

Rapid Increases in Tolerance of Surviving Corals Across Extreme Heatwaves

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Climate change poses an existential threat to coral reefs as mass bleaching and mortality from marine heatwaves become more frequent and severe. Understanding how corals respond to recurrent heatwaves, and in particular whether heat tolerance increases in the surviving community, is critical for forecasting reef futures, but suffers from a lack of data. Here, we used observations of >59,000 individual corals in Florida to assess bleaching responses across three marine heatwaves in the last decade, including the most extreme on record in 2023. We found significant variation in current heat tolerance within and among species, with bleaching thresholds ranging from <2 to >20 degree heating weeks (DHWs). Moreover, we found that median bleaching thresholds increased from 3.9 DHWs in 2014 to 11.5 in 2023, reflecting an increase in heat tolerance of 0.96°C in under a decade—ten times higher than previous estimates. Species experiencing larger population declines and hosting higher symbiont diversity showed even greater increases (up to 1.6°C), indicating that differential mortality and symbiont shifts are driving these rapid gains. Despite bleaching of up to 90% of corals in 2023, these findings reveal the potential for unanticipated rapid responses to warming on depleted reefs, which may extend the survival window for remaining corals and stimulate action to maximize reef resilience until climate stabilization.