Land-sea interactions and water quality in the Great Barrier Reef Lagoon

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The Great Barrier Reef

Marine Park (1975) and WHA (1981)

Largest coral reef system in the world

>3000 reefs;

2,200 km long;

350,000 km^2

Shallow lagoon, wide shelf,

Fringing and platform reefs

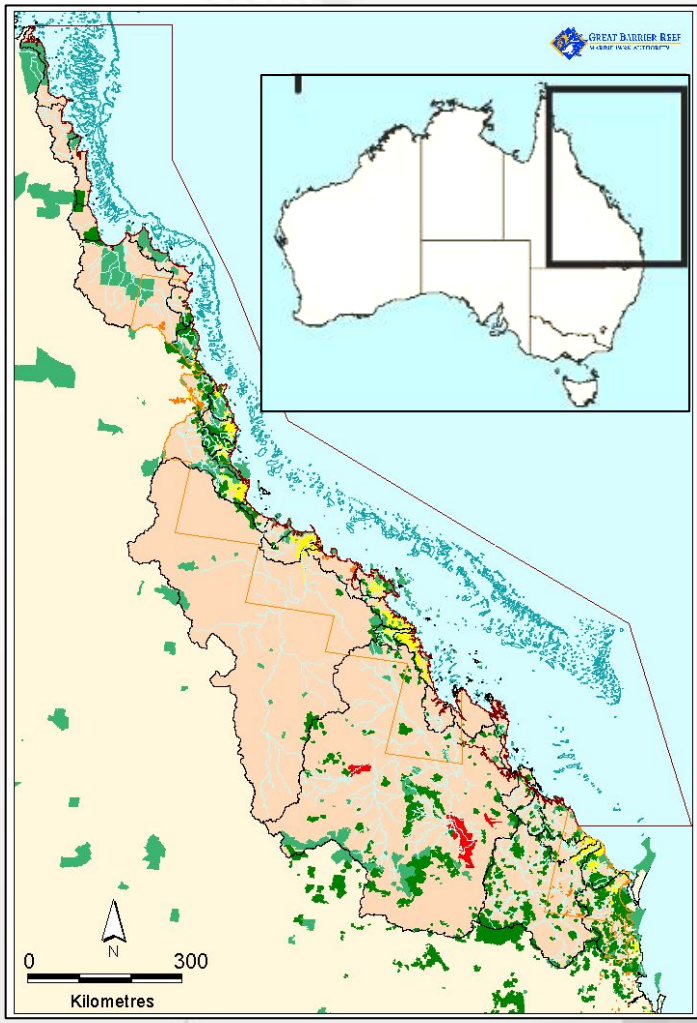
The GBR Catchment

- 422,000 km^2
- 26 river catchments

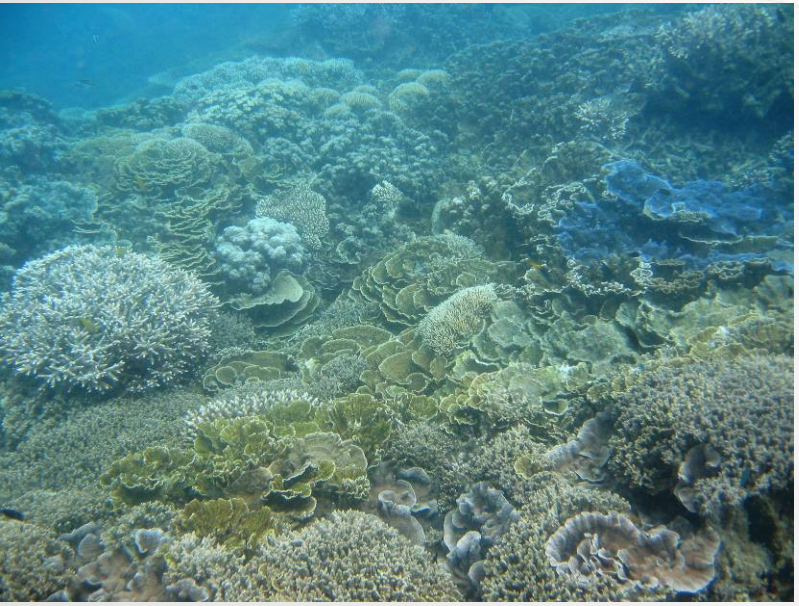
- ~20% “pristine”

<u>Land-uses</u>

- Agriculture (beef & sugar)
- Urban & industrial areas
- Ports
- Aquaculture



The need to meet the challenge of climate change



Current threats to the GBR:

1. Climate change: Temperature, cyclones, floods, ocean acidification
2. Water quality: nutrients, turbidity, sedimentation
3. Fishing and other harvest

Threats to GBR: 1.Water quality

The issue:

- River floods carrying nutrients, sediments and herbicides from eroding farm soils into the sea
- Predicted significant intensification of coastal development in QLD

Catchment to reef connection

2007 river floods of most catchments

(image: Matt Slivkoff)

GBR rivers export large amounts of

- Freshwater (long-term average ~70 million ML)
- Suspended sediments (long-term average ~10-15 Mt)
- Nutrients (mainly DIN, DON)
- Pesticides

Water quality in coastal and inshore areas of the GBR Lagoon

Drivers

- Inputs via monsoonal floods
- Recurrent availability via resuspension

Main problems

- High turbidity
- Increased chlorophyll
- Increased organic matter
- Measurable levels of herbicides

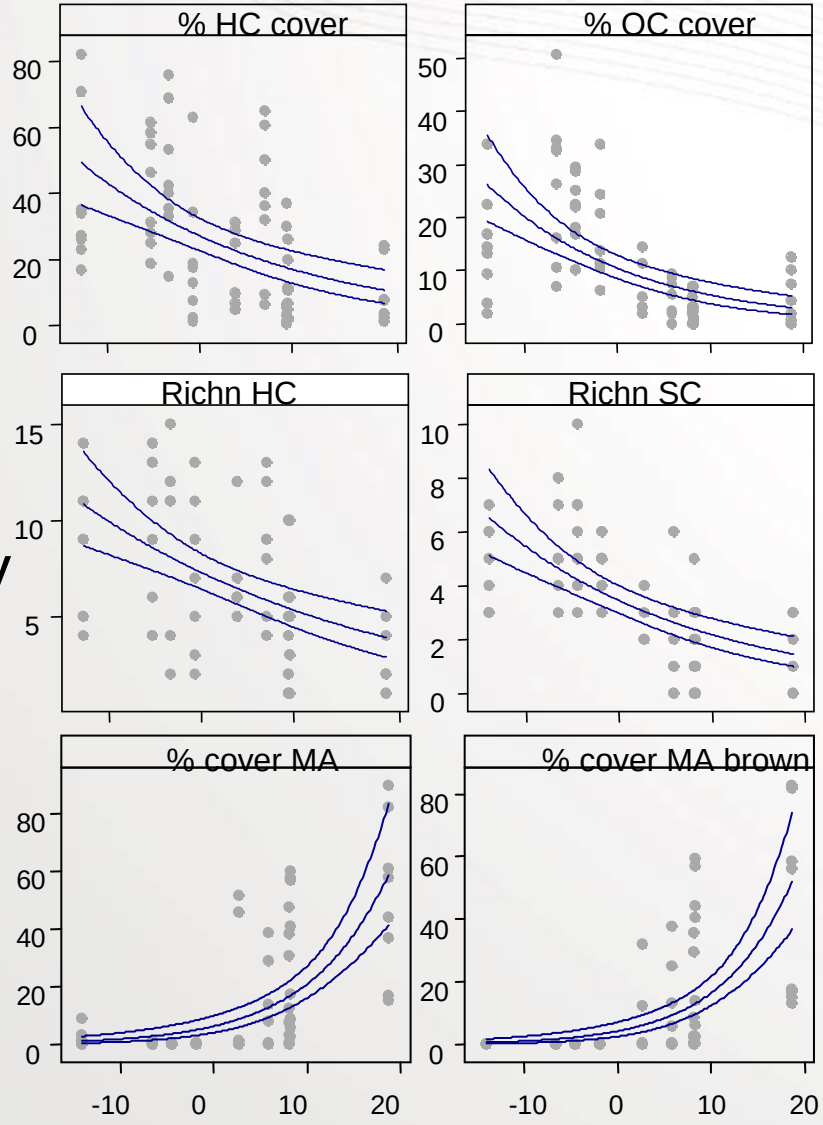
Floods and resuspension drive the system

Reef communities change along WQ gradient

Decreasing coral cover

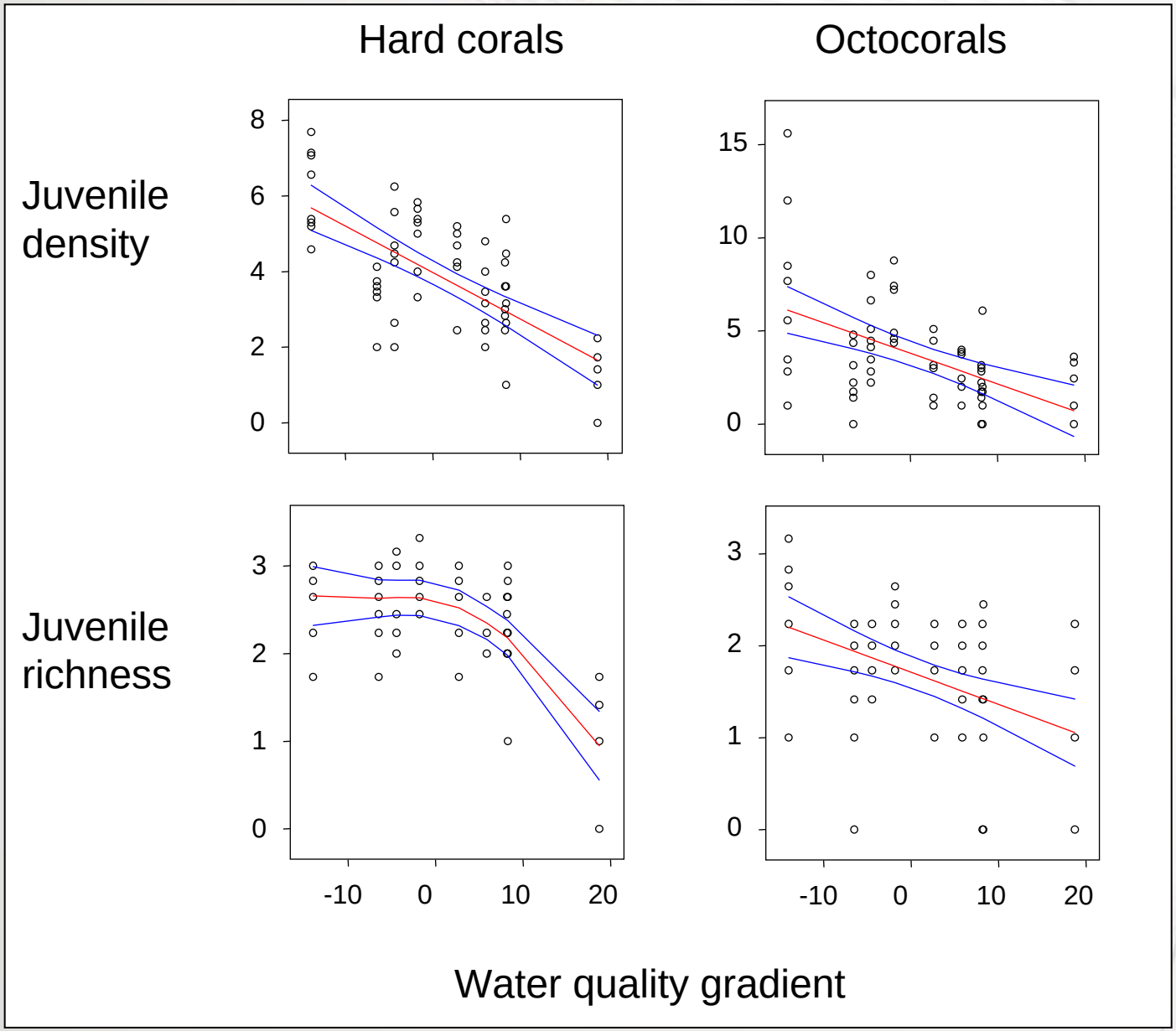
Deceasing Coral diversity

Increasing macroalgal cover

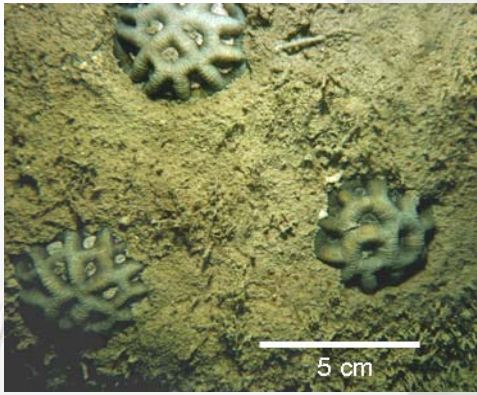


Fabricius et al 2005
Fabricius & De'ath 2004

Effects of water quality on coral reefs

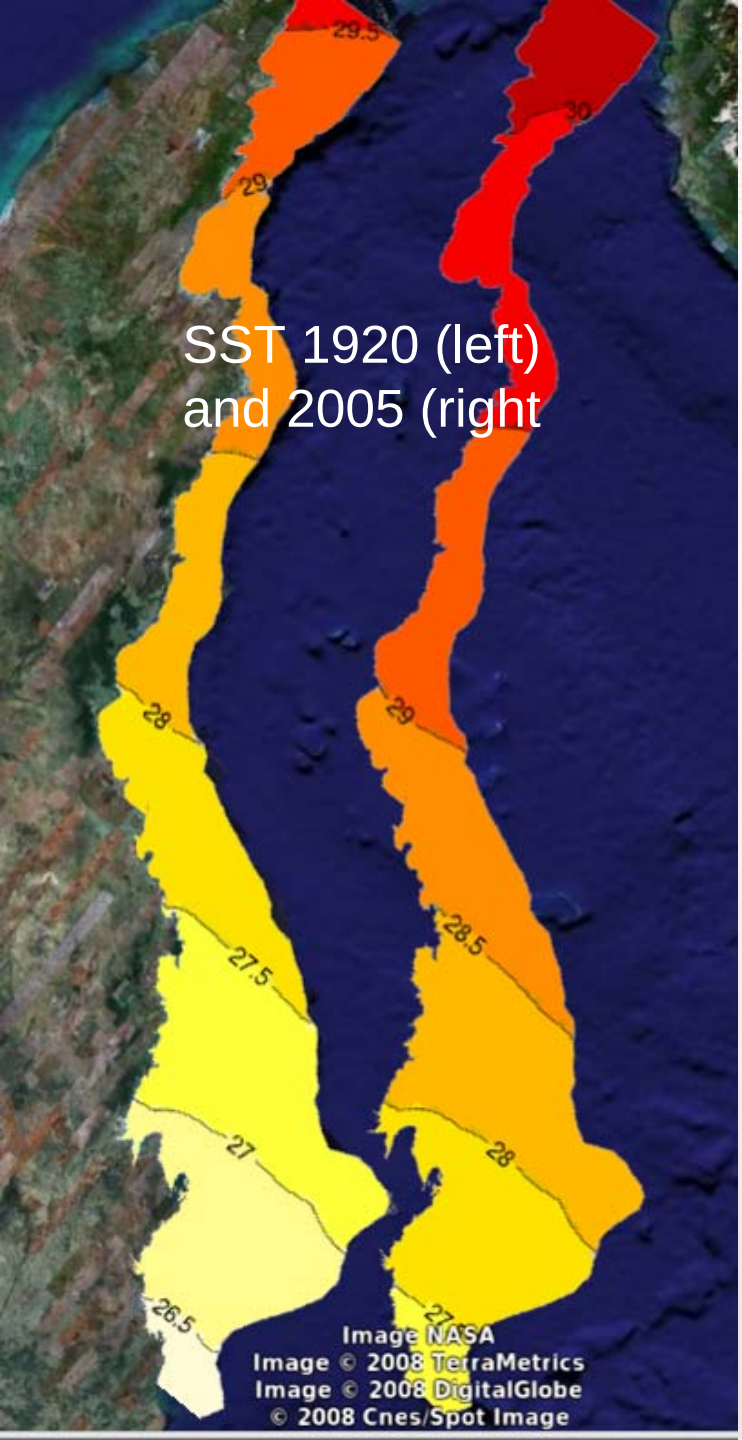


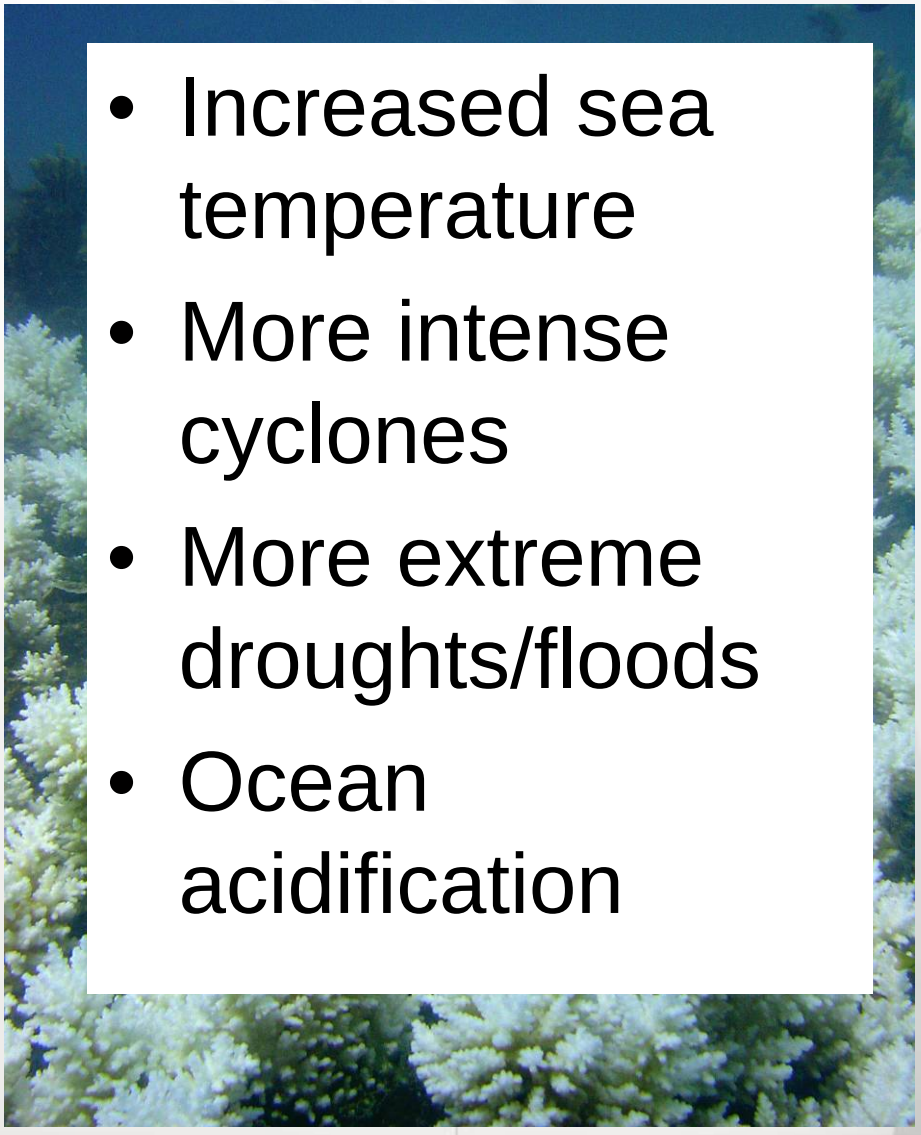
Less juvenile corals with decreasing water quality



Fabricius in prep.

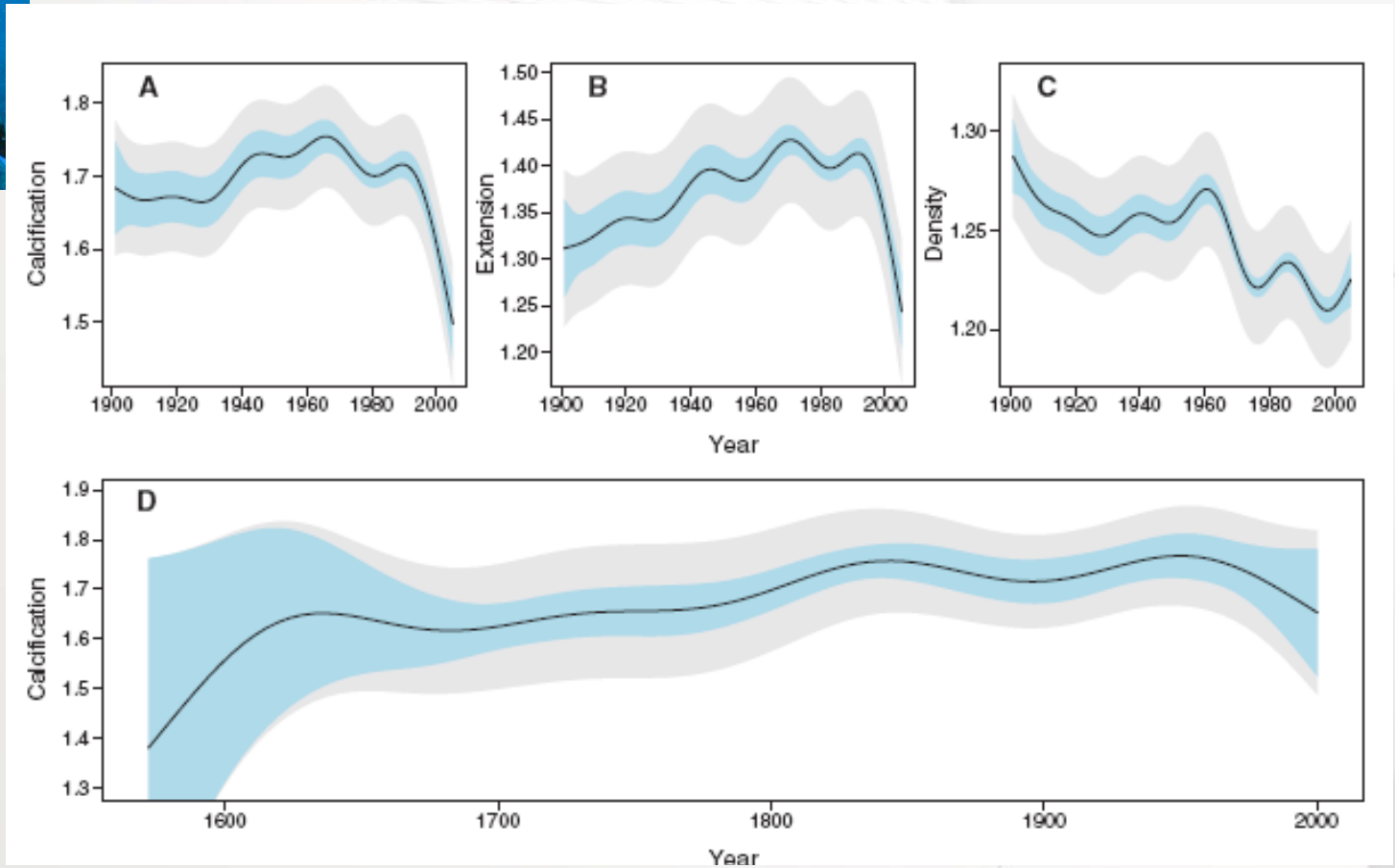
Threats to GBR: 2. Climate change





- Increased sea temperature
- More intense cyclones
- More extreme droughts/floods
- Ocean acidification

Declining coral calcification

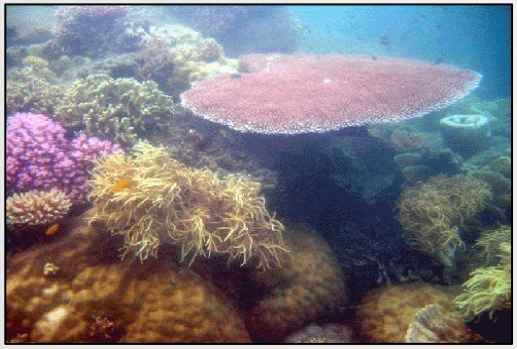


15% decline in coral calcification

De'ath et al. (2009)
Science 323

Water quality and climate change interactions- indirect

- Climate change will lead to more disturbance of reefs
- How do reefs recover after disturbance under different water quality conditions?



- coral recruitment & growth
- moderate algal growth, mainly turfs

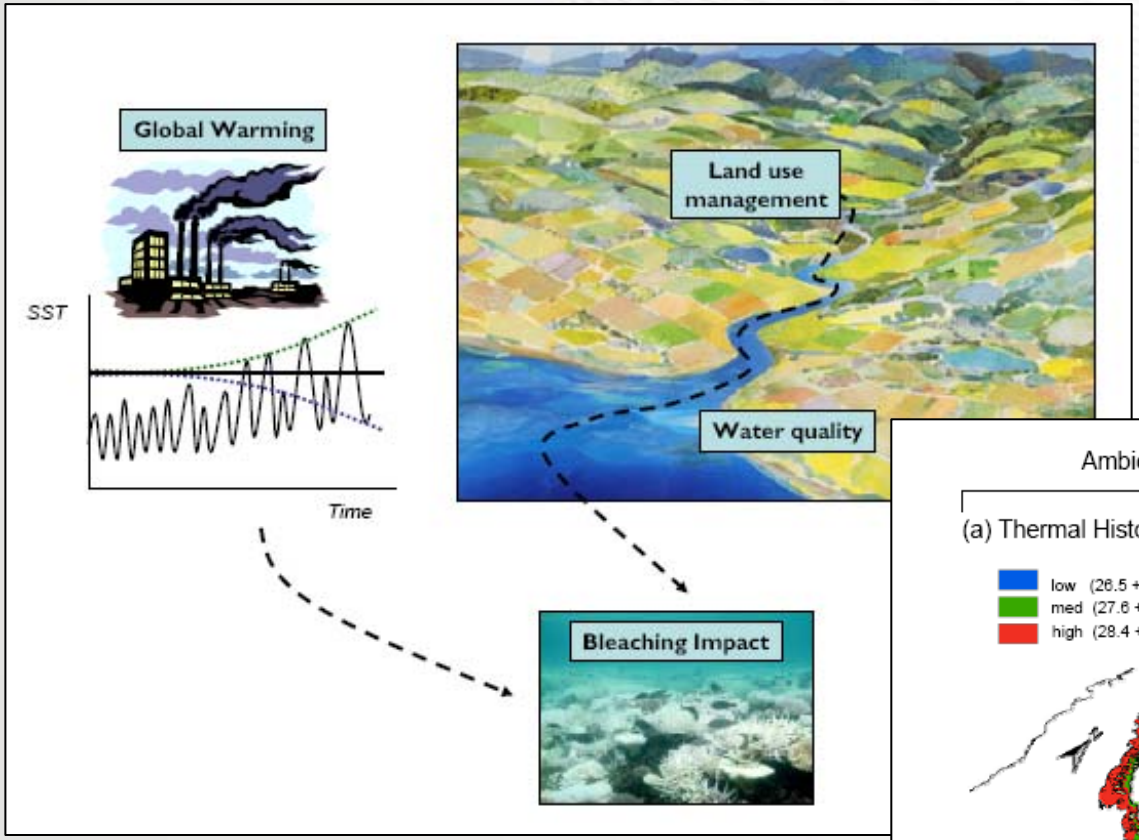
→ Recovery

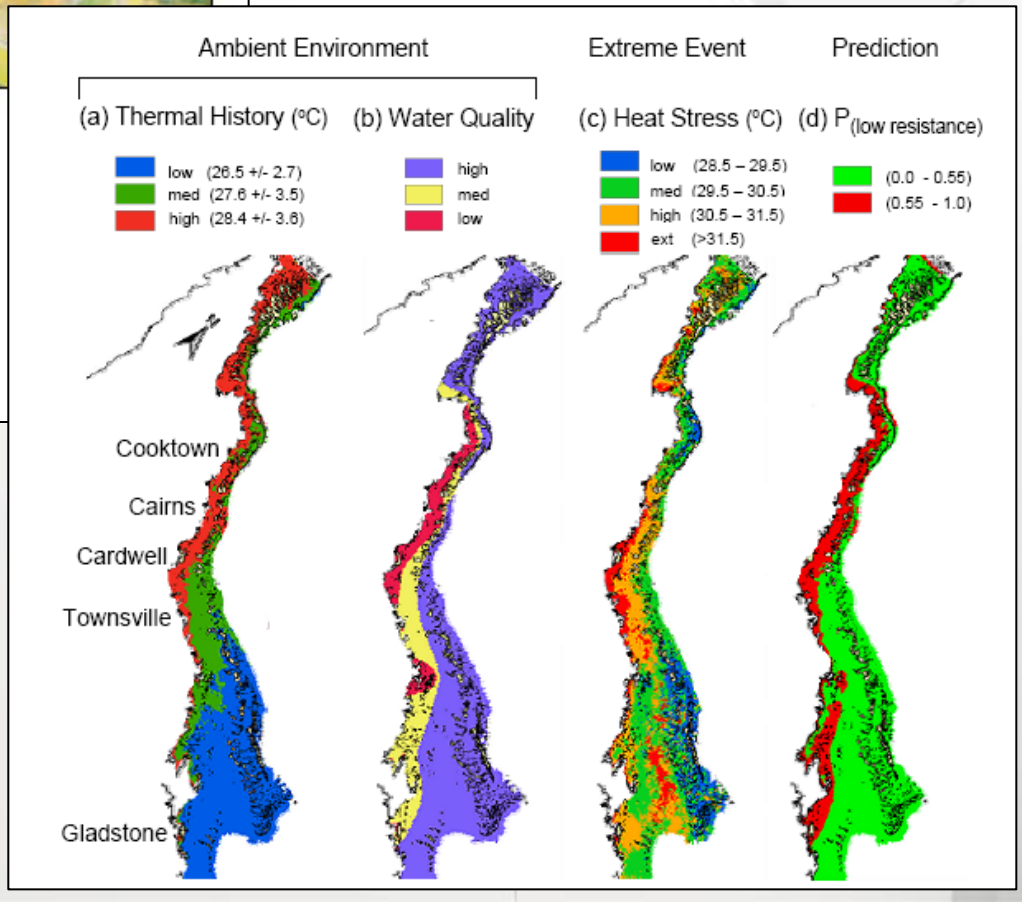
- coral recruitment reduced
- enhanced algal growth
- coral/algal competition

→ slow or no recovery, reduced diversity

=low resilience to disturbance

Water quality/climate change interactions - direct





Coral in areas exposed to land runoff have lower resistance to bleaching

Wooldridge 2009, Marine Pollution Bulletin
Wooldridge & Done 2009, Ecological Applications, in press

Management of water quality in the GBR lagoon

- Point sources (sewage, industrial effluent, land-based aquaculture, etc) well managed under permit processes and discharge license conditions
- Diffuse sources (e.g. agricultural run-off) managed by non-binding instruments
  - Reef Water Quality Protection Plan
  - National Action Plan for Salinity and Water Quality
  - Regional Natural Resource Management Plans
  - Water Quality Improvement Plans

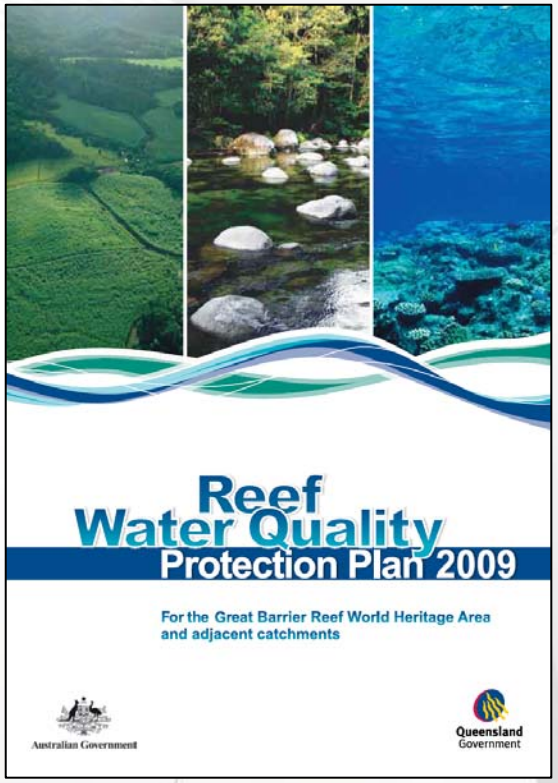
Great Barrier Reef Water Quality Protection Plan

Goals

- **2013:** Halt and reverse the decline in water quality entering the Reef by 2013.
- **2020:** To ensure that by 2020 the quality of water entering the Reef from adjacent catchments has no detrimental impact on the health and resilience of the Great Barrier Reef.

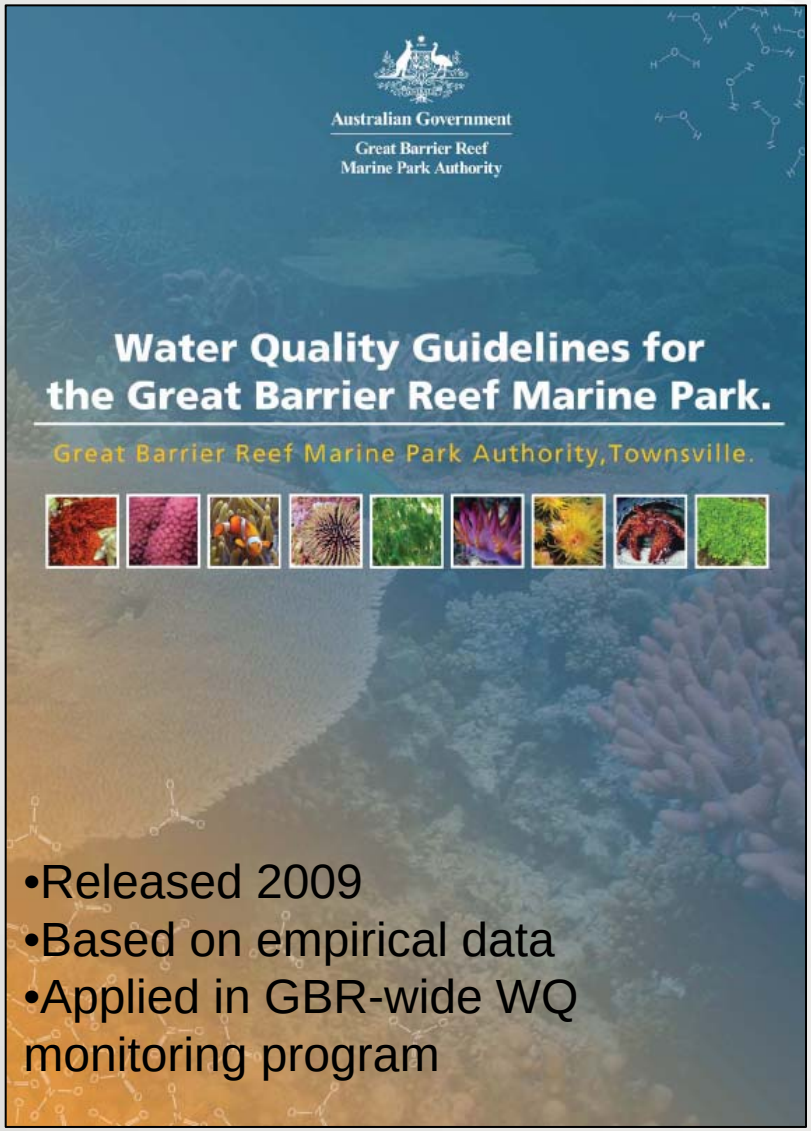
Objectives

1. Reduce the load of pollutants from non-point sources in the water entering the Reef.
2. Rehabilitate and conserve areas of the Reef catchment that have a role in removing water-borne pollutants.
   (e.g., flood plains, riparian zones, mangroves)

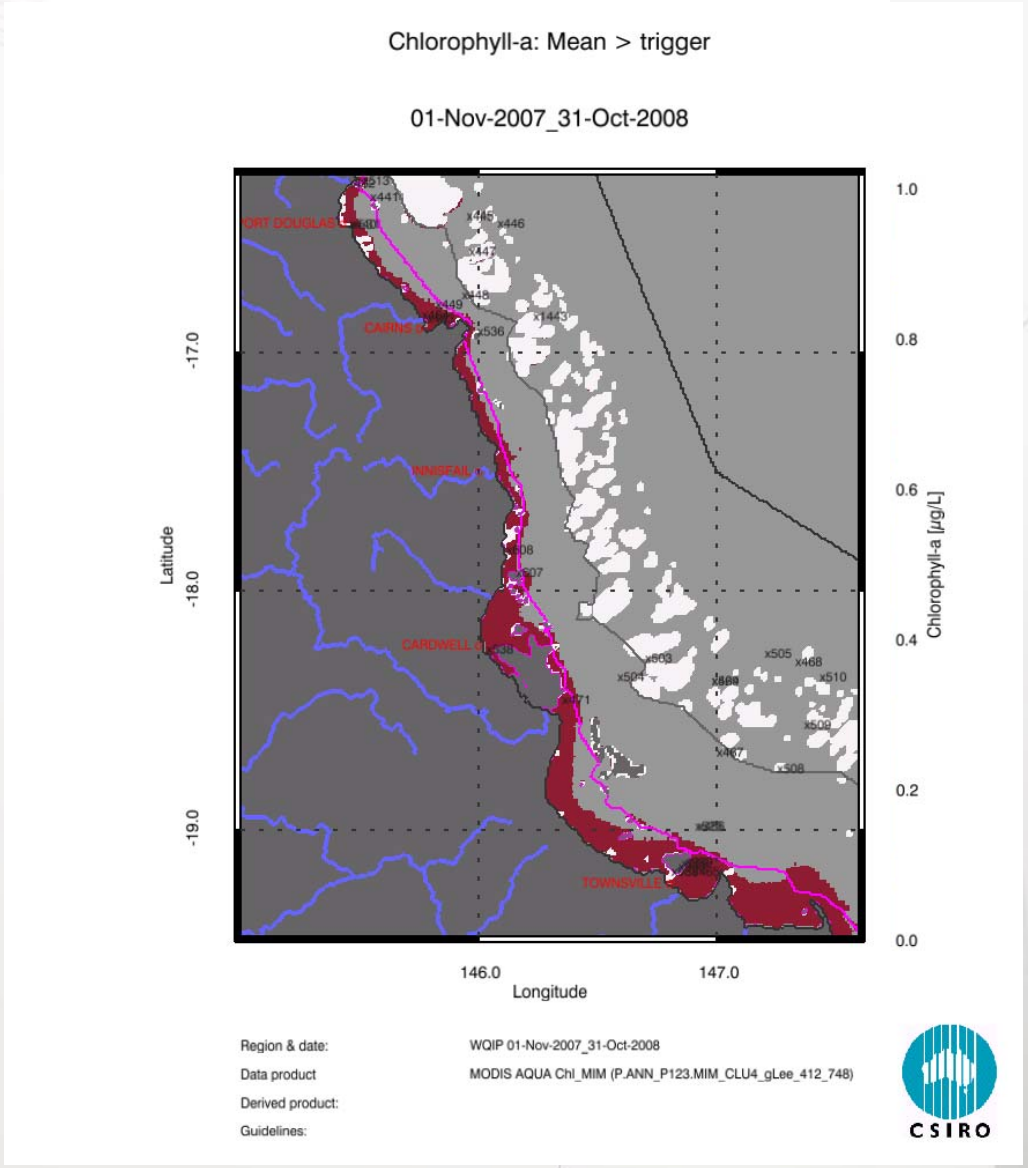


Released 2003
Reviewed 2009

GBR water quality guideline



- Released 2009
- Based on empirical data
- Applied in GBR-wide WQ monitoring program



V. Brando, CSIRO, unpubl.

Summary

- Climate change is the main threat to the GBR
- Coral calcification has declined by ~15% since 1990,
- Regional stressors such as water quality remain important, especially for scope for recovery after disturbance
- Regional stressors such as water quality can be regionally managed!
- Climate change and water quality affect coral reefs, both alone and in interaction
- Future research and management needs to urgently address these interactions


CATCHMENT TO REEF
Thank you
CONNECTIONS BETWEEN LAND AND SEA
WHAT WE DO IN OUR CATCHMENT AFFECTS THE REEF
One of the most immediate threats to the health of the Great Barrier Reef is runoff from the land. The way we use our catchments affects the health of local waterways, and ultimately the Great Barrier Reef. Much is being done to look after our waterways and you can find out more from the "ARE YOU CONNECTED" booklet that came with this poster.