Positive Effects of Hypoxia and Increasing Atmospheric CO$_2$ on Bloom-Forming Noctiluca scintillans

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Noctiluca scintillans (Noctiluca) is a large, marine, mixotrophic dinoflagellate measuring .5mm-1mm in diameter. Before the 1990’s Noctiluca was not a very prominent organism, however, in the past couple of decades it has been taking over the plankton trophic level of the Arabian Sea and severely restructuring its ecosystem. Since 2000 Noctiluca has been causing increasingly intense blooms in the Arabian Sea during the summer and winter. Noctiluca’s mixotrophic lifestyle makes it very resourceful but also incredibly challenging to understand. Past studies have separately indicated that Noctiluca benefits from the spread of hypoxia in the Arabian Sea and increasing atmospheric CO$_2$ levels. The purpose of my experiment is to study the combined effects that increasing atmospheric CO$_2$ and low oxygen levels have on the physiology and abundance of Noctiluca. In this experiment we exposed Noctiluca to artificial atmospheres of varying CO$_2$ and O$_2$ levels: 280ppm CO$_2$ (9ppm O$_2$), 400ppm CO$_2$ (6ppm O$_2$), 800ppm CO$_2$ (2ppm O$_2$), representing preindustrial, ambient, and projected end-of-the-century levels of CO$_2$, respectively, accompanied by decreasing levels of oxygen. Our results indicate that Noctiluca performs best under 800ppm CO$_2$ and 2ppm O$_2$ conditions, supporting our current hypothesis that its endosymbiont, Protoeuglena noctilucae, compliments Noctiluca well because of its evolution 1.2 Ga ago under similar, high-CO$_2$, low-O$_2$ conditions. Our results also differ significantly from a previous study done in our laboratory studying solely the effects of increasing atmospheric CO$_2$, indicating that the spread of hypoxia in the Arabian Sea has important implications regarding Noctiluca. These findings suggest that as atmospheric CO$_2$ continues to rise and the globe continues to warm, Noctiluca blooms will intensify and continue to disrupt the ecosystem and resources of the Arabian Sea.