Response of the coral *Plesiastrea versipora* to simulated marine heatwaves

Tessa Ramshaw

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Under the Supervision of
Thomas Wernberg[a] and Chenae Tuckett[a]
[a] School of Biological Sciences, The University of Western Australia

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Abstract

The ongoing rate of warming and extreme climatic events attributed to anthropogenic climate change is driving ecological systems towards irreversible transformations. In marine systems, the occurrence of marine heatwaves (MHWs), periods of prolonged, discrete and anomalously warm seawater, has had deleterious impacts on coral assemblages worldwide. Climate projections for the 21st century foresee an increase in the intensity and frequency of MHWs as a result of anthropogenic climate change. Under these conditions, incidences of thermal stress and coral bleaching may spread over larger geographic areas, into localities previously unaffected by mass bleaching events. In 2010/11, the southeast Indian Ocean experienced the highest intensity MHW ever recorded along coastal margins of Western Australia. Associated with this heatwave were unprecedented records of coral bleaching and mortality across 12° latitude, signifying coral assemblages are at risk of ocean warming irrespective of their latitudinal position. The present study investigated the temperature-response of the coral *Plesiastrea versipora*, which is common to Australian subtropical and temperate reefs to MHWs of increasing intensity. The study aimed to identify coral performance under thermal stress, providing a better understanding of their abilities to withstand acute climatic events. It was hypothesised that coral performance would decline with increasing heatwave intensity. Multivariate analyses of coral responses found heatwave intensities of 26°C and above significantly reduced coral performance. All corals at 28°C and 30°C underwent a complete loss of physiological functions, leading to mortality after 35 and 15 days, respectively. Corals maintained at 26°C showed gradual declines in performance after 44 days and is expected that if elevated temperatures were maintained for longer, this decline would have triggered a cascading effect leading to lethal responses. A four degree increase in temperature at 24°C did not significantly affect coral performance, suggesting this is the upper thermal threshold of *P. versipora.* These responses provide an important baseline against which the impact of future MHWs can be measured. With temperatures expected to reach unprecedented highs in the future, this study shows coral assemblages from southwest Australia are susceptible to widespread bleaching and mortality, capable of triggering rapid phase-shifts.

Keywords: Marine heatwaves, Coral bleaching, High-latitude, Western Australia, *Plesiastrea versipora*