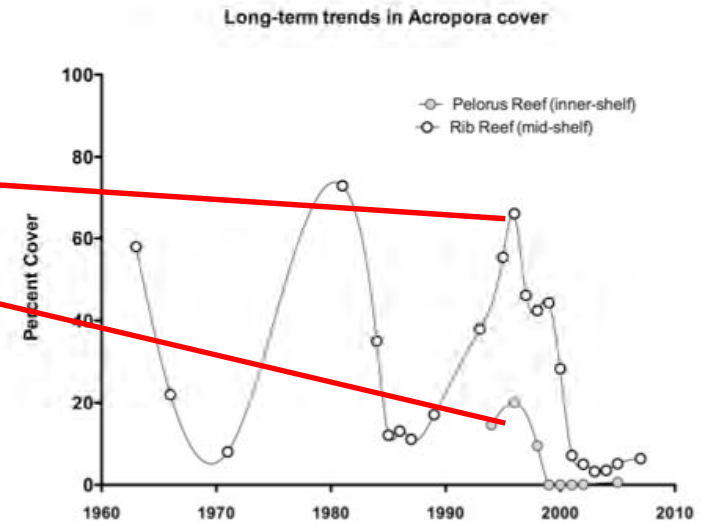
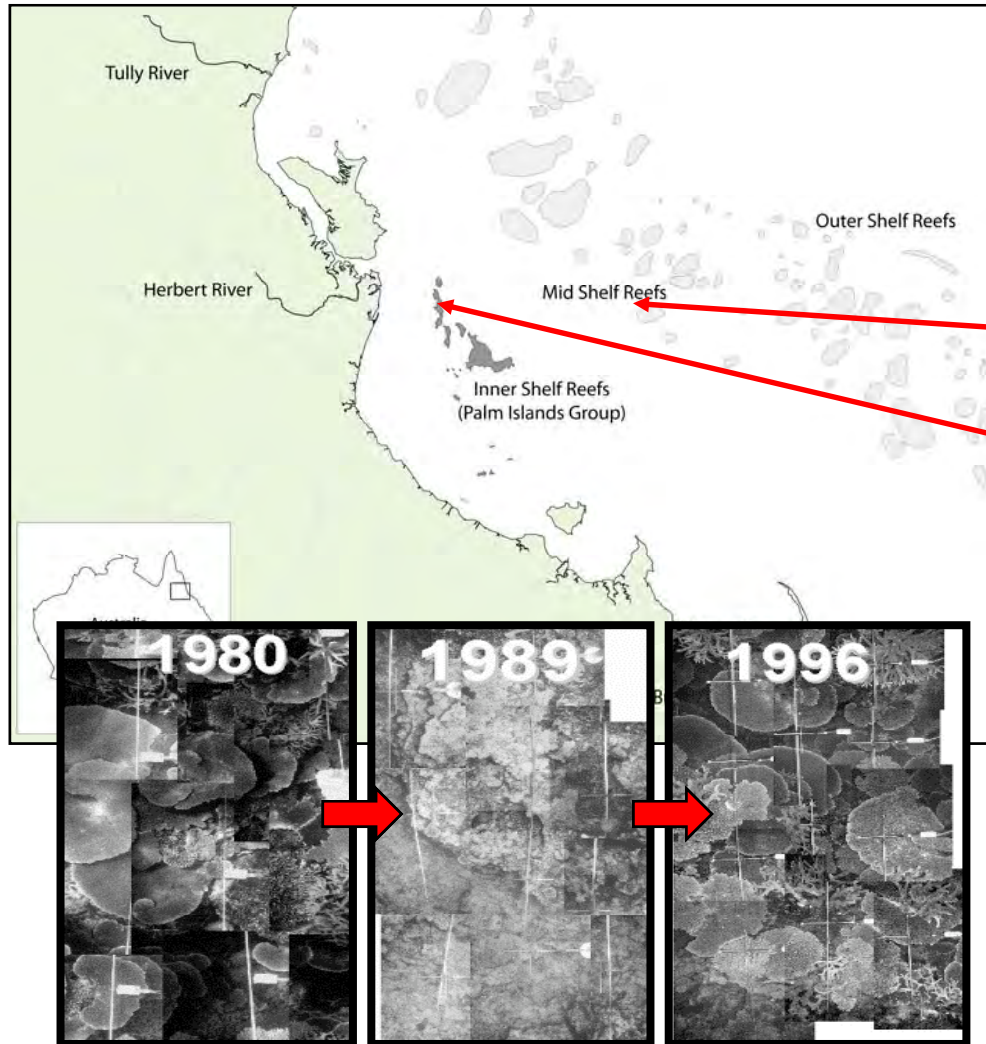
- Comparisons to published reef accretion rates from early-mid Holocene inshore GBR show that reef slope environments are accreting at rates equal to and exceeding those of the mid-Holocene 'optimum'.

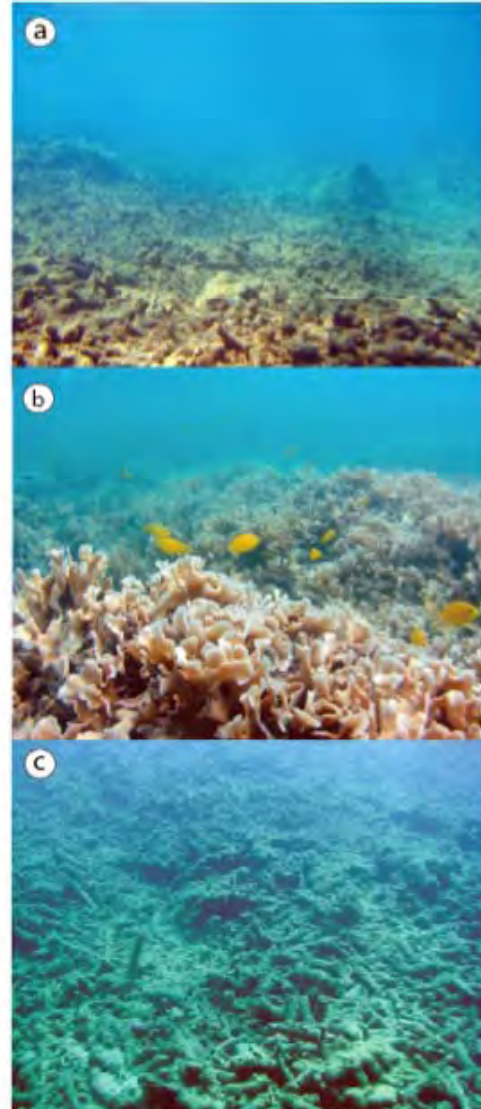


- 1) Late Holocene growth rates of two inshore fringing reefs from the Palm Islands region, central Great Barrier Reef
- 2) Palaeoecological evidence of a historical collapse of Acroporid corals on the inshore Great Barrier Reef following European settlement



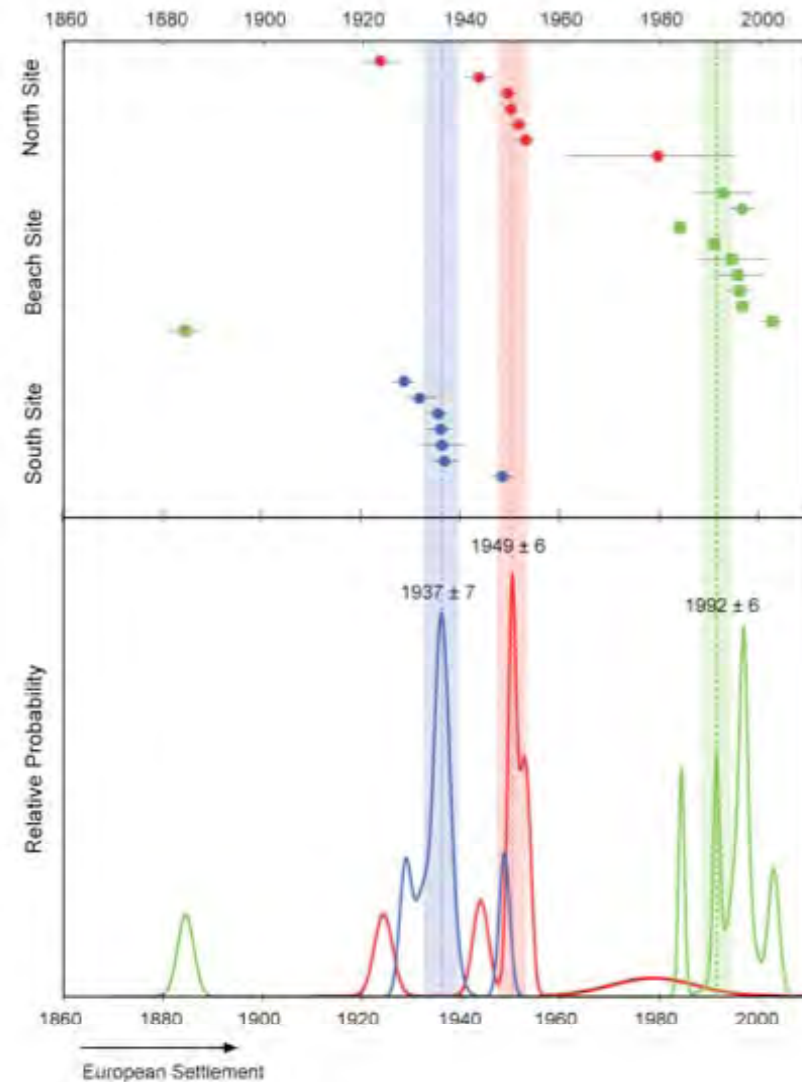
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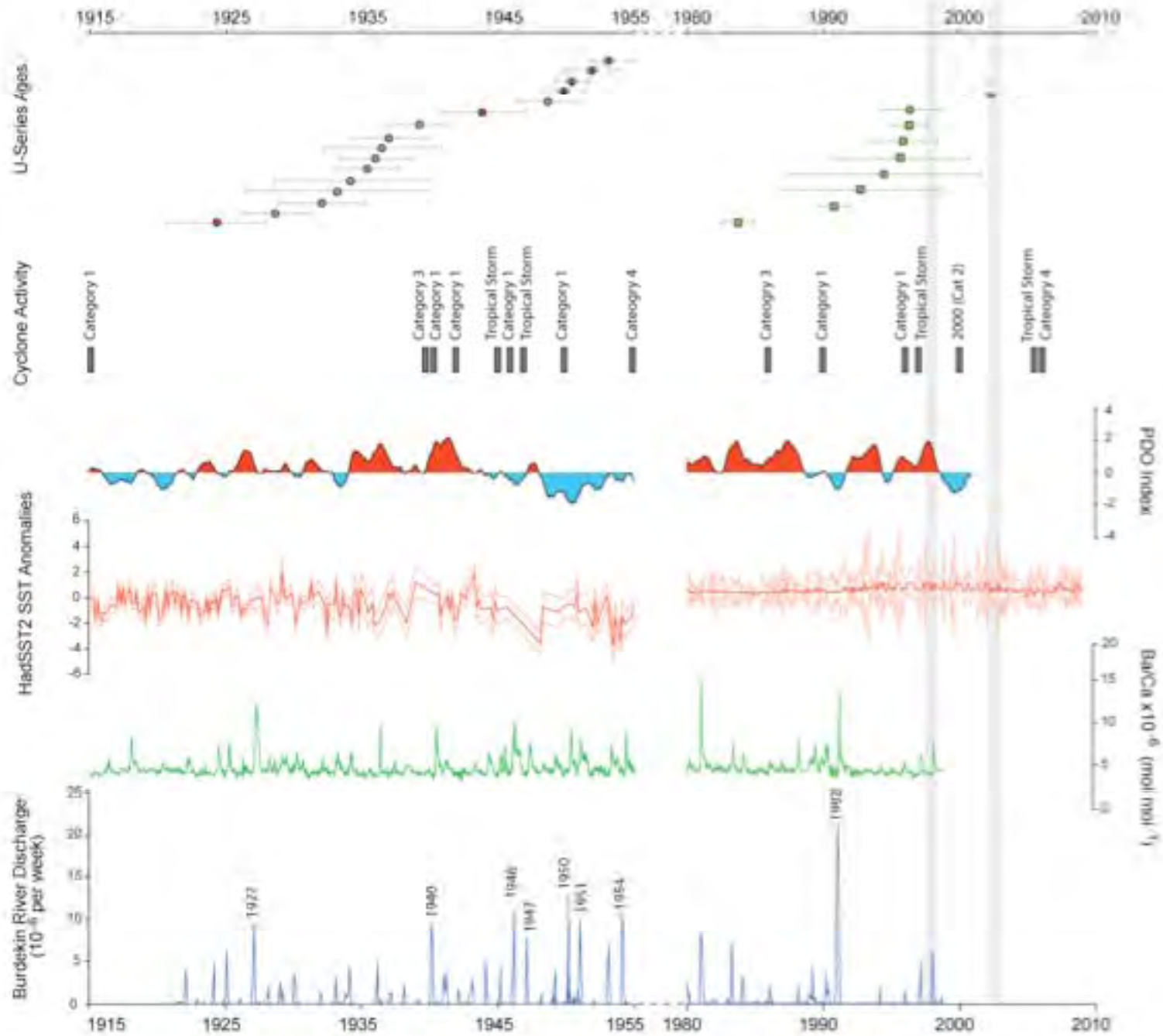






- U-Series dating indicates three distinct peaks in mortality
- Ages are well constrained, suggesting good preservation and a lack of transport in dead coral rubble at back reef locations (i.e. not cyclones!)
- If anything, U-Series underestimates timing of mortality
- Mortality occurred in *Acropora* assemblages at sites A and C at similar timing (1937 ± 7 and 1949 ± 6)
- Indicates Lack of recovery of *Acropora* coral communities in over 50 years
- Historical *Pavona cactus* communities at Site B indicate much more recent mortality (1992 ± 6)







Conclusions:

Our results indicate significant mortality events and lack of recovery of *Acropora* following the early – mid 20th Century & a shift to more sediment tolerant assemblages (unprecedented in modern records).

**i.e. present coral abundance may be a shifted or degraded state *AND* present "inshore corals" may really be "far inshore corals" –
- a shifted baseline - *on this island...***

LMcC1

And a threshold ('point of no return') where historically dominant *Acropora* become ecologically extinct

- Absence of a clear pattern of coral mortality and climatic drivers (PDO, ENSO)
- Implicates long-term chronic stressors as a cause of the failure to recover (i.e. increased sediment flux from the Burdekin River following European Settlement (1870 onwards))

Questions previous baseline for management, supports need for runoff reduction.

Need for sampling over larger area to establish generality & establish correlations with potential causes.

Slide 18

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change to emphasis that his suggests modern monitoring is monitoring a shifted baseline.

Laurence McCook, 17/05/2010



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