2010-11 mass coral bleaching across 12º of latitude in WA

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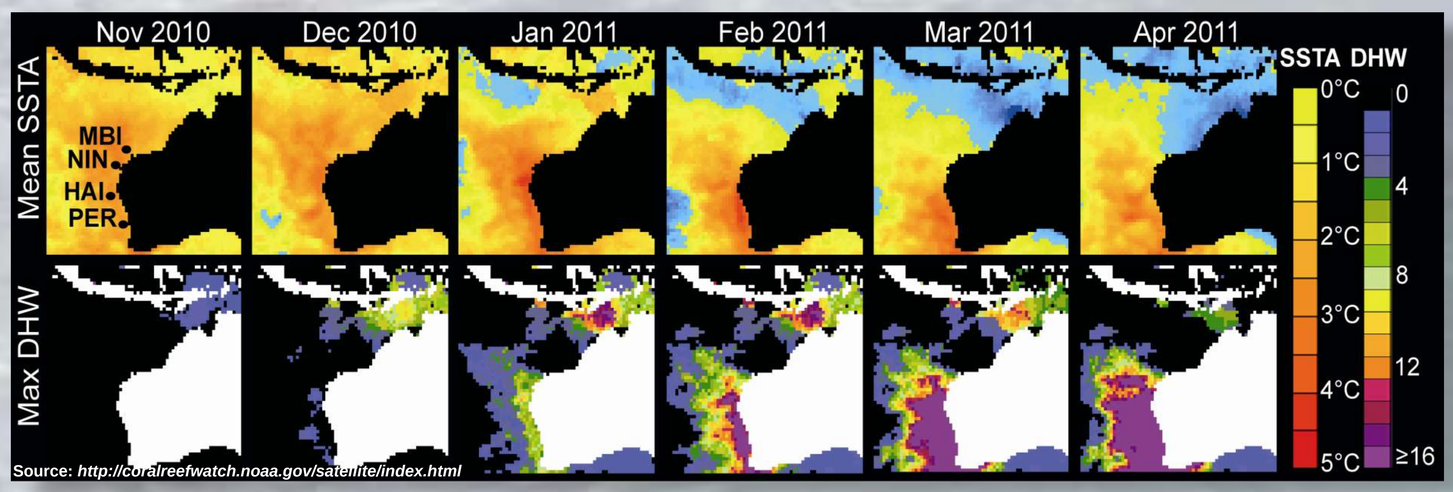

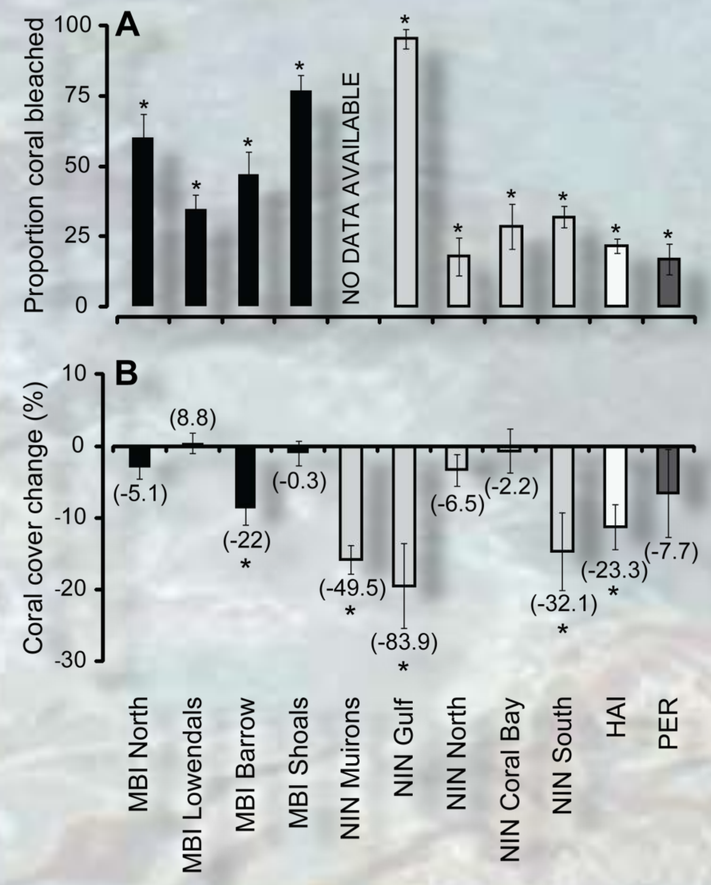

Figures clockwise from left Map of survey sites; sea surface temperature anomalies and degree heating week accumulation during the summer of 2010-11; (**A**) Mean proportion of coral bleached and (**B**) mean change in absolute coral cover (values in parentheses represent proportional change in coral cover). Error bars represent ±1SE. * $p < 0.05$

Introduction Globally, coral bleaching events have become increasingly frequent and widespread over the past two decades **[1]**. Whilst mass bleaching on large spatial scales has previously been recorded in Australia **[2]**, to date no record of such an event exists for coral reefs along the coast of WA.

This study documents the anomalous large-scale ocean warming and subsequent unprecedented levels of coral bleaching across more than 12º of latitude and 1200kms of Western Australian coastline during the summer of 2010-11.

Sea surface temperature and heat stress Strong La-Nina conditions drove anomalously high ocean temperatures during 2010-11. Temperature anomalies (SSTA) were up to 5ºC above long-term averages and peaked successively from tropical to temperate waters driven by an unusually strong Leeuwin Current. Maxima were attained in January 2011 for the Montebello/Barrow Islands and Ningaloo, February 2011 for the Houtman-Abrolhos Islands and March 2011 for Perth. Thermal stress to corals measured as Degree Heating Weeks (DHW) were ≥16 for most of the WA coast from February until at least the end of April and well exceeded thresholds that are normally associated with mass bleaching (DHW ≥ 4ºC weeks) and mortality (DHW ≥ 8ºC weeks).

Coral bleaching and coral cover change High to extreme levels of coral bleaching were recorded at all locations and ranged from 17% in Perth to 95% on reefs of the Exmouth Gulf in the Ningaloo Marine Park. Bleaching was highest in the northern region of our study, with lower levels recorded between the western side of Ningaloo and Rottnest Island and Hall Bank adjacent to Perth. Change in coral cover was spatially variable with significant declines in coral cover recorded for five of 11 surveyed locations. Coral loss was greatest across Ningaloo and ranged between -2.2% and -83.9% from pre-bleaching levels. Significant losses of coral were also recorded at Barrow Island and the Houtman-Abrolhos Islands. For further details see **[3]**.

Significance and conclusions The anomalous thermal stress of 2010-11 induced the first mass bleaching event recorded for WA coral reefs. Notably, significant coral bleaching was observed at multiple locations across the tropical-temperate divide spanning more than 1200kms of coastline. Resultant spatially patchy loss of coral cover under widespread and high levels of bleaching indicate that WA corals are potentially resilient. However, the spatial extent of bleaching casts some doubt over hypotheses suggesting that future impacts to coral reefs under forecast warming regimes may in part be mitigated by southern thermal refugia.

[1] Wilkinson CR (2008) Status of coral reefs of the world: 2008. Townsville, Australia: Global Coral Reef Monitoring Network and Reef and Rainforest Research Centre. 296 pp.
[2] Berkelmans R, De'ath G, Kininmonth S, Skirving WJ (2004) A comparison of the 1998 and 2002 coral bleaching events on the Great Barrier Reef: spatial correlation, patterns, and predictions. Coral Reefs 23: 74–83. doi:10.1007/s00338-003-0353-y.
[3] Moore J. A. Y., Bellchambers, L. M., Depczynski, M. R. and 13 others (*in review*) Unprecedented mass bleaching and loss of coral across 12º of latitude in Western Australia in 2010/11. *PLoS ONE*

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