

# Linking thermal history and population dynamics in a common coral

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## INTRODUCTION

Coral reefs are severely impacted by marine heatwaves which are becoming more frequent and severe. The response of corals to heat stress often varies temporally and spatially as a result of variation in thermal histories. This study centres on the contrast in thermal histories of two distinct regions in Palau, discerned from 36 years of temperature data. Hotspots situated in the southwest endure persistent heat stress, while thermal refugia in the northern areas experience comparatively lower levels of heat stress exposure. Notably, bleaching resistance and colony size for the common coral, *Acropora digitifera*, were both higher at thermal refugia. To unravel the drivers of these trends requires more detailed information on population dynamics.

## AIMS

- To investigate observed spatial and temporal patterns of coral populations in Palau, specifically focused on the common reef builder, *Acropora digitifera*, utilizing photographic data collected over two years.
- Consider the factors influencing population dynamics that result in smaller colonies at hotspots compared to refugia.

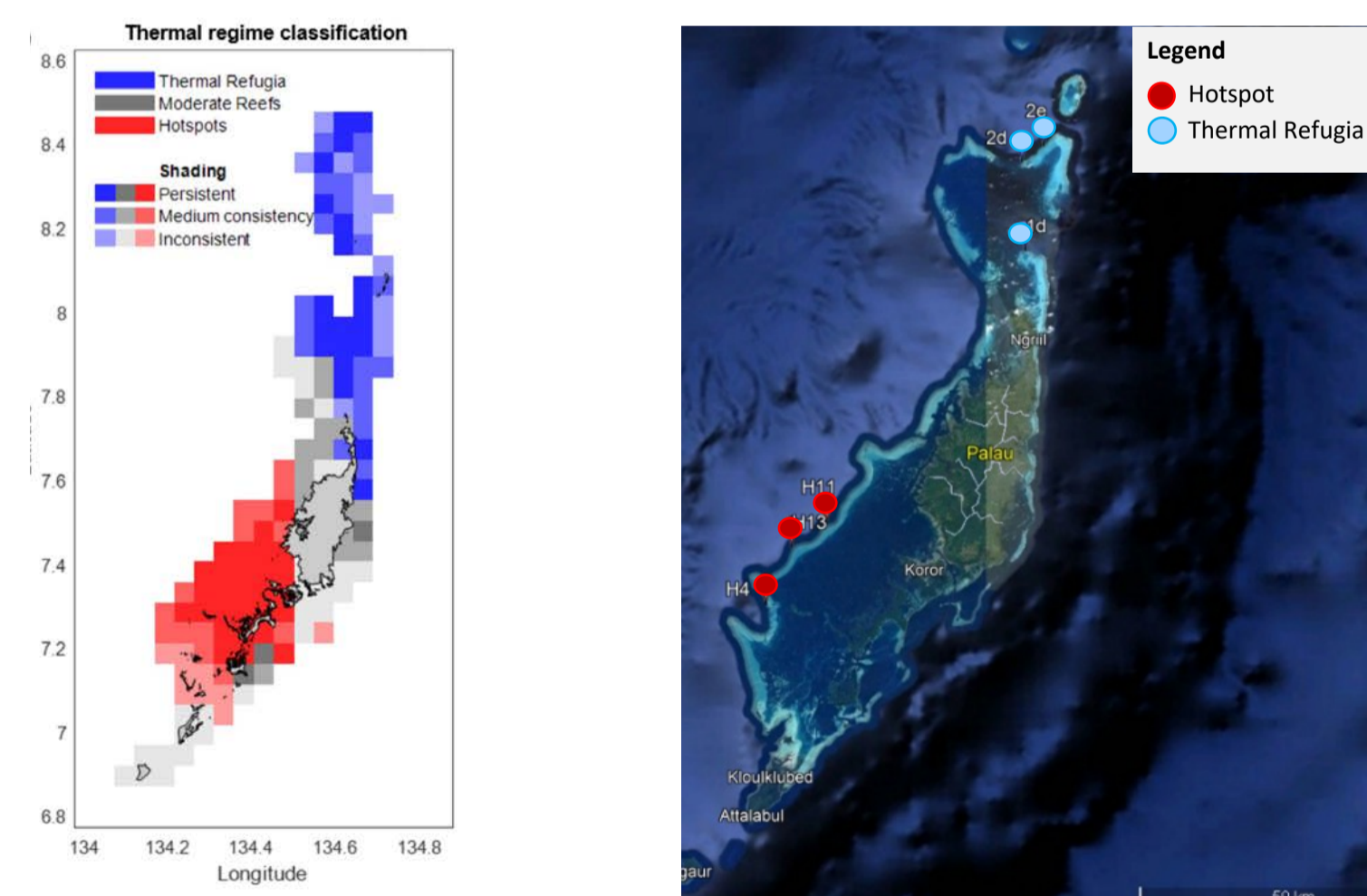


Fig 1 (above left): showing the thermal regime classification [1], Fig 2 (above right): Satellite image of a map of Palau showing the 6 sites selected. Red circles indicate the hotspot areas and blue show the thermal refugia (cold) sites.

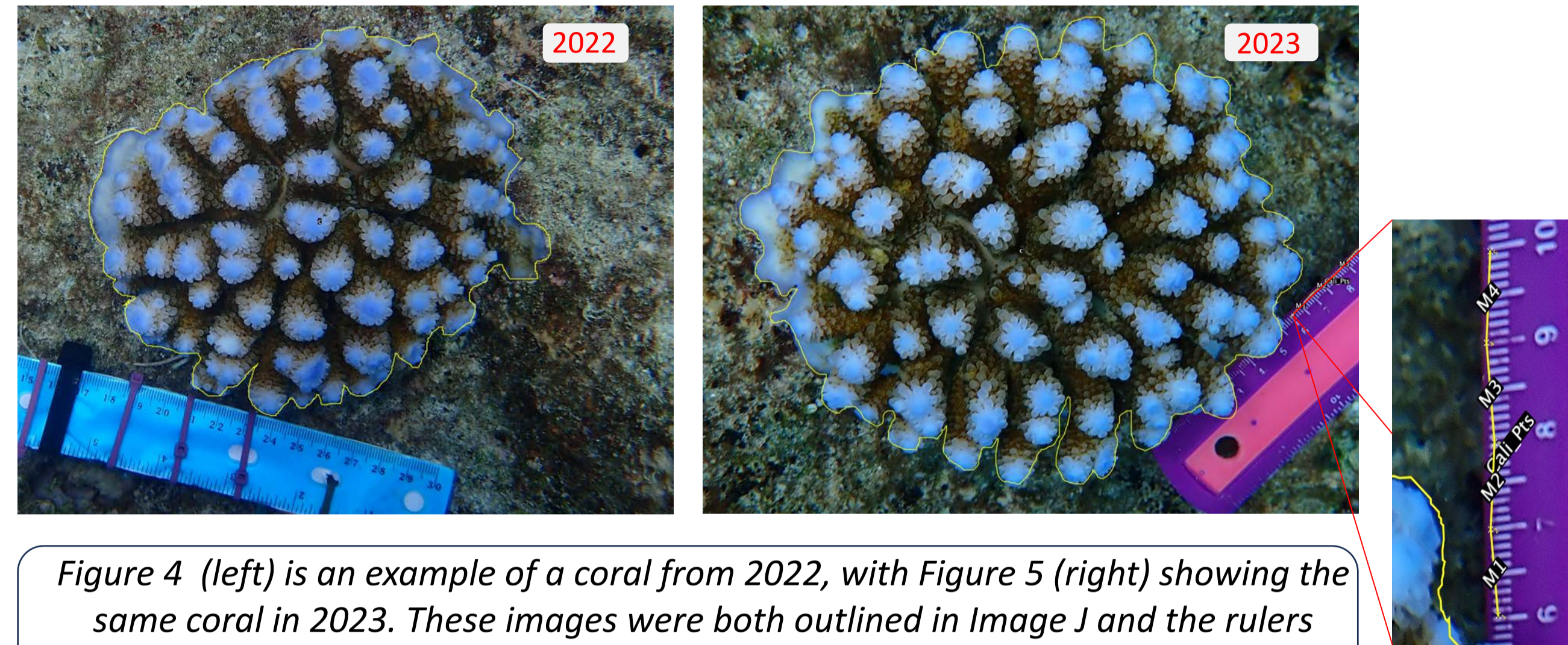


Figure 4 (left) is an example of a coral from 2022, with Figure 5 (right) showing the same coral in 2023. These images were both outlined in Image J and the rulers were used to calibrate the images (using a calibration of 1cm).

## METHODS

- Match up corals in the photographic data over the two years.
- Use software called Image J to process the coral by outlining and calibrating the images.
- Use SizeExtractR code [2] to extract data from Image J.
- Use python to analyze the data through creating box plots and comparing means using t-tests and ANOVA paired to Tukey's test.

Figure 3 (below): Showing an example of the *Acropora digitifera* coral species, characterized via small and thin branches with brightly colored blue tips.



## DISCUSSION

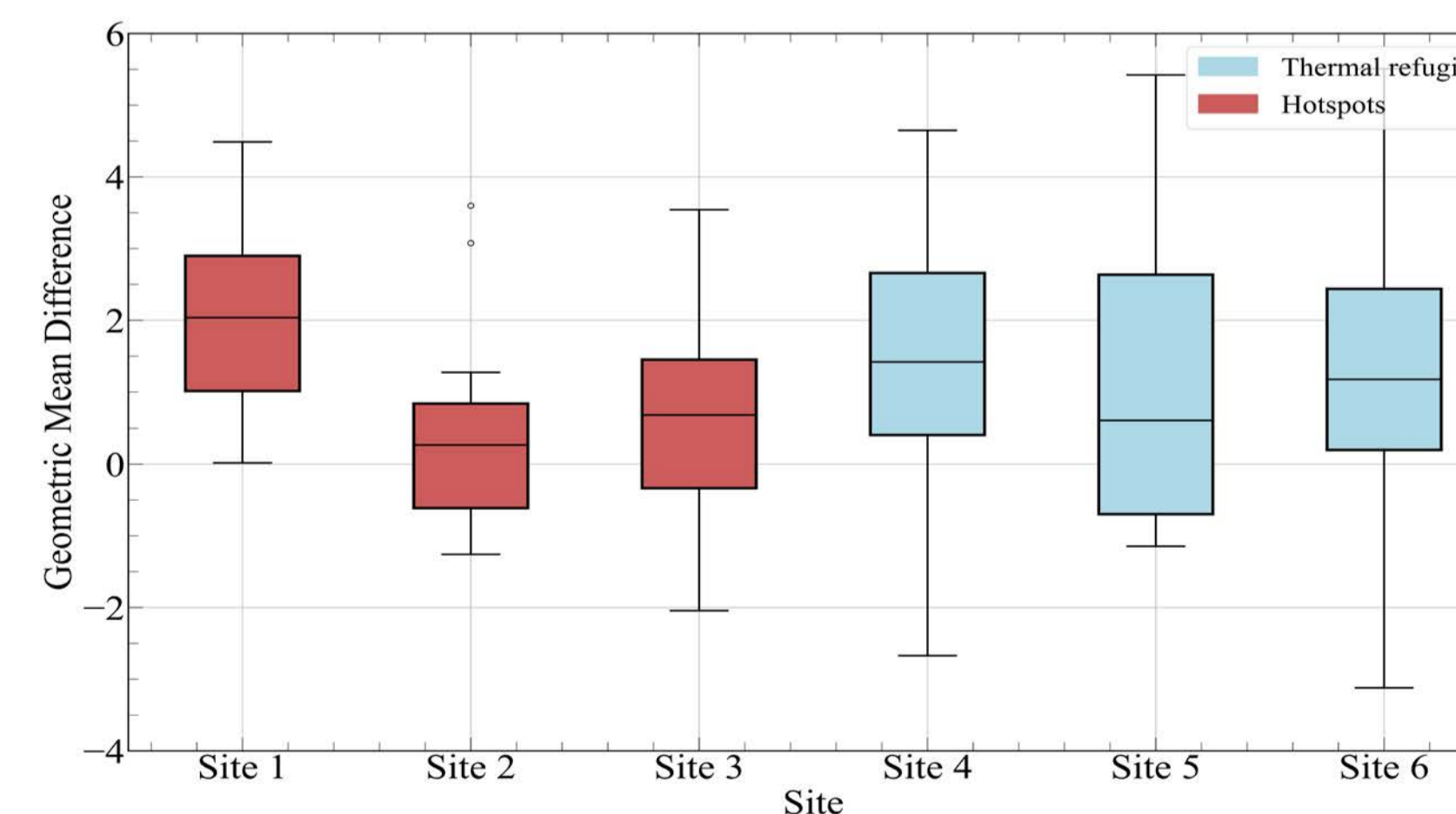
- Although the corals in refugia were larger than in the hotspots ( $P < 0.05$ ), there was no statistically significant difference in growth rates between the sites. This implies that the corals in the hotspots are most likely younger than the corals in the refugia. This could be due to either of the following reasons:
  - There was a mass disturbance recently meaning the corals are in recovery phase,

or

- The overall mortality rates are higher at hotspot sites, so the corals are not living as long and due to this do not reach such large sizes compared to the refugia corals.

## RESULTS

Figure 6: Geometric mean diameter size difference between 2022 and 2023 for each site.



**Geometric mean definition:** Measures central tendency by averaging set of products [3], useful here as the shapes of the corals are irregular

## CONCLUSION

- Given that *Acropora digitifera* colonies are displaying consistent growth rates across all sites but are smaller at hotspot locations, it suggests either recovery from a past significant disturbance or elevated rates of background mortality for the corals.
- Refugia sites seem to embody an overall more nurturing environment for this coral type.

## ACKNOWLEDGEMENTS

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## REFERENCES

- [1] Lachs et al (2023) bioRxiv 2023.06.16.545328, doi: <https://doi.org/10.1101/2023.06.16.545328>
- [2] Lachs et al. (2022). 'SizeExtractR': A workflow for rapid reproducible extraction of object size metrics from scaled images.' Ecology and Evolution, 12(3), p.e8724
- [3] Jim Frost, Geometric Mean: Definition, Formula & Finding <https://statisticsbyjim.com/basics/geometric-mean/#comments>