

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

James Moore¹, Lynda Bellchambers², Martial Depczynski³, Richard Evans^{1,4}, Scott Evans², Stuart Field^{1,4}, Kim Friedman^{1,4}, James Gilmour^{3,4}, Thomas Holmes^{1,4}, Rachael Middlebrook⁵, Ben Radford^{3,4}, Tyrone Ridgway^{3,4}, George Shedrawi¹, Heather Taylor⁶, Damian Thomson⁷, Shaun Wilson^{1,4}

¹ Marine Science Program, Department of Environment and Conservation, Kensington, Western Australia, Australia

² Biodiversity and Biosecurity Branch, Department of Fisheries WA, Hillarys, Western Australia, Australia

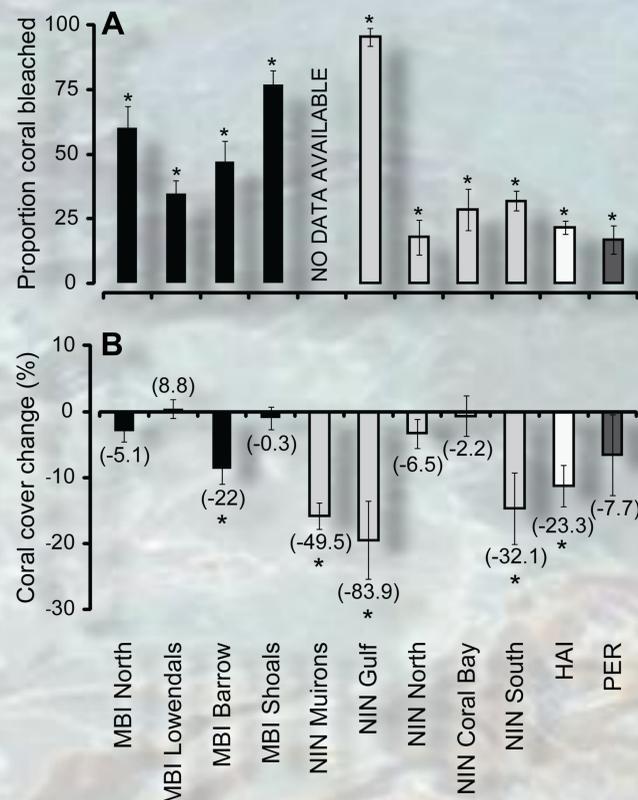
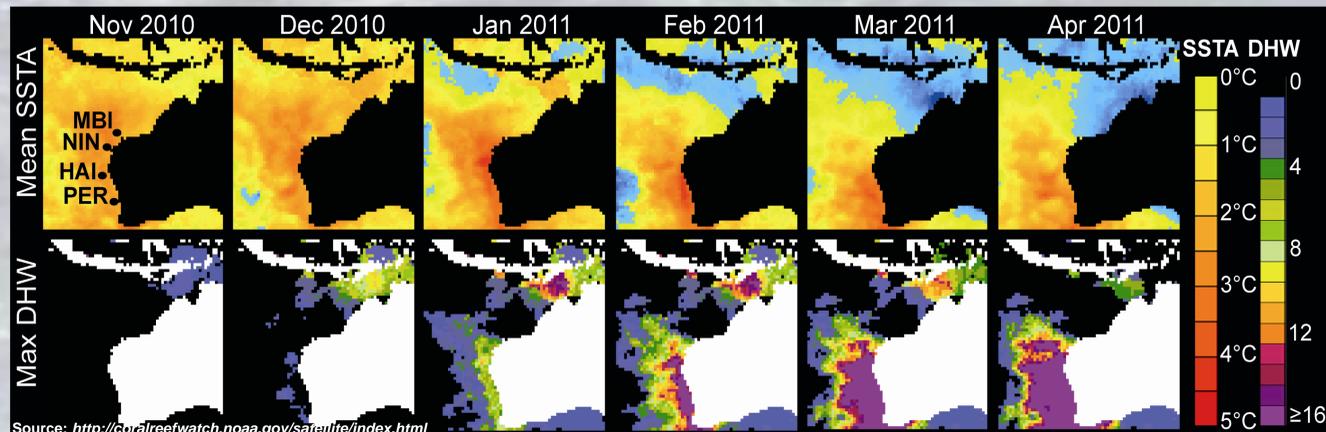
³ Australian Institute of Marine Science, Crawley, Western Australia, Australia

⁴ The Oceans Institute, University of Western Australia, Crawley, Western Australia, Australia

⁵ Pilbara Regional Services, Department of Environment and Conservation, Karratha, Western Australia, Australia

⁶ Pilbara Regional Services, Department of Environment and Conservation, Exmouth, Western Australia, Australia

⁷ Marine and Atmospheric Research, CSIRO, Floreat, Western Australia, Australia



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 $\pm 1SE$. * $p < 0.05$

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].

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 12° 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 5°C 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 $\geq 4^\circ\text{C}$ weeks) and mortality (DHW $\geq 8^\circ\text{C}$ weeks).

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] Berkemans 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 12° of latitude in Western Australia in 2010/11. *PLoS ONE*

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