



I would like to begin by acknowledging the *Baiyungu, Thalanyji and Yinikurtura* people, the traditional owners of the Ningaloo region, and pay our respect to their Elders past and present.



# Shallow reefs

*Improved understanding of ecological processes*

# *High rates of erosion on a wave exposed Eastern Indian Ocean fringing reef*

Damian Thomson, Shannon Dee, Chris Doropoulos, Melanie Orr,  
Andrew Hoey, Shaun Wilson



# Why is erosion important?

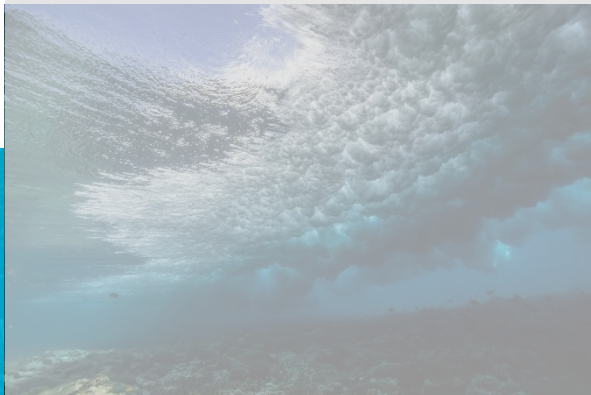


Why is erosion important?

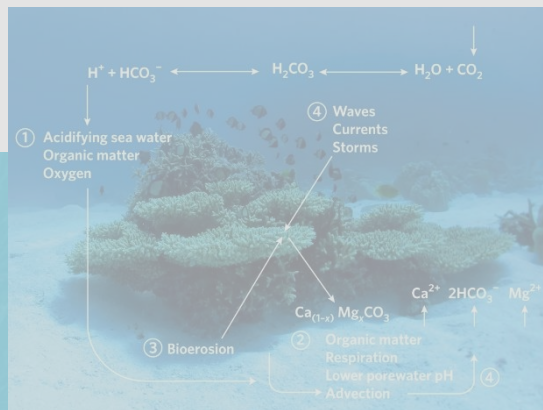


# Mechanisms of erosion

## Physical



## Chemical



## Biological



# Types of bioerosion: external versus internal

## External



Scrape the surface while feeding  
Up to 90% all bioerosion

## Internal



Bores into the reef  
Up to 50% all bio-erosion

# Challenges with measuring bioerosion

## External



## Internal



Large variability  
Interactions between processes  
Much occurs beneath the reef surface



# Methods to measure bioerosion

## Indirect estimates



Abundance x activity = erosion ( $\text{kg}/\text{m}^2/\text{yr}$ )

## Direct measurements



Volume removed = erosion ( $\text{kg}/\text{m}^2/\text{yr}$ )

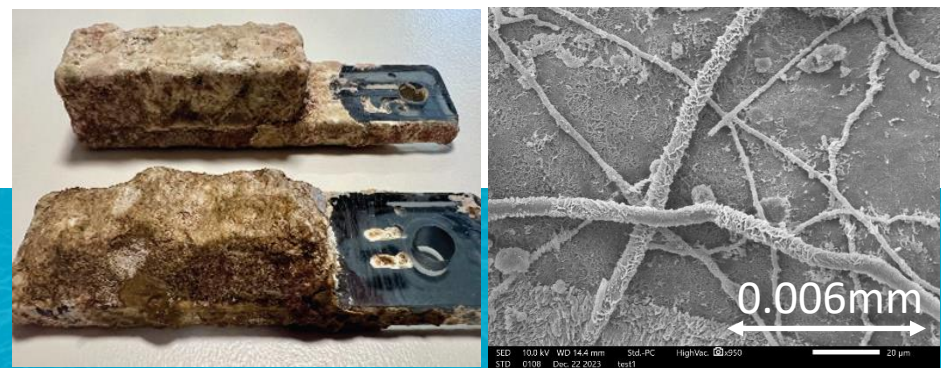
# Advantages and disadvantages

## Indirect



- Use traditional data sources
- Scalable to reef
- Large variability

## Direct



- Very precise
- Captures small organisms
- Invasive, expensive, time consuming

# Most studies use only one method

**Elevated Colonization of Microborers at a Volcanically Acidified Coral Reef**  
Ian C. Enochs<sup>1,2\*</sup>, Derek P. Manzello<sup>2</sup>, Aimee Tribollett<sup>2</sup>, Lauren Valentino<sup>1,2</sup>, Graham Kolodziej<sup>1,2</sup>, Emily M. Donham<sup>3,4\*</sup>, Mark D. Fritchett<sup>1</sup>, Renee Carlton<sup>1,2</sup>, Nichole M. Price<sup>6</sup>

**Initial Colonization, Erosion and Accretion on Coral Substrate**  
Experimental Results, Lizard Island, Great Barrier Reef  
Peter J. Davies and Patricia A. Huichings  
Bureau of Mineral Resources, Geology and Geophysics, P.O. Box 378, Canberra A.C.T. 2601, and Australian Museum, Sydney, Australia

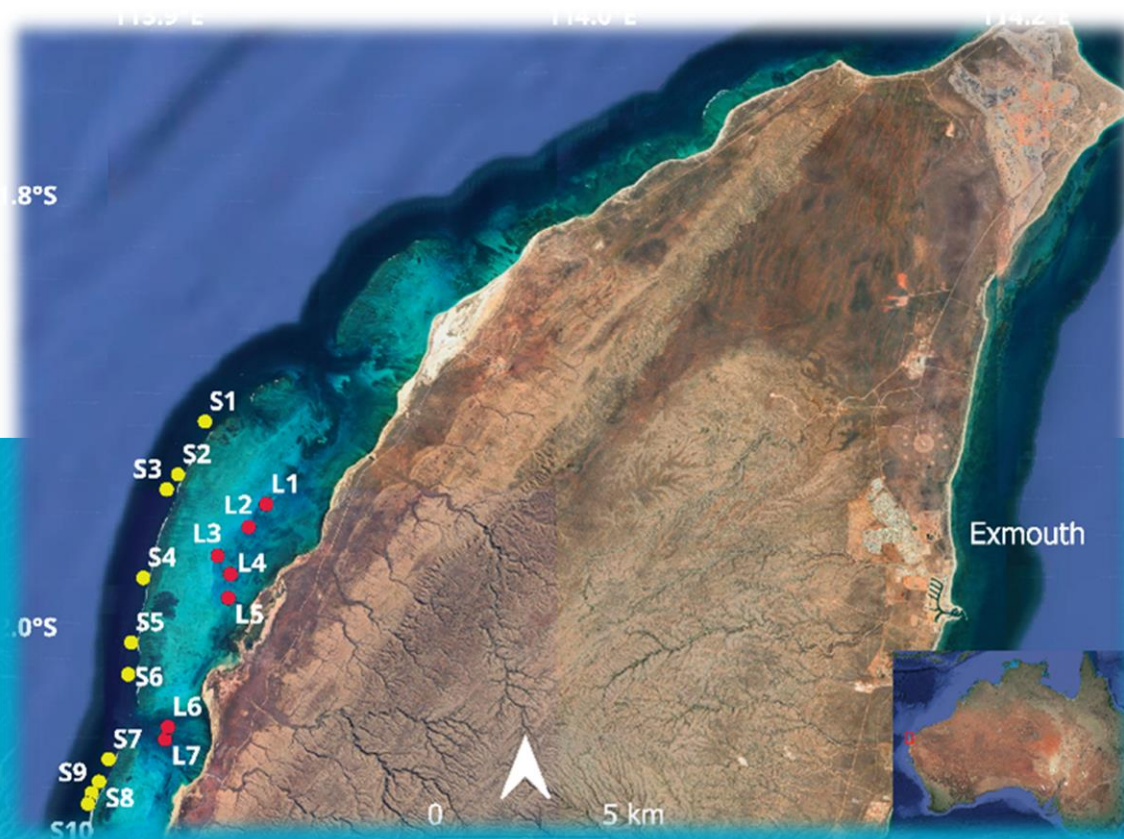
**Distribution, abundance and bioerosion of the grazing sea urchin *Echinometra mathaei* at Ningaloo Marine Park, Western Australia \***  
M W LANGDON<sup>1</sup>, M VAN KEULEN<sup>1</sup> & E IPALING<sup>2</sup>  
<sup>1</sup>School of Biological Sciences & Biotechnology, Murdoch University, South Street, Murdoch, WA, 6150, Australia.  
<sup>2</sup>Shirair Knight Merz 303 Adelaide Terrace, Perth, WA 6001, Australia.  
Corresponding author: [m.w.langdon@murdoch.edu.au](mailto:m.w.langdon@murdoch.edu.au)

**Direct estimate of bioerosion by two parrotfish species, *Chlorurus gibbus* and *C. sordidus*, on the Great Barrier Reef**  
D. R. Bellwood

**Quantifying endolithic bioerosion rates on remote coral reefs in the Central Indian Ocean**  
Jake E. Lloyd Newman<sup>1</sup>, Ines D. Lange<sup>1</sup>, Chris T. Perry<sup>1</sup>

Great Reef (2023) 4:21 1162-1173  
<https://doi.org/10.1007/s44238-023-00230-5>  
REPORT

# Integrated estimate of erosion at Ningaloo



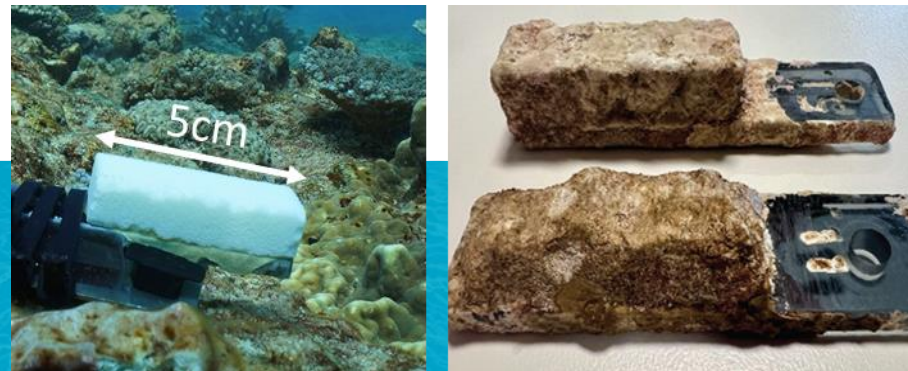
17 sites, 3 years (2019, 2020 and 2021)

# Data collected using two methods

## Indirect estimates



## Direct estimates

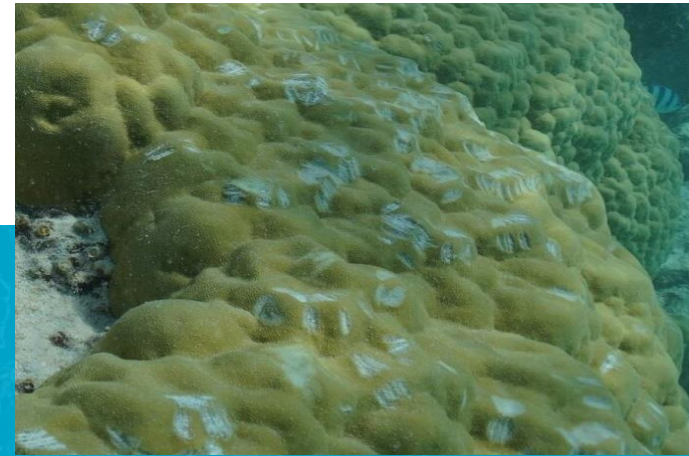
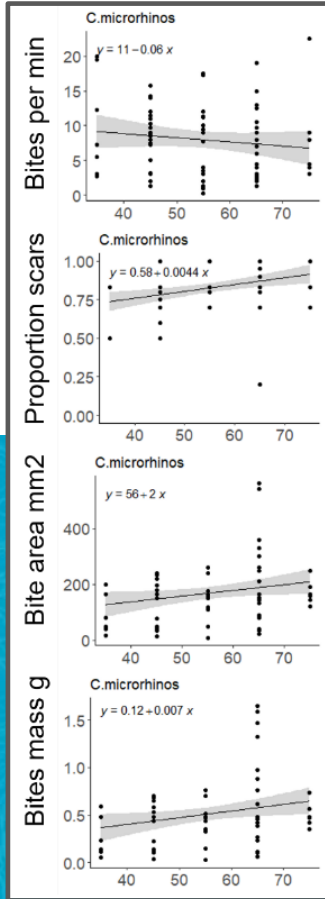




1000 Parrotfish counted, 6 spp  
300 Parrotfish, > 10,000 bites



# Parrotfish – bite mass equations



# Urchins

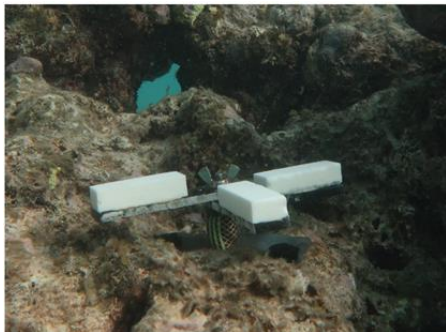


9000 Urchins counted, *Echinometra* and *Echinostrephus*  
Feeding rate 0.13 kg/m<sup>2</sup>/yr (Langdon 2012)

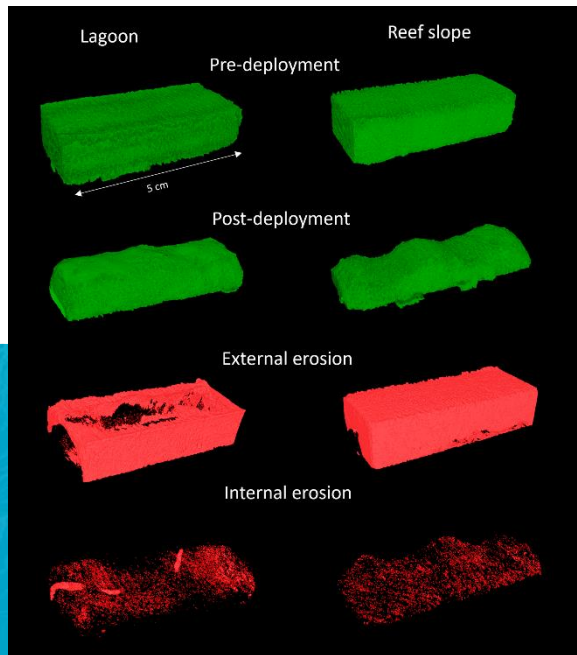


# Coral blocks

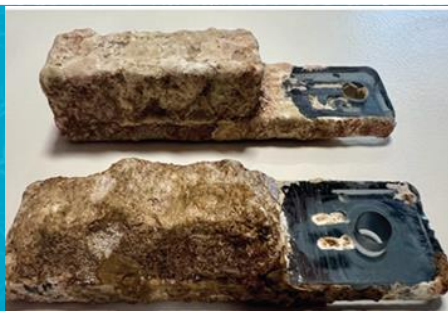
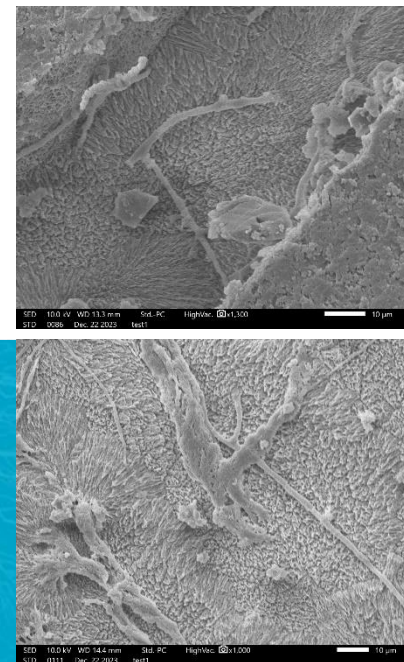
## 51 blocks deployed



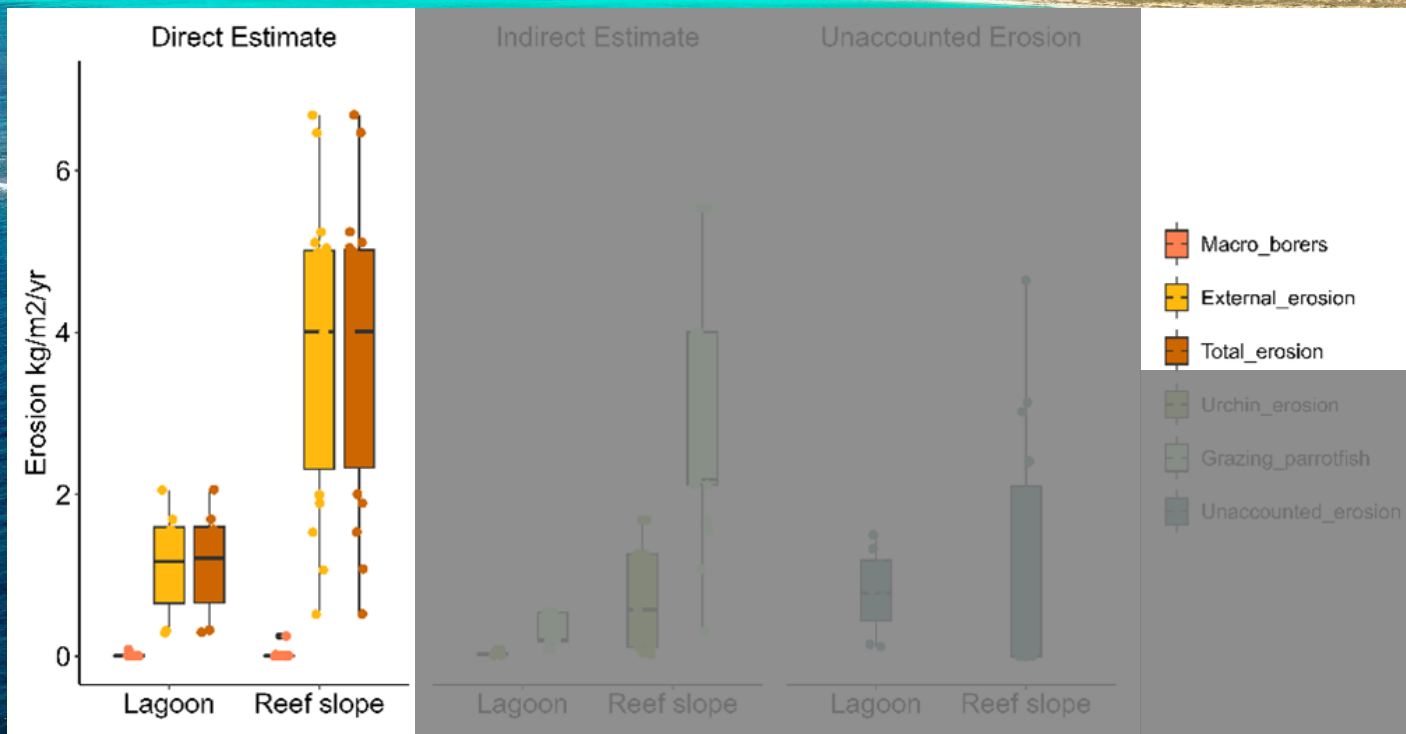
## CT scan >35 micron



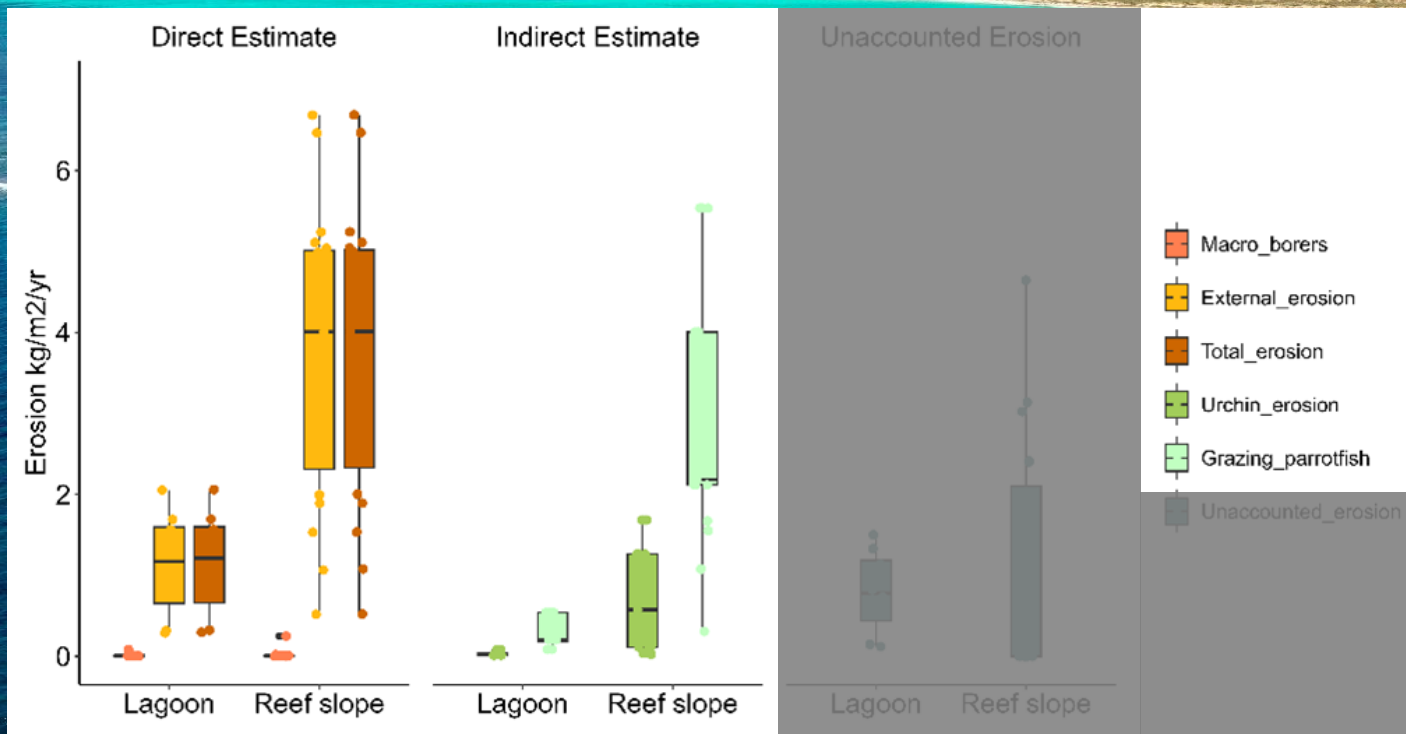
## SEM scan <35 micron



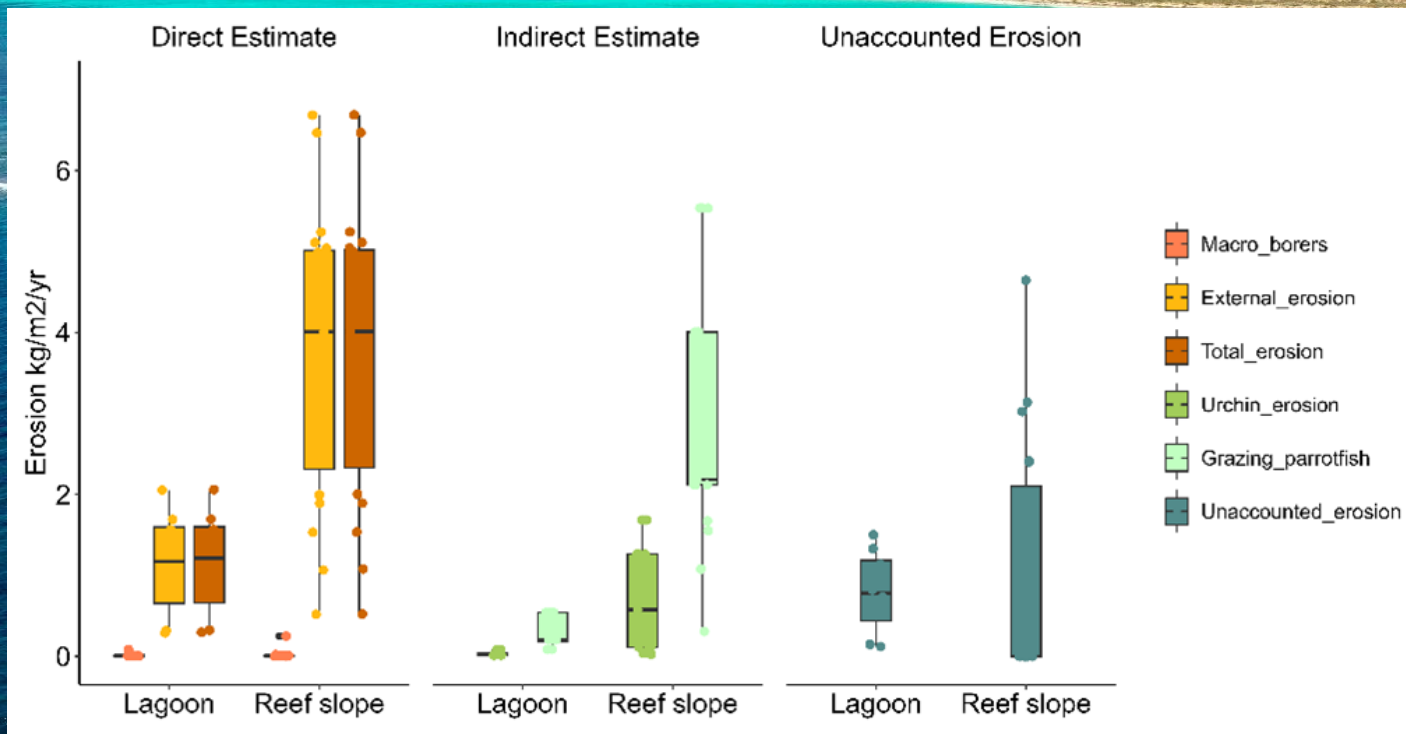
# Results



# Results



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# Conclusions

- High erosion rates  $3.07 \text{ kg/m}^2/\text{yr}$ 
  - Reef slopes higher erosion
- Large *Chlorurus microrhinos* primary bioeroder
  - Internal erosion rates low
- Significant part of erosion unaccounted



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## Loss of coral reef growth capacity to track future increases in sea level

[Chris T. Perry](#), [Lorenzo Alvarez-Filip](#), [Nicholas A. J. Graham](#), [Peter J. Mumby](#), [Shaun K. Wilson](#), [Paul S. Kench](#), [Derek P. Manzello](#), [Kyle M. Morgan](#), [Aimee B. A. Slangen](#), [Damian P. Thomson](#), [Fraser Januchowski-Hartley](#), [Scott G. Smithers](#), [Robert S. Steneck](#), [Renee Carlton](#), [Evan N. Edinger](#), [Jan C. Enochs](#), [Nuria Estrada-Saldívar](#), [Michael D. E. Haywood](#), [Graham Kolodziej](#), [Gary N. Murphy](#), [Esmeralda Pérez-Cervantes](#), [Adam Suchley](#), [Lauren Valentino](#), [Robert Boenish](#), [Margaret Wilson](#) & [Chancey Macdonald](#)

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# Thank you

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- *Malcolm McCulloch for Porites sp. skeletons*
- *DBCA staff for assisting with field logistics.*