

Species-specific control of external superoxide levels by the coral holobiont during a natural bleaching event

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Superoxide, a reactive oxygen species (ROS), is both beneficial and detrimental to biological systems. In corals, superoxide has been implicated in bleaching, while also having a potential role in defense against pathogens. However, an understanding of the superoxide dynamics and sources within corals is currently missing due to a lack of direct in situ superoxide measurements. By conducting the first direct measurements of superoxide produced by corals on a natural reef during a bleaching event, we show substantial species-specific variation in external superoxide levels, which reflect the balance of production and degradation processes. *Porites lobata*, *Porites compressa*, *Pocillopora damicornis*, and *Fungia scutaria* maintained average external levels of superoxide that were approximately 100, 50, 20, and 2 nM above background seawater concentrations, respectively. However, superoxide levels adjacent to *Montipora capitata* were below levels present in the surrounding seawater, pointing to net degradation of superoxide and possible involvement of extracellular antioxidants. In all species, external superoxide levels were decoupled from the abundance of the photosynthetic endosymbiont *Symbiodinium*. However, aposymbiotic coral larvae and cultures of bacterial symbionts produced extracellular superoxide and may contribute to external superoxide levels. These results suggest potential species-specific roles for extracellular superoxide dynamics in the health, development and recruitment of symbiotic corals.