Time and local geography determine long-term coral responses to recurrent mass mortalities in densely populated atolls

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Abstract

A quarter century after the 1998 El Niño, it is still difficult to predict how individual reefs will respond to recurring disturbances. Reports differ on the relative importance of anthropogenic influences, local geography and bleaching recurrence in determining resistance and recovery. It is assumed that coral traits largely determine winners and losers, based on bleaching susceptibility, recruitment, survival and growth. Whether this translates to the long-term fates of corals on reefs is still debated. We tracked multi-decadal coral compositional changes in reefs across the densely populated Lakshadweep Archipelago to explore how global bleaching events and local geographical factors (depth and wave exposure) influenced responses to repeated mass bleaching. Coral resistance increased with recurrent bleaching, uninfluenced by local geography. However, wave exposure regimes positively influenced recovery rates, given sufficient time between mortality events (>7 years). The overall trajectory though, was of protracted decline interspersed with periods of halting recovery, with many losers, and few resistant genera that lose less. Based on these responses, we identified six community clusters that describe contrasting long-term responses to local and global factors. Interestingly, genera with different functional traits cluster together, sharing similar fates, as a result of complex interactions between bleaching susceptibility, local geography and inter-bleaching intervals. These clusters provide a clear site-specific predictive framework of long-term community change, indicating that geography, community and time largely determine local responses to climate disturbances.

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