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TITLE: Host adaptation and unexpected symbiont partners enable reef-building corals to tolerate extreme temperatures

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ABSTRACT:

Understanding the potential for coral adaptation to warming seas is complicated by interactions between symbiotic partners that define stress responses and the difficulties of tracking selection in natural populations. To overcome these challenges, we characterized the contribution of both animal host and symbiotic algae to thermal tolerance in corals that have already experienced considerable warming on par with end-of-century projections for most coral reefs. Thermal responses in *Platygyra daedalea* corals from the hot Persian Gulf where summer temperatures reach 36°C were compared with conspecifics from the milder Sea of Oman. Persian Gulf corals had higher rates of survival at elevated temperatures (33 and 36°C) in both the nonsymbiotic larval stage (32-49% higher) and the symbiotic adult life stage (51% higher). Additionally, Persian Gulf hosts had fixed greater potential to mitigate oxidative stress (31-49% higher) and their Symbiodinium partners had better retention of photosynthetic performance under elevated temperature (up to 161% higher). Superior thermal tolerance of Persian Gulf vs. Sea of Oman corals was maintained after 6-month acclimatization to a common ambient environment and was underpinned by genetic divergence in both the coral host and symbiotic algae. In *P. daedalea* host samples, genomewide SNP variation clustered into two discrete groups corresponding with Persian Gulf and Sea of Oman sites. Symbiodinium within host tissues predominantly belonged to ITS2 rDNA type C3 in the Persian Gulf and type D1a in the Sea of Oman contradicting patterns of Symbiodinium thermal tolerance from other regions. Our findings provide evidence that genetic adaptation of both host and Symbiodinium has enabled corals to cope with extreme temperatures in the Persian Gulf. Thus, the persistence of coral populations under continued warming will likely be determined by evolutionary rates in both, rather than single, symbiotic partners.

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