**Coral resilience to unprecedented heat stress**

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**Summary**

**Main text**

Here, we provide the first evidence that corals have the capacity to regain their symbionts and recover from bleaching while still under intense thermal stress (Figure 1b, 2ab).

-Figure 2 paragraph - rare symbionts save the day!!

Global climate change is superimposed on a suite of local stressors on coral reefs ranging from overfishing to pollution. Coral reef management has typically focused on minimizing local stressors, through marine protected areas that restrict fishing pressure or limiting agricultural runoff and sewage inputs, rather than attempting to directly mitigate underlying climate stressorsbut see vanOppen et al. 2015 PNASetc.etc. Local management measures can significantly enhance reef recovery rates following bleaching events, for example, by protecting populations of herbivorous fishes which indirectly provision space for new coral recruits by mediating competition between coral and macroalgae. What is unclear is if local management can also influence coral resistance to heat stress, and if so via which mechanisms. Coral bleaching and mortality on the Great Barrier Reef during the 2015-2016 El Niño event occurred irrespective of local protection, with no detectable differences across water quality or fishing pressure levelsHughes et al. 2017. –plus Emily’s paper showing protection in Kenya didn’t matter either –describe other studies that may have provided evidence that local protection does enhance resistance (Carilli? Etc) – but the mechanism was still unknown. –then a sentence describing what is known about how local protection influences symbiodinium communities. –then BOOM! Our findings (evidence PLUS the mechanism because we rock)!!!

Notes:

-it has been unclear via what mechanism local protection would enhance coral resistance to heat stress – Here, we show that it does enhance coral resistance to heat stress \*\*AND\*\* we show the mechanism of how it does so.

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**Author Contributions**: D.C.C., R.D.G.., and J.K.B. planned the project, D.C.C., K.L.T. and J.K.B. collected the data and conducted lab analyses. D.C.C. conducted the bioinformatics and statistical analyses. More to come here on interpreting results, writing, editing……

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**Figure 1 | Thermal stress experienced by corals, and the transition of one such coral from healthy – bleached – recovered, at the epicentre of the 2015-2016 El Niño event. a.** Degree Heating Weeks (DHW), on Kiritimati Island over the course of the 2015-2016 El Niño event. Corals are sensitive to temperatures warmer than 1°C above their normal highest summertime mean sea surface temperature (SST), known as the bleaching threshold. DHW shows how much heat stress has accumulated in an area over the past twelve weeks by summing any temperature exceeding the bleaching threshold during that period. Horizontal lines show expected bleaching severity levels: 4°C (yellow line), NOAA Coral Reef Watch (CRW) Bleaching Alert Level 1 (significant bleaching likely); 8°C (light orange line), Bleaching Alert Level 2 (widespread bleaching and mortality may occur); 12°C (dark orange line), ‘mass coral mortality’ expected to occur (Hoegh-Guldberg 2011); 24°C (dark red line) ‘not experienced by reefs yet’ (Hoegh-Guldberg 2011). Solid black line indicates *in situ* calculated DHW, and fill colors correspond to bleaching severity levels. Dashed vertical gray lines show the six sampling time points. **b.** Photographs of the same tagged *Platygyra* coral colony (#99), from the six time points (dashed grey lines), showing the initially healthy colony (i-ii) bleached after two months of heat stress (iv), ‘recovered’ to a normal brown colour after ten months of heat stress (v), and still alive six months post heat stress (vi).

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**Figure 2 | Shift in *Symbiodinium* community composition from clade C to clade D dominance over the course of the 2015-2016 El Niño. a.** *Symbiodinium* community composition at each of five sampled time points for **a.** the entire pool of tagged *Platygyra* coral colonies (n= X - Y colonies per time point). **b.** a single representative tagged *Platygyra* colony.

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Figure 3 |

a. [Danielle to write this one: - will be the Constrained ordination plot showing groupings of *Symbiodinium* communities from individual *Platygyra* colonies, grouping into two distinct areas according to level of local disturbance….]; b. Bar plots showing *Symbiodinium*community composition for individual *Platygya* colonies at a single time point prior to the heat stress, from sites with high (top) and low (bottom) levels of local disturbance levels.]

Potentially fit the symbiodinium network plot in here as two subpanels.

**[insert extended data figure 1 here]**

**Extended Data Figure 1 | Transition of individual tagged coral colonies on Kiritimati Island from healthy – bleached – recovered over the course 2015-2016 El Niño event.** Photographs of **a.** *Favites* pentagona, **b.** *Favia mathii*, **c.** Hydno??? taken prior to (i-iii), during (iv-v) and after (v) the the heat stress. Roman numerals (i-vi) align with those in Figure 1.

**Extended Data Figure 2 |** Potentially the rank abundance plot for Platy…..