**Coral resilience to unprecedented heat stress**

Danielle C. Claar1, Kristina L. Tietjen1, Ruth D. Gates2, Julia K. Baum1,2

Institute: 1 Department of Biology, University of Victoria, PO Box 1700 Station CSC, Victoria, British Columbia, V8W 2Y2, Canada; 2 Hawaii Institute of Marine Biology, 46-007b Lilipuna Road, Kaneohe, HI 96744, USA

Corresponding Author: Danielle C. Claar, Tel: (208) 250-0161, Email: [dclaar@uvic.ca](mailto:dclaar@uvic.ca)

Keywords: coral bleaching, El Niño, heat stress, climate change, resilience, Symbiodinium, symbiosis

**Summary**

**Main text**

**Acknowledgements** Thanks to H. Putnam and R. for discussions about *Symbiodinium* and bioinformatics, J. Davidson for logistical and lab support, A. Eggers for molecular sequencing, and anyone else? DCC acknowledges scholarship support from an NSERC Vanier Canada Graduate Scholarship, as well as funding from the American Academy of Underwater Sciences, International Society for Reef Studies, National Geographic Young Explorers Grant, University of Victoria (UVic), and the Women Divers Hall of Fame, and equipment grants from Sea-Bird Electronics and Diver Alert Network. R.G. and J.K.B. acknowledge support from NSF RAPID (insert grant # here). DCC and JKB acknowledge funding from UVic’s Centre for Asia-Pacific Initiatives. JKB acknowledges support from the Packard Foundation, the Rufford Maurice Laing Foundation, an NSERC Discovery Grant, the Canadian Foundation for Innovation, and the University of Victoria.

**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……

**Author Information**: The authors declare no competing financial interests.

**[input figure 1 file here when we are ready to submit]**

**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).

**[input figure 2 file here when we are ready to submit]**

**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.

**[input figure 2 file here when we are ready to submit]**

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…..