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April 9th, 2023

Dear Dr. Christina Karlsson Rosenthal,

We are excited to submit for your consideration the attached manuscript entitled “Coral thermal stress and bleaching enrich and restructure reef microbial communities via altered organic matter exudation” for publication as an Article in Communications Biology.

Dissolved organic matter (DOM) exudation by healthy corals is an important source of organic carbon for coral reef bacterioplankton. Multiple studies by our research group and others have revealed that corals exude compositionally distinct DOM that enriches unique bacterioplankton communities in both bottle incubations and *in situ* surveys. Extending this to periods of thermal stress and/or bleaching is a high priority for a holistic understanding of how ocean warming will alter reef microbiology and carbon cycling.

The impacts of both elevated temperatures and subsequent bleaching on coral holobiont physiology are well studied, yet comparatively little work has investigated how these stressors might influence DOM fluxes that drive the microbial ecology of the reef ecosystem. Crucial questions include how these stressors influence coral derived DOC flux and DOM composition, and if the microbial impacts of shifting DOM exudation suggest thermally-induced bleaching will feed back to make coral reefs less healthy and even accelerate their degradation. Research in this area is a high priority as coral reefs across the globe experience more frequent and severe marine heatwaves due to global climate change.

We leveraged natural distributions of bleached and unbleached corals in Mo'orea, French Polynesia to address these key questions. Bleached and unbleached corals were exposed to ambient and elevated temperatures in aquaria followed by a DOM exudation experiment and bacterioplankton dark dilution cultures. This novel experiment revealed that the impacts of both short-term thermal stress and long-term bleaching appear to extend beyond the coral holobiont into the water column, altering coral DOC flux and DOM composition, increasing bacterioplankton growth, and enriching for putative pathogens and copiotrophs. Elevated microbial loads and increases in these specific bacterial guilds may negatively impact how coral reefs respond to, and recover from, mass bleaching events. This is, to our knowledge, the first experiment to assess the exudation of DOM by thermally stressed and/or bleached corals and subsequent bacterioplankton growth and community structure changes in a controlled setting. Our data reveal an important and understudied impact of marine heatwaves on coral reef water column biogeochemistry and ecosystem health. We therefore believe this manuscript will be of interest to a diverse array of scientists in academia and beyond, specifically in basic research fields of microbial oceanography, coral reef ecology, and marine biology, but also in conservation fields seeking to understand reef degradation and improve methods to monitor coral reef health and mitigate harmful effects of marine heatwaves. We strongly believe that the

scope and target audience of this manuscript fits extremely well with Communications Biology and we look forward to your decision.

The manuscript and the data underlying it has not been previously published and is not simultaneously submitted elsewhere for publication.

Thank you for your consideration,

Wesley J. Sparagon, on behalf of my coauthors:
Milou Arts and Dr. Andreas Haas from the Royal Netherlands Institute for Sea Research
Zach Quinlan, Dr. Linda Wegley Kelly, Irina Koester, and Dr. Lihini Aluwihare from Scripps Institution of Oceanography
Jacqueline Comstock and Dr. Craig Carlson from University of California Santa Barbara
Dr. Pieter Dorrestein from University of California San Diego
And Jessica Bullington and Dr. Craig Nelson from University of Hawai‘i at Mānoa

Despite this preliminary understanding, many questions remain. Do corals alter the quantity of dissolved organic carbon (DOC) they exude when they are stressed by elevated temperatures? Does the composition of their DOM exudate change? Does this yield a subsequent change in bacterioplankton growth and community structure? And importantly, do these patterns change depending on the degree of heating/bleaching corals experience (i.e. short-term thermal stress vs. long-term bleaching[BM2])?

[BM2]Going back to my earlier comment, I think it is crucial to clarify that elevated SSTs first cause stress and when they persist cause dysbiosis and the release of zoox (i.e., bleaching). You imply this hear, but I would see to make it clearer.