



National Environmental  
Research Program

TROPICAL ECOSYSTEMS *hub*

# Historical changes on the GBR: looking to the past to manage the future

## NERP Project 1.3

J. Zhao, J. Pandolfi, **T. Clark**, T. Done, S. Smithers, S. Lewis, M. McCulloch, G. Roff,  
L. McCook, K. Welsh, Y. Feng, A. Rodriguez-Ramirez, E. Liu, H. Markham, N.  
Leonard, M. Lepore, M. Prazeres, I. Butler, J. D'Olive, E. Rogers, E. Ryan



The Reef and its ecosystems – how are they shaping up?





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## RELEVANCE OF WORK

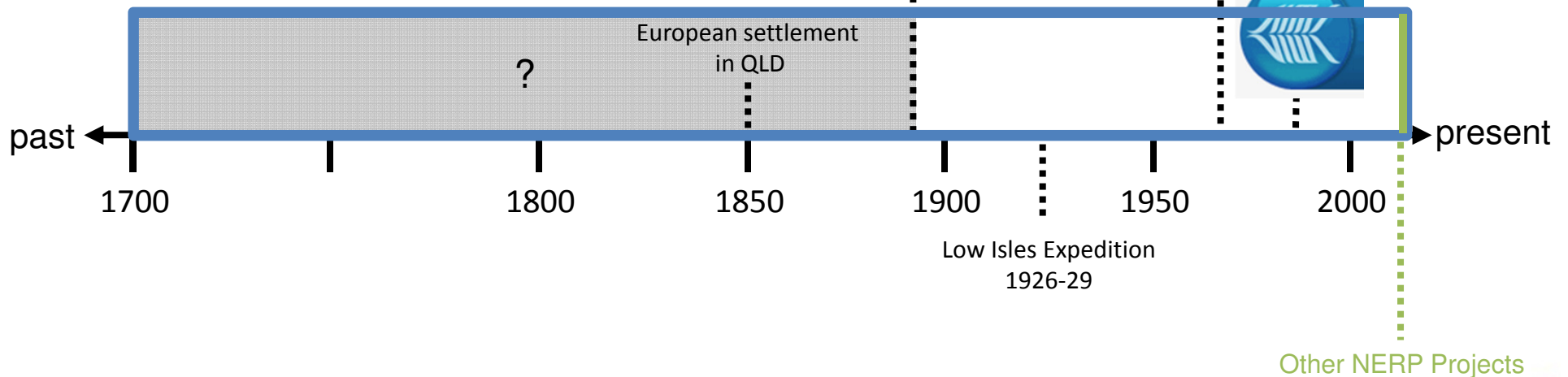
First methodological survey  
following COTS outbreak:

THE APPARENT EXTENT OF RECOVERY OF REEFS OF AUSTRALIA'S  
GREAT BARRIER REEF DEVASTATED BY THE  
CROWN-OF-THORNS STARFISH

by R. Endean and W. Stablum



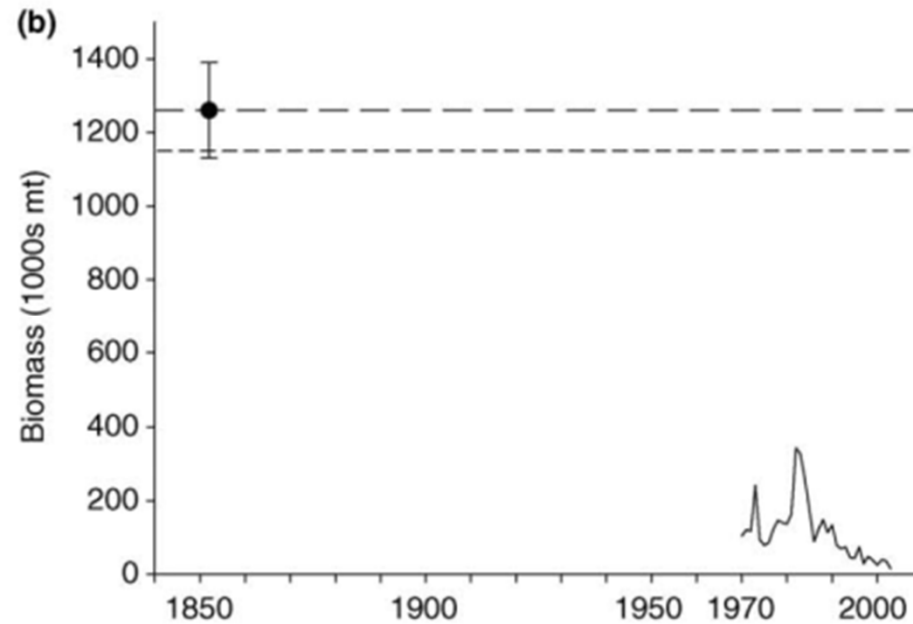
Historical photographs  
1893-onwards





## RELEVANCE OF WORK

Lack of long-term knowledge = risk of 'shifting baseline syndrome'



Lotze and Worm 2009 *Trends in Ecology and Evolution*



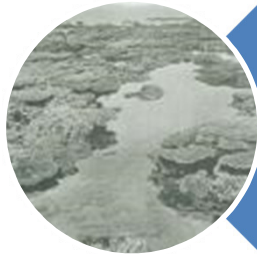
## PROJECT GOALS



What are the environmental changes on inshore GBR reefs over broad temporal scales?



What are the ecological changes in inshore GBR coral reef communities over broad temporal scales?



How do inshore GBR communities respond to environmental change?





# RESULTS

## Wet Tropics

Fitzroy Is  
High Is  
Frankland Islands  
Green Is  
Michaelmas Rf  
Double Is  
Low Isles  
Alexandra Rf  
Yule Point

## Palm Islands

Pelorus Is  
Orpheus Is  
Fantome Is  
Havannah Is  
Pandora Rf

## Whitsundays

Hayman Is  
Lindeman Is  
Border Is  
Stone Is  
Bramston Rf

## Keppel Islands

North Keppel Is  
Halfway Is  
Barren Is  
Pelican Is

Hervey Bay

# RESULTS



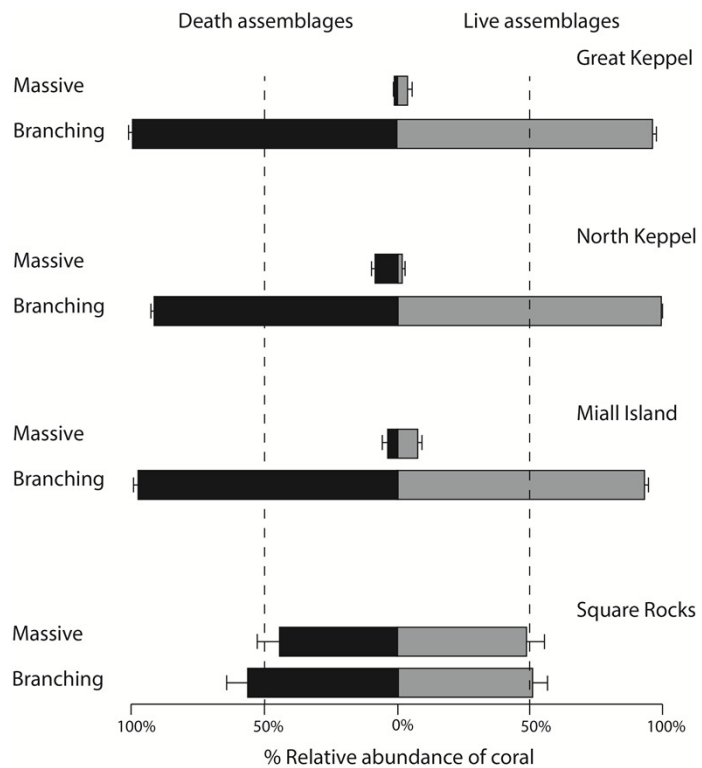
Keppel Islands

pic.twitter.com/l0KewT8X



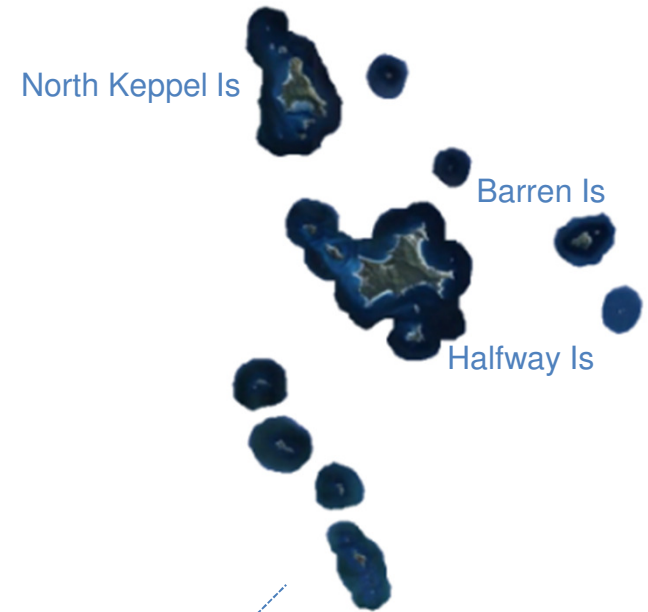


## RESULTS – KEPPEL ISLANDS



% live coral

% dead coral

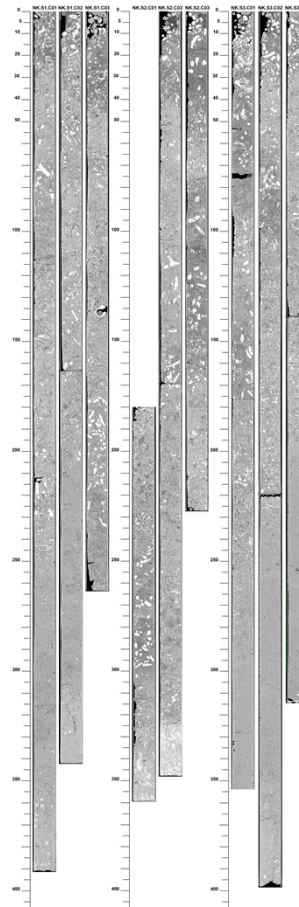
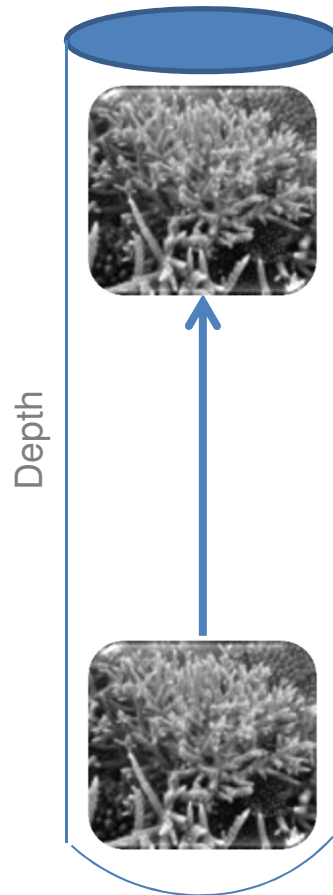




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## RESULTS – KEPPEL ISLANDS



North Keppel Is

Barren Is

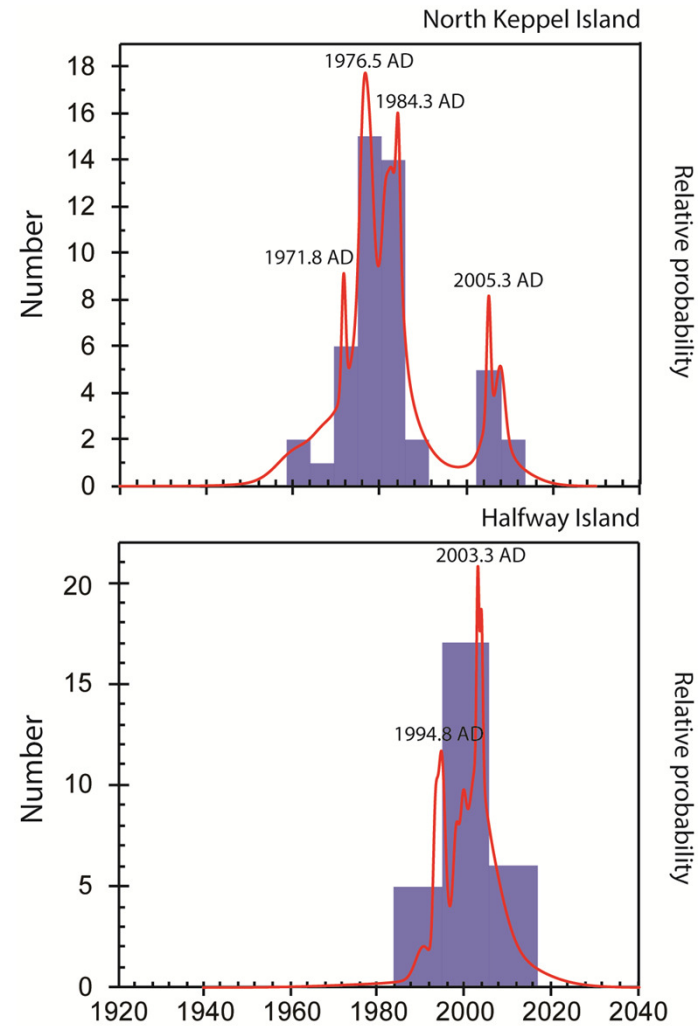
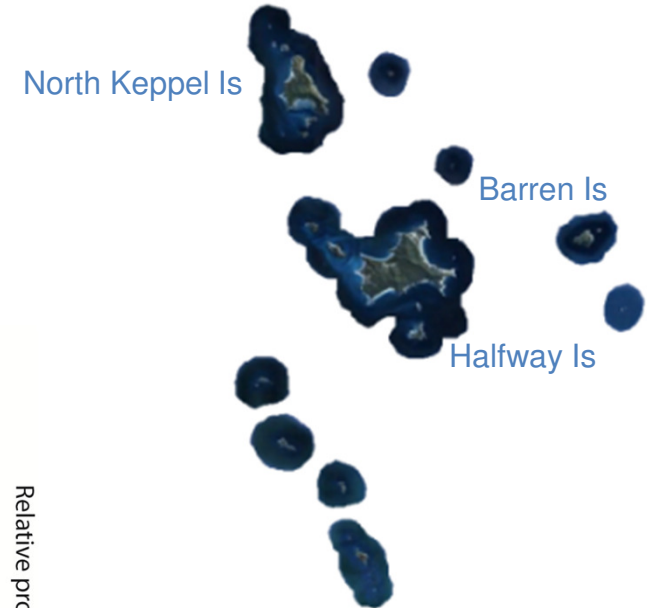
Halfway Is



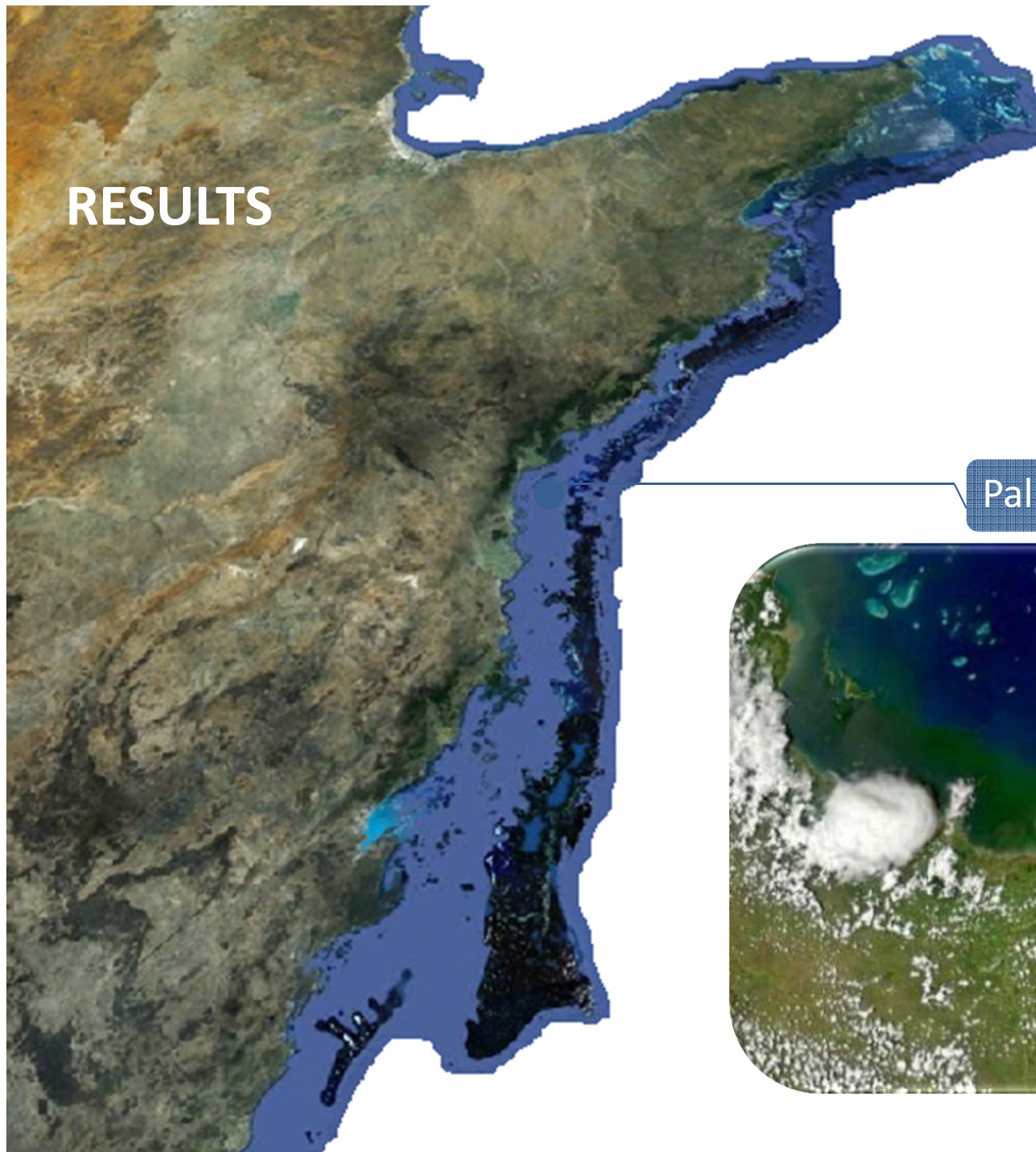




## RESULTS – KEPPEL ISLANDS



# RESULTS



Palm Islands

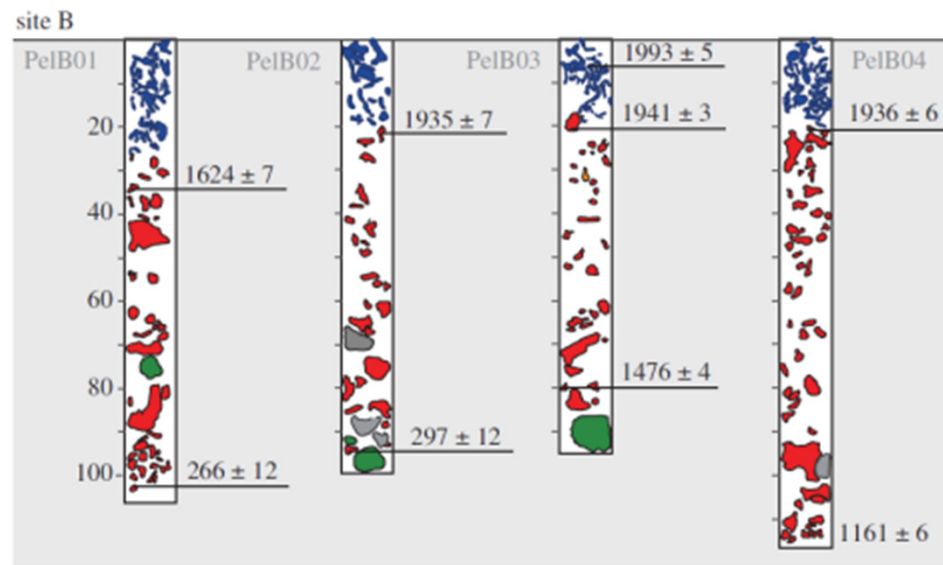
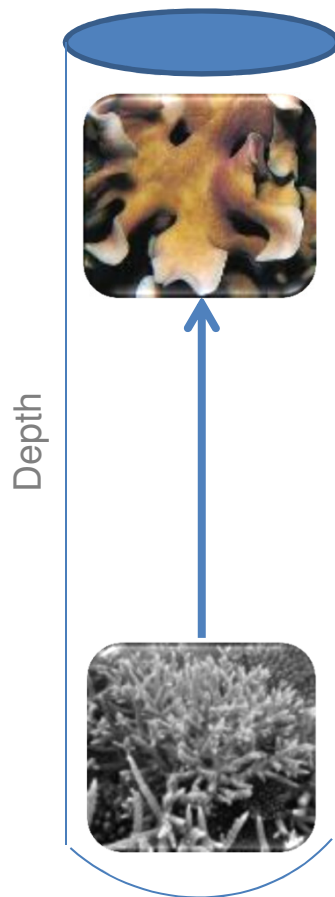


Photo: NASA/ Norman Kuring



## RESULTS – PALM ISLANDS

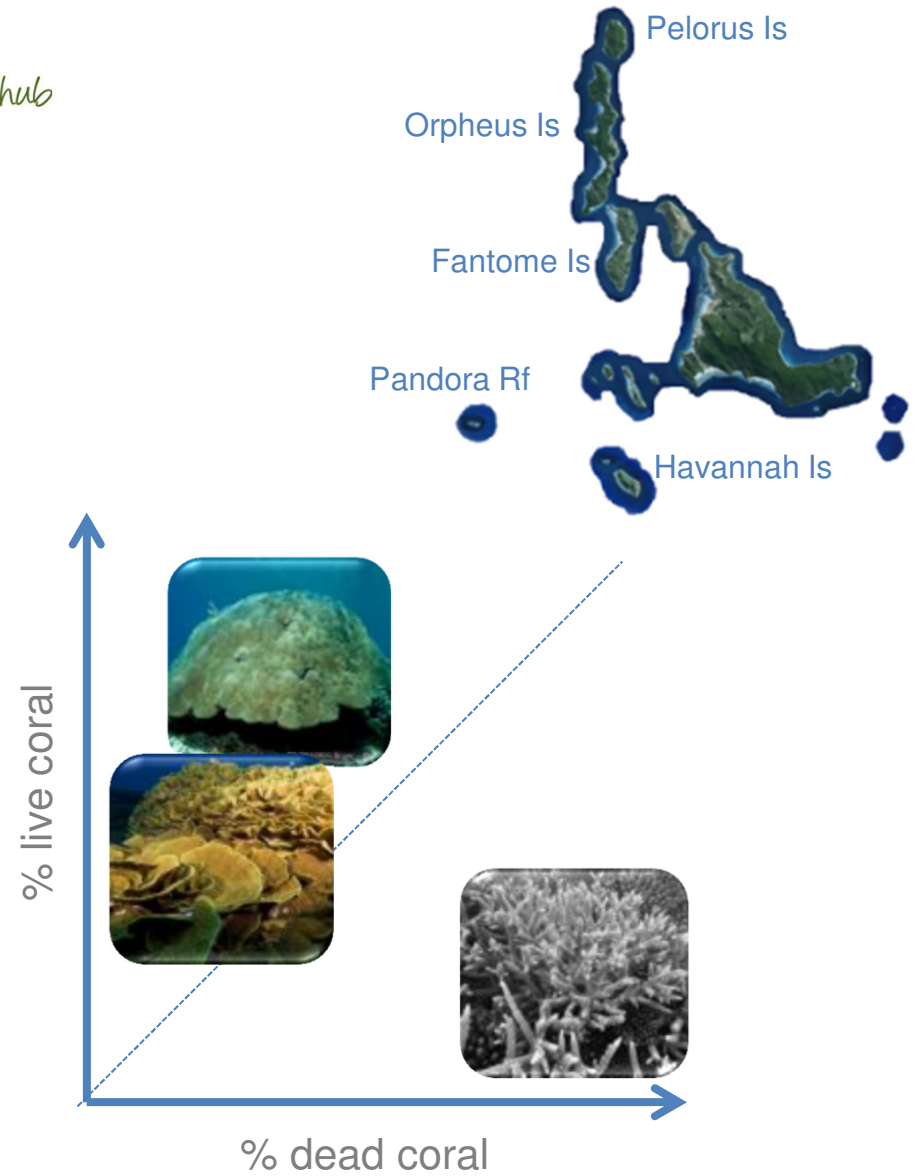
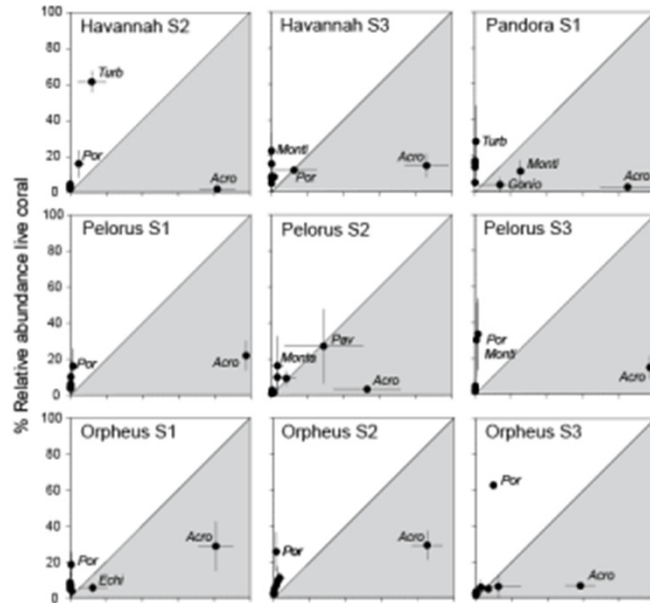
Phase shift – unprecedented over the past ~1500 yrs





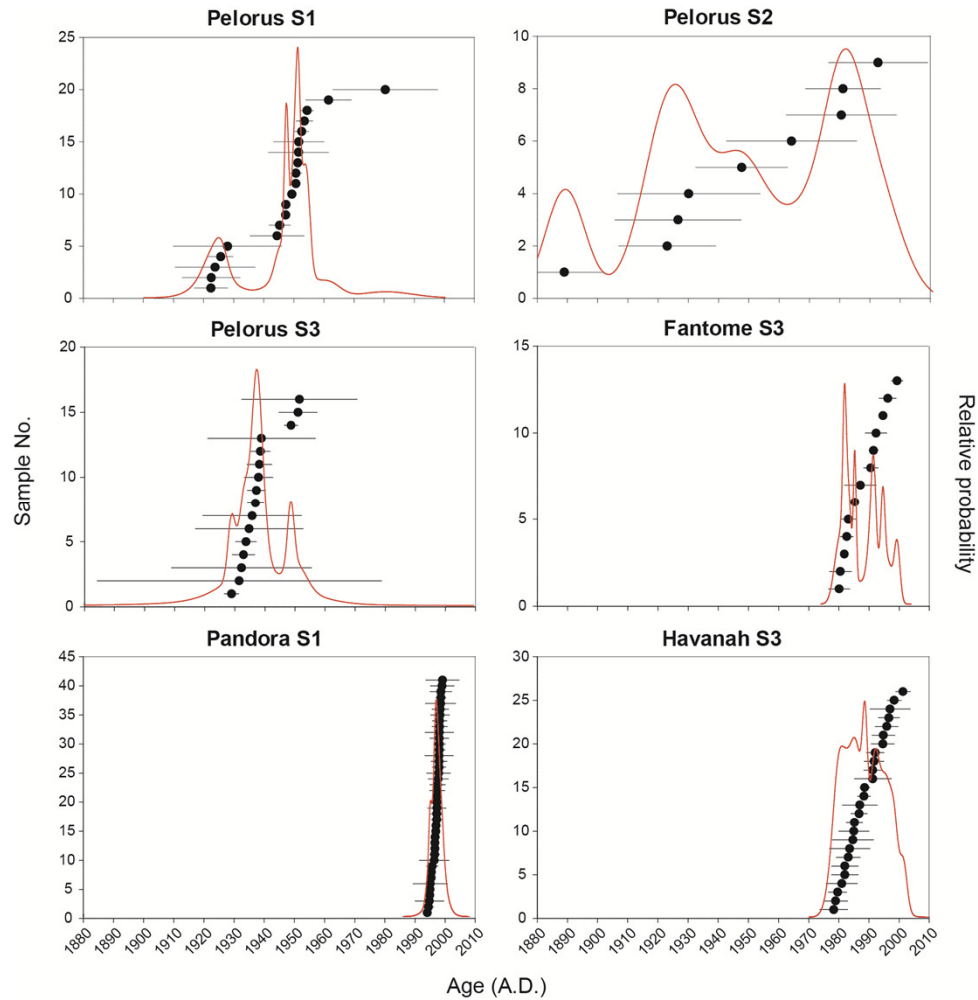


## RESULTS – PALM ISLANDS





## RESULTS – PALM ISLANDS





## RESULTS: PALM VS KEPPEL ISLANDS

DESCRIPTION	KEPPEL ISLANDS	PALM ISLANDS
Region	Southern GBR	Central GBR
<i>Acro</i> live v dead assemblage	↑ abundance in both live and dead assemblage	Dominates dead assemblage
<i>Acro</i> reef-matrix cores	Dominant past 6ka	Phase shift
Mortality patterns	Spatially variable	Spatially variable
Current <i>Acro</i> cover	High*	Low
Time since most recent mortality	< 10 yrs	> 60 yrs

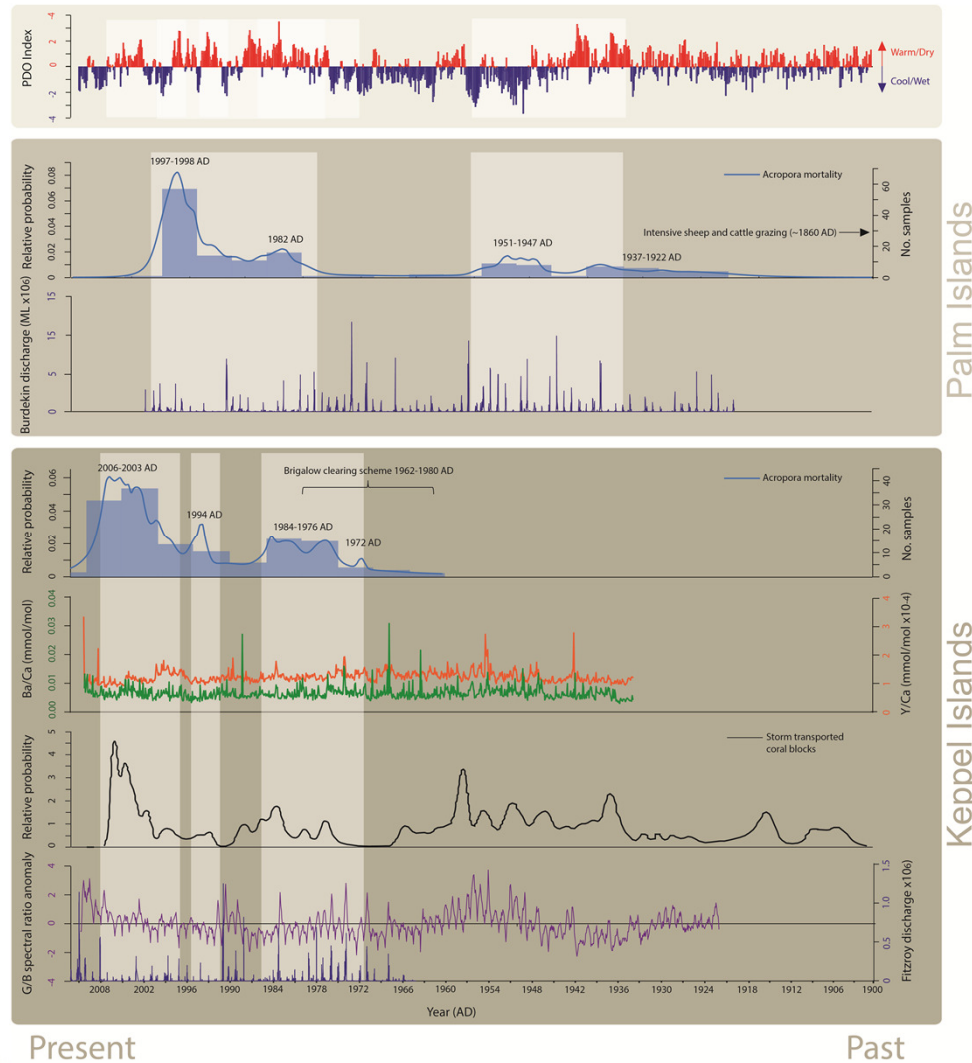
\*until 2011 flood caused widespread mortality










## RESULTS: PALM VS KEPPEL ISLANDS





## APPLICATION OF WORK

OUTCOME	APPLICATION TO MANAGEMENT
Evidence of what the reef was like prior to European colonization and LTM	<div></div> <div>PastRecent pastPresent</div> <ul style="list-style-type: none"><li>• Overcome 'shifting baseline'</li><li>• Target for reef restoration</li></ul>
Long-term records of environmental and ecological variability <ul style="list-style-type: none"><li>• How have reefs responded in the past?</li><li>• Recovery rates</li></ul>	<ul style="list-style-type: none"><li>• Identify drivers of change – anthropogenic or climatic?</li><li>• Assist with cost-benefit analysis</li></ul>
Robust scientific knowledge to support management decisions	<ul style="list-style-type: none"><li>• Identify vulnerable/resilient reefs</li><li>• Promote restoration</li><li>• Enhance protection</li></ul>





## FUTURE DIRECTIONS

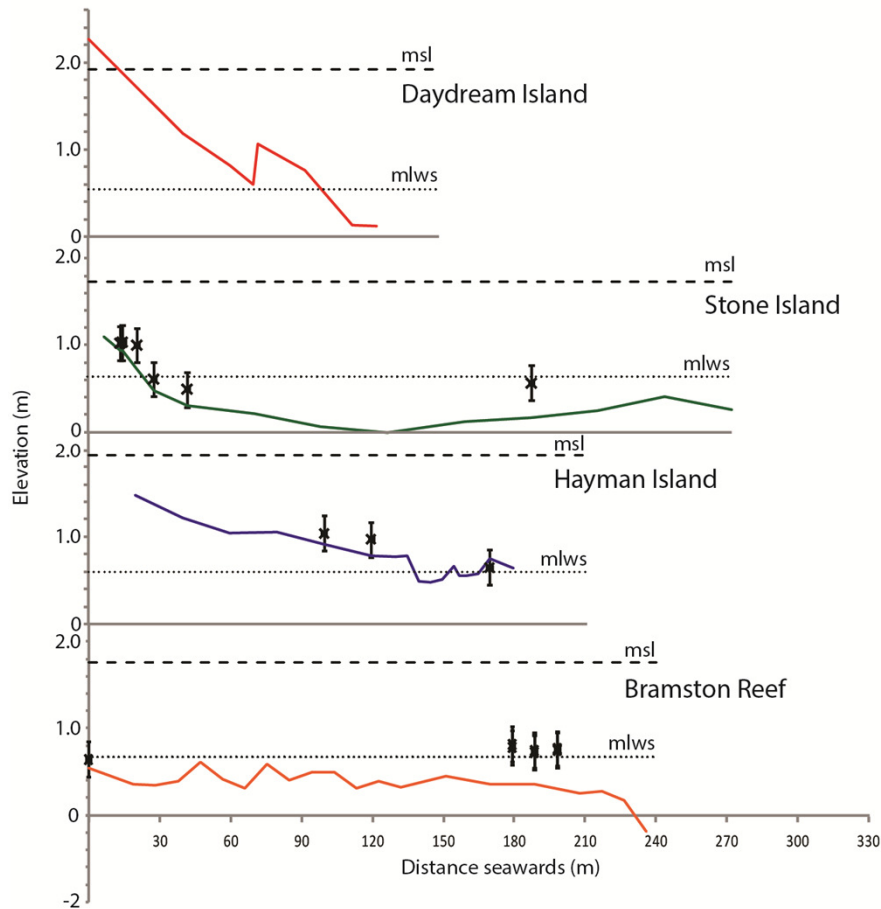
- Broad-scale understanding of ecological and environmental changes on the GBR
- Long-term (millennial-scale) records of environmental change
- Disentangle anthropogenic disturbances from climatic and natural mortality
- Extend sampling design to high latitude/marginal reefs







## FUTURE DIRECTIONS



Stone Island



Source: GBRMPA



Source: GBRMPA





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## NERP Historical Working Group

The University of Queensland

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# THANK YOU



THE UNIVERSITY  
OF QUEENSLAND  
AUSTRALIA



JAMES COOK  
UNIVERSITY  
AUSTRALIA



Australian Government  
Great Barrier Reef  
Marine Park Authority



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